WARNING: ALL INDIVIDUALS INTERESTED IN BIDDING ON THIS PROJECT MUST OBTAIN THE FINAL PLANS AND SPECIFICATIONS FROM THE DEPARTMENT MANAGING THE PROJECT OR AS OTHERWISE STATED IN THE ADVERTISEMENT FOR BIDS FOR THE PROJECT. DO NOT USE THE PLANS AND SPECIFICATIONS POSTED ON THE CLERK OF THE BOARD'S WEBSITE FOR BIDDING ON THIS PROJECT.

SAN BERNARDINO COUNTY
PROBATION DEPARTMENT
WEST VALLEY REGIONAL TRAINING CENTER INDOOR GUN RANGE AC

9478 Etiwanda Avenue
Rancho Cucamonga, CA 91739

Project # 10.10.1151

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SECTION 01 3000
SUBMITTALS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. This Section includes administrative and procedural requirements for submittals required for performance of the Work, including the following:
   1. Contractor's Construction Schedule.
   2. Shop Drawings.
   3. Product Data.
   4. Samples.
   5. Daily Construction Reports.

B. Administrative Submittals: Refer to other Division 1 Sections and other Contract Documents for requirements for Administrative Submittals. Such submittals include, but are not limited to, the following:
   1. Permits.
   2. Applications for Payment.
   3. Performance and Payment Bonds.
   4. Insurance Certificates.
   5. List of Subcontractors.

C. Related Sections: The following sections contain requirements that relate to this section:
   1. Section 01 3100 - "Coordination" specifies requirements governing preparation and submittal of required coordination drawings.
   2. Section 01 4200 - "Quality Control" specifies requirements for submittal of inspection and test reports.

1.02 DEFINITIONS

A. Coordination Drawings show the relationship and integration of different construction elements that require careful coordination during fabrication or installation to fit in the space provided or to function as intended.
   1. Preparation of coordination drawings is specified in Section 01 3100 - "Coordination" and may include components previously shown in detail on Shop Drawings or Product Data.

B. Field Samples are full-size physical examples erected on-site to illustrate finishes, coatings, or finish materials. Field samples are used to establish the standard by which the work will judged.

C. Mockups are full-size assemblies for review of construction, coordination, testing or operation; they are not Samples.

1.03 SUBMITTAL PROCEDURES

A. Coordination: Coordinate preparation and processing of submittals with performance of construction activities. Transmit each submittal sufficiently in advance of performance of related construction activities to avoid delay.
   1. Processing: To avoid the need to delay installation as a result of the time required to process submittals, allow sufficient time for submittal review, including time for resubmittals.
      a. Allow two (2) weeks for initial review. Allow additional time if the Architect must delay processing to permit coordination with subsequent submittals.
      b. If an intermediate submittal is necessary, process the same as the initial submittal.
      c. Allow two (2) weeks for reprocessing each submittal.
      d. No extension of Contract Time will be authorized because of failure to transmit submittals to the Architect sufficiently in advance of the work to permit processing.

B. Submittal Transmittal: Package each submittal appropriately for handling. Transmit each submittal from the Contractor to the Architect using a transmittal form, including Job Name, Specification Section Number and Required Lead-Time. The Architect will not accept submittals received from sources other than the Contractor.

1.04 CONTRACTOR'S CONSTRUCTION SCHEDULE

A. Submit five (5) copies of the Construction Schedule, broken down by trade or material, to the Architect for approval prior to the first Application for Payment. Schedule shall be by CPM or bar graph type, and shall show proposed starting and completion dates for each trade and activity for the work. Submit five (5) copies of the updated schedule at each Application for Payment review to the Architect.
   1. Within each time bar, indicate estimated completion percentage in 10 percent increments. As work progresses, place a contrasting mark in each bar to indicate Actual Completion.

B. Submit completed Construction Schedule to Architect no later than 20 calendar days after the date established for "Notice to Proceed", and update monthly during construction. Submit current schedule with each Application for Payment.

C. Distribution: Following response to the initial submittal, print and distribute copies to the Architect, Owner, Subcontractors and other parties required to comply with scheduled dates. Post copies in the Project Meeting Room and temporary field office.

D. Submit completed material delivery schedule to the Architect no later than 20 calendar days after the "Notice to Proceed". Identify material critical to the progress of the Project and those for which long lead-time in procurement is anticipated. Indicate projected dates for submittal, order and delivery of such material.

1.05 SHOP DRAWING SUBMITTAL SCHEDULE

A. After development and acceptance of the Contractor's Construction Schedule, prepare a complete Schedule of Submittals. Submit the Schedule within 10 days of the date required for submittal of the Contractor's Construction Schedule.

1.06 SHOP DRAWINGS (SUBMITTALS)

A. Submit newly prepared information drawn accurately to scale. Highlight, encircle, or otherwise indicate deviations from the Contract Documents. Do not reproduce Contract Documents or copy standard information as the basis of Shop Drawings. Standard information prepared without specific reference to the Project is not a Shop Drawing.

B. Shop Drawings include fabrication and installation drawings, setting diagrams, schedules, patterns, templates and similar drawings. Include the following information:
   1. Job Name.
   2. Location.
   3. Dimensions.
   4. Notation of dimensions established by field measurements.
   5. If Shop Drawings are rejected twice by the Architect and a third submittal is required, the Trade Contractor will be billed $150/hour for review time.

1.07 PRODUCT DATA

A. Collect Product Data into a single submittal for each element of construction or system. Product Data includes printed information, such as manufacturer's installation instructions, catalog cuts, standard color charts, roughing-in diagrams and templates, standard wiring diagrams, and performance curves.

B. A copy of manufacturer's installation instructions and warranty literature shall be provided for all products at time of Shop Drawing submittal. However, this submission shall not relieve the Contractor's duty to assemble warranty manuals and installation literature at the end of the project. Refer to Section 01 7700 - "Closeout Procedures".

1.08 SAMPLES

A. Submit full-size, fully fabricated Samples cured and finished as specified and physically identical with the material or product proposed. Samples include partial sections of manufactured or fabricated components, cuts or containers of materials, color range sets, and swatches showing color, texture and pattern.
   1. Submit samples for review of size, kind, finish, color, pattern and texture. Submit samples for a final check of these characteristics with other elements and a comparison of these

characteristics between the final submittal and the actual component as delivered and installed.
   a. Where variation in color, pattern, texture or other characteristic is inherent in the material or product represented, submit at least three (3) multiple units that show approximate limits of the variations.
2. Maintain sets of Samples, as returned, at the project site, for quality comparisons throughout the course of construction.

1.09 ARCHITECT'S ACTION

A. Except for submittals for the record or information, where action and return is required, the Architect will review each submittal, mark to indicate action taken, and return.
   1. Compliance with specified characteristics is the Contractor's responsibility.

B. Action Stamp: The Architect will stamp each submittal with a uniform, action stamp. The Architect will review each submittal, mark to indicate action taken, and return.
   1. Final Unrestricted Release: When the Architect marks a submittal "No Exception Taken", the work covered by the submittal may proceed provided it complies with requirements of the Contract Documents.
   2. Final-but-Restricted Release: When the Architect marks a submittal "Make Corrections Noted", the work covered by the submittal may proceed provided it complies with notations or corrections on the submittal and requirements of the Contract Documents.
   3. Returned for Resubmittal: When the Architect marks a submittal "Rejected", "Revise and Resubmit" do not proceed with work covered by the submittal, including purchasing, fabrication, delivery or other activity. Revise or prepare a new submittal according to the notations; resubmit without delay. Repeat if necessary to obtain different action mark.
      a. Do not use, or allow others to use, submittals marked "Rejected", "Revise and Resubmit" at the project site or elsewhere where work is in progress.

C. Unsolicited Submittals: The Architect will return unsolicited submittals to the sender without action.

1.10 DAILY CONSTRUCTION REPORTS

A. Prepare a Daily Construction Report recording the following information concerning events at the site, and submit duplicate copies to the Owner by 4:30pm the following day.
   1. List of Subcontractors at the site.
   2. Approximate count of personnel at the site.
   3. High and low temperatures, general weather conditions.
   4. Accidents and unusual events.
   5. Meetings and significant decisions.
   6. Stoppages, delays, shortages and losses.
   7. Emergency procedures.
   8. Orders and requests of governing authorities.
   9. Services connected, disconnected.
   10. Equipment or system tests and startups.

PART 2 PRODUCTS

-- NOT APPLICABLE --

PART 3 EXECUTION

-- NOT APPLICABLE --

END OF SECTION

SECTION 01 3100
COORDINATION

PART 1 GENERAL

1.01 GENERAL COORDINATION PROVISIONS

A. Carefully study and compare Contract Documents before proceeding with fabrication and installation of work. Promptly advise Architect of any error, inconsistency, omission or apparent discrepancy discovered.

B. Allot time in construction scheduling for liaison with Architect; establish procedures for handling queries and clarifications. Use "Request for Information " (RFI) form for requesting information.

C. If Architect is able to respond to a Request for Information (RFI), by making specific reference to Drawing sheet of Specification section, Contractor shall reimburse Owner for charges of Architect and Architect's Consultants for performing review services for the Contractor.

D. Coordinate work of various specification sections having interdependent responsibilities for installation, connection and operation.

1.02 SUMMARY

A. This section includes administrative and supervisory requirements necessary for coordinating construction operations including, but not necessarily limited to, the following:
   1. General project coordination procedures.
   2. Administrative and supervisory personnel
   3. Cleaning and protection.

B. Related Sections: The following sections contain requirements that relate to this section:
   1. Section 01 3000 - "Submittals" for preparing and submitting the Project Manager's Construction Schedule.
   2. Section 01 7700 - "Closeout Procedures" for coordinating contract closeout.

1.03 COORDINATION DRAWINGS AND LAYOUTS

A. General:
   1. Coordination Drawings are not Shop Drawings and are not to be submitted to Architect for approval.
   2. Coordination drawings show relationship and integration of different construction elements that require careful coordination during fabrication or installation to fit in space provided or to function as intended.

B. Coordinate in field with affected trades for proper relationship to work based on project conditions.

C. Notify Architect of conflicts and other coordination issues requiring resolution prior to commencing construction in each affected area.

D. Make coordination documents available in field office for review by Architect and Owner during entire period of construction.

1.04 COORDINATION

A. Coordinate construction operations included in various sections of these specifications to assure efficient and orderly installation of each part of the work.
   1. Schedule construction operations in the sequence required to obtain the best results where installation of one part of the work depends on installation of other components, before or after its own installation.
   2. Coordinate installation of different components to assure maximum accessibility for required maintenance, service and repair.
   3. Make provisions to accommodate items scheduled for later installation.

B. The Contractor shall review the entire construction document set for dimensional coordination. Special attention should be placed on architectural/structural dimension coordination.

1. If discrepancies occur, the Contractor is directed to place a written request to the Project Architect for clarification. This request must occur prior to any work occurring.
2. Proceeding into an area of work without checking the documents for dimensional coordination and resolving the condition in a timely manner will in no way release the Contractor from correction procedures.

C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and assure orderly progress of the work. Such administrative activities include, but are not limited to, the following:
1. Preparation of schedules.
2. Installation and removal of temporary facilities.
3. Delivery and processing of submittals.
4. Progress meetings.
5. Project closeout activities.

PART 2 PRODUCTS

-- NOT APPLICABLE --

PART 3 EXECUTION

3.01 GENERAL COORDINATION PROVISIONS

A. Inspection of Conditions: Require the installer of each major component to inspect both the substrate and conditions under which Work is to be performed. Do not proceed until unsatisfactory conditions have been corrected in an acceptable manner.

B. Coordinate temporary enclosures with required inspections and tests to minimize the necessity of uncovering completed construction for that purpose.

3.02 CLEANING AND PROTECTION

A. Clean and protect construction in progress and adjoining materials in place, during handling and installation. Apply protective covering where required to assure protection from damage or deterioration at Substantial Completion.

B. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to assure operability without damaging effects.

C. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period. Where applicable, such exposures include, but are not limited to, the following:
1. Excessively high or low temperatures.
2. Excessively high or low humidity.
3. Air contamination or pollution.
4. Water or ice.
5. Solvents.
6. Chemicals.
7. Light.
8. Radiation.
9. Puncture.
10. Heavy traffic.
11. Soiling, staining and corrosion.
12. Combustion.
13. Electrical current.
14. Improper lubrication.
15. Unusual wear or other misuse.
16. Contact between incompatible materials.

17. Misalignment.
18. Excessive weathering.
19. Unprotected storage.
20. Improper shipping or handling.
21. Theft.
22. Vandalism.

END OF SECTION

SECTION 01 4200
REFERENCE STANDARDS AND DEFINITIONS

PART 1 GENERAL

1.01 REFERENCES

A. The Contract Documents contain references to various standard specifications, codes, practices and requirements for materials, work quality, installation, inspections and tests, which references are published and issued by the organizations listed hereinafter by abbreviation and name. Such references are hereby made a part of these Contract Documents to the extent indicated or required.

1.02 DEFINITIONS

A. General: Basic contract definitions are included in the General and Special Conditions of the Contract.

B. "Indicated": The term "indicated" refers to graphic representations, notes or schedules on the Drawings; or to other paragraphs or schedules in the Specifications and similar requirements in the Contract Documents. Terms such as "shown", "noted", "scheduled" and "specified" are used to help the user locate the reference. Location is not limited.

C. "Directed": Terms such as "directed", "requested", "authorized", "selected", "approved", "required" and "permitted" mean directed by the Architect, requested by the Architect, and similar phrases.

D. "Approved": The term "approved", when used in conjunction with the Architect's action on the Contractor's submittals, applications and requests, is limited to the Architect's duties and responsibilities as stated in the General and Supplementary Conditions of the Contract.

E. "Regulations": The term "regulations" includes laws, ordinances, statutes and lawful orders issued by authorities having jurisdiction, as well as rules, conventions, and agreements within the construction industry that control performance of the Work.

F. "Furnish": The term "furnish" means to supply and deliver to the project site, ready for unloading, unpacking, assembly, installation and similar operations.

G. "Install": The term "install" describes operations at the project site including the actual unloading, temporary storage, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning and similar operations.

H. "Provide": The term "provide" means to furnish and install, complete and ready for the intended use.

I. "Installer": An installer is the Contractor or another entity engaged by the Contractor, either as an employee, subcontractor or contractor of lower tier, who performs a particular construction activity including installation, erection, application, or similar operations. Installers are required to be experienced in the operations they are engaged to perform.

1. The term "experienced", when used with the term "installer", means having successfully completed a minimum of 5 previous projects similar in size and scope to this project, being familiar with the specified requirements indicated; and having complied with requirements of authorities having jurisdiction.
2. Trades: Using terms such as "carpentry" does not imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as "carpenter". It also does not imply that requirements specified apply exclusively to tradespeople of the corresponding generic name.
3. Assigning Specialists: Certain sections of the Specifications require that specific construction activities shall be performed by specialists who are recognized experts in those operations. The specialists must be engaged for those activities, and their assignments are requirements over which the Contractor has no option. However, the ultimate responsibility for fulfilling contract requirements remains with the Contractor.

a. This requirement shall not be interpreted to conflict with enforcing building codes and similar regulations governing the work. It is also not intended to interfere with local trade-union jurisdictional settlements and similar conventions.

J. "Project Site" is the space available to the Contractor for performing construction activities, either exclusively or in conjunction with others performing work as part of the Project. The extent of the project site is shown on the drawings and may or may not be identical with the description of the land on which the Project is to be built.

K. "Testing Agencies": A testing agency is an independent entity engaged to perform specific inspections or tests, either at the project site or elsewhere, and to report on and, if required, to interpret results of those inspections or tests.

1.03 SPECIFICATION FORMAT AND CONTENT EXPLANATION

A. Specification Format: These Specifications are organized into Divisions and Sections based on the Construction Specifications Institute's 2004 "Masterformat" numbering system.

B. Specification Content: These Specifications use certain conventions for the style of language and the intended meaning of certain terms, words and phrases when used in particular situations. These conventions are as follows:

1. Abbreviated Language: Language used in Specifications and other Contract Documents is abbreviated. Words and meanings shall be interpreted as appropriate words implied, but not stated, shall be interpolated as the sense requires. Singular words shall be interpreted as plural and plural words interpreted as singular where applicable as the context of the Contract Documents indicates.
2. Imperative mood and streamlined language are generally used in the Specifications. Requirements expressed in the imperative mood are to be performed by the Contractor. At certain locations in the text, subjective language is used for clarity to describe responsibilities that must be fulfilled indirectly by the Contractor or by others when so noted.
   a. The words "shall", "shall be" or "shall comply with", depending on the context, are implied where a colon (:) is used within a sentence or phrase.

1.04 INDUSTRY STANDARDS

A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such Standards are made a part of the Contract Documents by reference.

B. When the effective date of a Reference Standard is not given, it shall be understood that the current edition or latest revision thereof and any amendments or supplements thereto in effect on the date of issue of these Contact Documents, as indicated by the date on the cover sheet or in the Invitation to Bid, shall govern the work.

C. Conflicting Requirements: Where compliance with 2 or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer uncertainties and requirements that are different but apparently equal to the Architect for a decision before proceeding.

1. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of the requirements. Refer uncertainties to the Architect for a decision before proceeding.

D. Copies of Standards: Each entity engaged in construction on the Project must be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.

1. Where copies of standards are needed to perform a required construction activity, the Contractor shall obtain copies directly from the publication source and make them available on request.

E. Abbreviations and Names: Trade association names and titles of general standards are frequently abbreviated. The following list of general reference standards is common to the construction industry. This list is not all-inclusive nor does the presence of a reference standard imply necessarily that it is referenced in the Specifications or other Contract Documents.

AA	Aluminum Association
AABC	Associated Air Balance Council
AAMA	American Architectural Manufacturers Association
AASHTO	American Association of State Highway and Transportation Officials
ACI	American Concrete Institute International
ADC	American Diffusion Council
AGA	American Gas Association
AIA	American Institute of Architects
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
ALSC	American Lumber Standards Committee
AMCA	Air Movement and Control Association International
ANSI	American National Standards Institute
APA	Engineered Wood Association (Formerly American Plywood Ass'n)
ARI	Air Conditioning and Refrigeration Institute
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigerating and Air Conditioning Engrs
ASME	The American Society of Mechanical Engineers
ASPE	American Society of Plumbing Engineers
ASSE	The American Society of Sanitary Engineers
ASTM	American Society for Testing and Materials
AWI	Architectural Woodwork Institute
AWS	American Welding Society
BHMA	Builders Hardware Manufacturers Association
BIA	Brick Industry Association
CISCA	Ceilings & Interior Systems Construction Association
CISPI	Cast Iron Soil Pipe Institute
CLFMI	Chain Link Fence Manufacturers Institute
CRSI	Concrete Reinforcing Steel Institute
DHI	Door and Hardware Institute (Formerly Ntl. Builders Hardware Assoc)
EIMAEIFS	Industry Manufacturers Association
FGMA	Flat Glass Marketing Association
FM	Factory Mutual Research Corporation
GA	Gypsum Association
GANA	Glass Association of North America

IAPMO	International Association of Plumbing and Mechanical Officials
ICBO	International Conference of Building Officials
ICC	International Code Council
IEEE	Institute of Electrical and Electronics Engineers
IESNA	Illuminating Engineering Society of North America
IGCC	Insulating Glass Certification Council
MBMA	Metal Building Manufacturers Association
NAAMM	The National Association of Architectural Metal Manufacturers
NCMA	National Concrete Masonry Association
NEBB	National Environmental Balancing Bureau
NECA	National Electrical Contractors Association
NEMA	National Electrical Manufacturers Association
NETA	National Electrical Contractors Association
NFPA	National Fire Protection Association
NRCA	National Roofing Contractors Association
NSFNSF	International (National Sanitation Foundation)
PCA	Portland Cement Association
PDI	Plumbing and Drainage Institute
SDI	Steel Door Institute
SGCC	Safety Glazing Certification Council
SJI	Steel Joist Institute
SMACNA	Sheet Metal and Air Conditioning Contractors' National Association
TCA	Tile Council of America
UBC	Uniform Building Code (International Conference of Building Officials)
UL	Underwriters Laboratories, Inc.
WCLIB	West Coast Lumber Inspection Bureau
WDMA	Window and Door Manufacturers Association (Formerly NWWDA)
WIC	Woodwork Institute of California

F. Federal Government Agencies and Acronyms: Names and titles of Federal Government standards - or specification-producing agencies are often abbreviated. The following abbreviations and acronyms which may be referenced in the Contract Documents indicate names of standards - or specification-producing agencies of the Federal Government. This list is not all-inclusive nor does presence on the list imply necessarily that the abbreviation is referenced in the Specifications or other Contract Documents.

ADA	Americans with Disabilities Act
CFR	Code of Federal Regulations
COE	Corps of Engineers, U S Army
CPSC	Consumer Product Safety Commission
DOC	Department of Commerce
DOT	Department of Transportation
EPA	Environmental Protection Agency
FAA	Federal Aviation Administration

FCC	Federal Communications Commission
FDA	Food and Drug Administration
FHA	Federal Housing Administration
FS	Federal Specifications and Standards (General Services Admin)
GSA	General Services Administration
MIL	Military Specifications and Standards (U S Dept of Defense)
NIST	National Institute of Standards and Technology
OSHA	Occupational Safety and Health Administration (U S Dept of Labor)
PS	Product Standards (U S Dept of Commerce)
USDA	United States Department of Agriculture
USPS	United States Postal Service

PART 2 PRODUCTS

-- NOT APPLICABLE --

PART 3 EXECUTION

-- NOT APPLICABLE --

END OF SECTION

SECTION 01 4500
QUALITY CONTROL

PART 1 GENERAL

1.01 SUMMARY

A. This section includes administrative and procedural requirements for quality-control services.

B. Quality-Control services include inspections, tests and related actions, including reports performed and/or directed by the Contractor, by independent agencies, and by governing authorities. They do not include contract enforcement activities performed by Architect.

C. Inspection and testing services are required to verify compliance with requirements specified or indicated in the Construction Documents. These services do not relieve Contractor of responsibility for compliance with Contract Document requirements.

1.02 RESPONSIBILITIES

A. Owner will employ and pay for services of an Independent Testing Laboratory to perform specified inspections and testing.

B. Contractor Responsibilities:
   1. Deliver to laboratory at designated location, adequate samples of materials proposed to be used which require testing, along with proposed mix designs.
   2. Cooperate with laboratory personnel, and provide access to the work, and to manufacturer's facilities.
   3. Provide incidental labor and facilities to provide access to work to be tested, to obtain and handle samples at the site or at source of products to be tested, to facilitate tests and inspections, storage and curing of test samples.
   4. Notify Architect/Engineer and laboratory 24 hours prior to expected time for operations requiring inspection and testing services.
      a. Unless otherwise indicated as the responsibility of another identified entity, Contractor shall provide inspections, tests and other quality-control services specified elsewhere in the Contract Documents and required by authorities having jurisdiction. Costs for these services are included in the Contract Sum.
         1) Where individual sections specifically indicate that certain inspections, tests, and other quality-control services are the Contractor's responsibility, the Contractor shall employ and pay a qualified independent testing agency to perform quality-control services. Costs for these services are included in the Contract Sum.

C. Retesting: The Contractor is responsible for retesting where results of inspections, tests or other quality-control services prove unsatisfactory and indicate noncompliance with Contract Document requirements.
   1. The cost of retesting construction, revised or replaced by the Contractor or Trade Subcontractor, is the Trade Subcontractor's responsibility where required tests performed on original construction indicated noncompliance with Contract Document requirements.
   2. Associated Services: Cooperate with agencies performing required inspections, tests and similar services, and provide reasonable auxiliary services as requested. Notify the agency sufficiently in advance of operations to permit assignment of personnel. Auxiliary services required include, but are not limited to, the following:
      a. Provide security and protection of samples and test equipment a the project site.

D. Duties of the Testing Agency: The Independent Agency engaged to perform inspections, sampling and testing of materials and construction specified in individual sections shall cooperate with the Architect and the Contractor in performance of the agency's duties. The testing agency shall provide qualified personnel to perform required inspections and tests.
   1. The agency shall notify the Architect and the Contractor promptly of irregularities or deficiencies observed in the work during performance of its services.
   2. The agency is not authorized to release, revoke, alter or enlarge requirements of the Contract Documents or approve or accept any portion of the work.

E. Coordination: Coordinate the sequence of activities to accommodate required services with a minimum of delay. Coordinate activities to avoid the necessity of removing and replacing construction to accommodate inspections and tests.
   1. The Contractor is responsible for scheduling times for inspections, tests, taking samples, and similar activities.

1.03 SUBMITTALS

A. The Independent Testing Agency shall submit a certified written report, in duplicate, of each inspection, test or similar service to the Architect and Structural Engineer. If the Contractor is responsible for the service, submit a certified written report, in duplicate, of each inspection, test, or similar service through the Contractor.
   1. Submit additional copies of each written report directly to the governing authority, when the authority so directs.
   2. Report Data: Written reports of each inspection, test or similar service include, but are not limited to, the following:
      a. Date of issue.
      b. Project title and number.
      c. Name, address and telephone number of testing agency.
      d. Dates and locations of samples and tests or inspections.
      e. Names of individuals making the inspection or test.
      f. Designation of the work and test method.
      g. Identification of product and Specification Section.
      h. Complete inspection or test data.
      i. Test results and an interpretation of test results.
      j. Ambient conditions at the time of sample taking and testing.
      k. Comments or professional opinion on whether inspected or tested work complies with Contract Document requirements.
      l. Name and signature of laboratory inspector.
      m. Recommendations on retesting.

1.04 REFERENCES AND STANDARDS

A. For products and workmanship specified by reference to a document or documents not included in the Project Manual, also referred to a Reference Standards, comply with requirements of the Standard, except when more rigid requirements are specified or are required by applicable codes.

B. Conform to Reference Standard of date of issue current on date of Contract Documents, except where a specific date is established by applicable code.

C. Obtain copies of Standards where required by product specification sections.

D. Maintain copy at project site during submittals, planning and progress of the specific work, until Substantial Completion.

E. Should specified reference standards conflict with Contract Documents, request clarification from Architect before proceeding.

F. Neither the contractual relationships, duties or responsibilities of the parties in contract nor those of Architect shall be altered from the Contract Documents by mention or inference in any reference document.

1.05 QUALITY ASSURANCE

A. Qualifications of Service Agencies: Engage inspection and testing service agencies, including independent testing laboratories, that are prequalified as complying with the American Council of Independent Laboratories' "Recommended Requirements for Independent Laboratory Qualification" and that specialize in the types of inspections and tests to be performed.
   1. Each Independent Inspection and Testing Agency engaged on the project shall be authorized by authorities having jurisdiction to operate in the state where the project is located.

PART 2 PRODUCTS

-- NOT APPLICABLE --

PART 3 EXECUTION

3.01 REPAIR AND PROTECTION

A. General: Upon completion of inspection, testing, sample taking and similar services, repair damaged construction and restore substrates and finishes. Comply with Contract Document requirements for Section 01 7000 - "Execution Requirements".

B. Protect construction exposed by or for quality-control service activities, and protect repaired construction.

C. Repair and protection is Contractor's responsibility, regardless of the assignment of responsibility for inspection, testing or similar services.

D. Should manufacturer's instructions conflict with Contract Documents, request clarification from Architect before proceeding.

E. Comply with specified standards as minimum quality for the work except where more stringent tolerances, codes or specified requirements indicate higher standards or more precise workmanship.

F. Have work performed by persons qualified to produce required and specified quality.

G. Verify that field measurements are as indicated on Shop Drawings or and instructed by the manufacturer.

H. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion and disfigurement.

3.02 MANUFACTURER'S FIELD SERVICES

A. When specified in individual specification sections, require material or product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment, test, adjust and balance of equipment as applicable, and to initiate instructions when necessary.

B. Report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.

END OF SECTION

SECTION 01 5713
TEMPORARY EROSION CONTROL

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Prevention of erosion due to construction activities.

B. Prevention of sedimentation of waterways, open drainage ways, and storm and sanitary sewers due to construction activities.

C. Restoration of areas eroded due to insufficient preventive measures.

D. Performance bond.

E. Compensation of Owner for fines levied by authorities having jurisdiction due to non-compliance by Contractor.

1.02 RELATED REQUIREMENTS

A. Section 31 1000 - Site Clearing: Limits on clearing; disposition of vegetative clearing debris.

B. Section 31 2200 - Grading: Temporary and permanent grade changes for erosion control.

1.03 REFERENCE STANDARDS

A. ASTM D4355/D4355M - Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon Arc Type Apparatus; 2014.

B. ASTM D4491/D4491M - Standard Test Methods for Water Permeability of Geotextiles by Permittivity; 1999a (Reapproved 2014).

C. ASTM D4491 - Standard Test Methods for Water Permeability of Geotextiles by Permittivity; 1999a (Reapproved 2014).

D. ASTM D4533 - Standard Test Method for Trapezoid Tearing Strength of Geotextiles; 2011.

E. ASTM D4632/D4632M - Standard Test Method for Grab Breaking Load and Elongation of Geotextiles; 2015a.

F. ASTM D4751 - Standard Test Method for Determining Apparent Opening Size of a Geotextile; 2012.

1.04 PERFORMANCE REQUIREMENTS

A. Coordinate work of this section with Owner-provided "Storm Water Pollution Prevention Plan (SWPPP).
   1. Where requirements of both plans are in conflict, comply with the SWPPP.

B. Develop and follow an Erosion and Sedimentation Prevention Plan and submit periodic inspection reports.

C. Do not begin clearing, grading, or other work involving disturbance of ground surface cover until applicable permits have been obtained; furnish all documentation required to obtain applicable permits.

D. Provide to Owner a Performance Bond covering erosion and sedimentation preventive measures only, in an amount equal to 100 percent of the cost of erosion and sedimentation control work.

E. Timing: Put preventive measures in place as soon as possible after disturbance of surface cover and before precipitation occurs.

F. Storm Water Runoff: Control increased storm water runoff due to disturbance of surface cover due to construction activities for this project.
   1. Prevent runoff into storm and sanitary sewer systems, including open drainage channels, in excess of actual capacity or amount allowed by authorities having jurisdiction, whichever is less.
   2. Anticipate runoff volume due to the most extreme short term and 24-hour rainfall events that might occur in 25 years.

G. Erosion On Site: Minimize wind, water, and vehicular erosion of soil on project site due to construction activities for this project.
   1. Control movement of sediment and soil from temporary stockpiles of soil.
   2. Prevent development of ruts due to equipment and vehicular traffic.
   3. If erosion occurs due to non-compliance with these requirements, restore eroded areas at no cost to Owner.

H. Erosion Off Site: Prevent erosion of soil and deposition of sediment on other properties caused by water leaving the project site due to construction activities for this project.
   1. Prevent windblown soil from leaving the project site.
   2. Prevent tracking of mud onto public roads outside site.
   3. Prevent mud and sediment from flowing onto sidewalks and pavements.
   4. If erosion occurs due to non-compliance with these requirements, restore eroded areas at no cost to Owner.

I. Sedimentation of Waterways Off Site: Prevent sedimentation of waterways off the project site, including rivers, streams, lakes, ponds, open drainage ways, storm sewers, and sanitary sewers.
   1. If sedimentation occurs, install or correct preventive measures immediately at no cost to Owner; remove deposited sediments; comply with requirements of authorities having jurisdiction.

J. Open Water: Prevent standing water that could become stagnant.

K. Maintenance: Maintain temporary preventive measures until permanent measures have been established.

1.05 SUBMITTALS

A. See Section 01 3000 - "Submittals", for submittal procedures.

B. Erosion and Sedimentation Control Plan:
   1. Include:
      a. Site plan identifying soils and vegetation, existing erosion problems, and areas vulnerable to erosion due to topography, soils, vegetation, or drainage.
      b. Site plan showing grading; new improvements; temporary roads, traffic accesses, and other temporary construction; and proposed preventive measures.
      c. Where extensive areas of soil will be disturbed, include storm water flow and volume calculations, soil loss predictions, and proposed preventive measures.
      d. Schedule of temporary preventive measures, in relation to ground disturbing activities.
      e. Other information required by law.
      f. Format required by law is acceptable, provided any additional information specified is also included.
   2. Obtain the approval of the Plan by authorities having jurisdiction.
   3. Obtain the approval of the Plan by Owner.

C. Certificate: Mill certificate for silt fence fabric attesting that fabric and factory seams comply with specified requirements, signed by legally authorized official of manufacturer; indicate actual minimum average roll values; identify fabric by roll identification numbers.

D. Inspection Reports: Submit report of each inspection; identify each preventive measure, indicate condition, and specify maintenance or repair required and accomplished.

PART 2 PRODUCTS

2.01 MATERIALS

A. Mulch: Use one of the following:
   1. Straw or hay.
   2. Wood waste, chips, or bark.
   3. Erosion control matting or netting.
   4. Polyethylene film, where specifically indicated only.

B. Grass Seed For Temporary Cover: Select a species appropriate to climate, planting season, and intended purpose. If same area will later be planted with permanent vegetation, do not use species known to be excessively competitive or prone to volunteer in subsequent seasons.

C. Bales: Air dry, rectangular straw bales.
   1. Cross Section: 14 by 18 inches, minimum.
   2. Bindings: Wire or string, around long dimension.

D. Bale Stakes: One of the following, minimum 3 feet long:
   1. Steel U- or T-section, with minimum mass of 1.33 pound per linear foot.
   2. Wood, 2 by 2 inches in cross section.

E. Silt Fence Fabric: Polypropylene geotextile resistant to common soil chemicals, mildew, and insects; non-biodegradable; in longest lengths possible; fabric including seams with the following minimum average roll lengths:
   1. Average Opening Size: 30 U.S. Std. Sieve, maximum, when tested in accordance with ASTM D4751.
   2. Permittivity: 0.05 sec^-1, minimum, when tested in accordance with ASTM D4491/D4491M.
   3. Ultraviolet Resistance: Retaining at least 70 percent of tensile strength, when tested in accordance with ASTM D4355/D4355M after 500 hours exposure.
   4. Tensile Strength: 100 pounds-force, minimum, in cross-machine direction; 124 pounds-force, minimum, in machine direction; when tested in accordance with ASTM D4632/D4632M.
   5. Elongation: 15 to 30 percent, when tested in accordance with ASTM D4632/D4632M.
   6. Tear Strength: 55 pounds-force, minimum, when tested in accordance with ASTM D4533.
   7. Color: Manufacturer's standard, with embedment and fastener lines preprinted.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine site and identify existing features that contribute to erosion resistance; maintain such existing features to greatest extent possible.

3.02 PREPARATION

A. Schedule work so that soil surfaces are left exposed for the minimum amount of time.

3.03 SCOPE OF PREVENTIVE MEASURES

A. In all cases, if permanent erosion resistant measures have been installed temporary preventive measures are not required.

B. Storm Drain Curb Inlet Sediment Trap: Protect each curb inlet using one of the following measures:
   1. Filter fabric wrapped around hollow concrete blocks blocking entire inlet face area; use one piece of fabric wrapped at least 1-1/2 times around concrete blocks and secured to prevent dislodging; orient cores of blocks so runoff passes into inlet.
   2. Straw bale row blocking entire inlet face area; anchor into pavement.

C. Storm Drain Drop Inlet Sediment Traps: As detailed on drawings.

D. Temporary Splash Pads: Stone aggregate over filter fabric; size to suit application; provide at downspout outlets and storm water outlets.

E. Soil Stockpiles: Protect using one of the following measures:
   1. Cover with polyethylene film, secured by placing soil on outer edges.

F. Mulching: Use only for areas that may be subjected to erosion for less than 6 months.
   1. Wood Waste: Use only on slopes 3:1 or flatter; no anchoring required.

G. Temporary Seeding: Use where temporary vegetated cover is required.

3.04 INSTALLATION

A. Straw Bale Rows:

1. Install bales in continuous rows with ends butting tightly, with one bale at each end of row turned uphill.
2. Install bales so that bindings are not in contact with the ground.
3. Embed bales at least 4 inches in the ground.
4. Anchor bales with at least two stakes per bale, driven at least 18 inches into the ground; drive first stake in each bale toward the previously placed bale to force bales together.
5. Fill gaps between ends of bales with loose straw wedged tightly.
6. Place soil excavated for trench against bales on the upslope side of the row, compacted.

B. Temporary Seeding:
1. When hydraulic seeder is used, seedbed preparation is not required.
2. When surface soil has been sealed by rainfall or consists of smooth undisturbed cut slopes, and conventional or manual seeding is to be used, prepare seedbed by scarifying sufficiently to allow seed to lodge and germinate.
3. If temporary mulching was used on planting area but not removed, apply nitrogen fertilizer at 1 pound per 1000 sq ft.
4. Irrigate as required to thoroughly wet soil to depth that will ensure germination, without causing runoff or erosion.
5. Repeat irrigation as required until grass is established.

3.05 MAINTENANCE

A. Inspect preventive measures weekly, within 24 hours after the end of any storm that produces 0.5 inches or more rainfall at the project site, and daily during prolonged rainfall.

B. Repair deficiencies immediately.

C. Straw Bale Rows:
1. Promptly replace bales that fall apart or otherwise deteriorate unless need has passed.
2. Remove silt deposits that exceed one-half of the height of the bales.
3. Repair bale rows that are undercut by runoff or otherwise damaged, whether by runoff or other causes.

D. Place sediment in appropriate locations on site; do not remove from site.

3.06 CLEAN UP

A. Remove temporary measures after permanent measures have been installed, unless permitted to remain by Architect.

B. Clean out temporary sediment control structures that are to remain as permanent measures.

C. Where removal of temporary measures would leave exposed soil, shape surface to an acceptable grade and finish to match adjacent ground surfaces.

END OF SECTION

SECTION 01 6000
PRODUCT REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Products.

B. Transportation and handling.

C. Storage and protection.

D. Product options.

E. Substitutions.

1.02 PRODUCTS

A. Products: Means new material, machinery, components, equipment, fixtures, and systems forming the Work. Does not include machinery and equipment used for preparation, fabrication, conveying and erection of the Work. Products may also include existing materials or components required for reuse

B. Do not use materials and equipment removed from existing premises, except as specifically permitted by the Contract Documents.

C. Provide interchangeable components of the same manufacturer, for similar components.

1.03 TRANSPORTATION AND HANDLING

A. Transport and handle Products in accordance with manufacturer's instructions

B. Promptly inspect shipments to assure that Products comply with requirements, quantities are correct, and Products are undamaged.

C. Provide equipment and personnel to handle Products by methods to prevent soiling, disfigurement, or damage.

1.04 STORAGE AND PROTECTION

A. Store and protect Products in accordance with manufacturer's instructions, with seals and labels intact and legible. Store sensitive products in weather-tight, climate controlled enclosures.

B. For exterior storage of fabricated products, place on sloped supports, above ground.

C. Provide off-site storage and protection when site does not permit on-site storage or protection.

D. Cover Products subject to deterioration with impervious sheet covering. Provide ventilation to avoid condensation.

E. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.

F. Provide equipment and personnel to store Products by methods to prevent soiling, disfigurement, or damage.

G. Arrange storage of Products to permit access for inspection. Periodically inspect to assure Products are undamaged and are maintained under specified conditions

1.05 PRODUCT OPTIONS

A. Products Specified by Reference Standards or by Description Only: Any Product meeting those standards or description.

B. Products Specified by Naming One or More Manufacturers with a Provision for Substitutions: Submit a request for substitution for any manufacturer not named.

C. Products specified by naming only one Manufacturer is intended to establish the standard required. It is not intended to limit the selection of equal products of other manufacturers.

1.06 SUBSTITUTIONS

A. Owner, Architect/Engineer will consider requests for Equal / Substitutions at any time up to 35 days after the date of Owner Contractor Agreement.

B. Equal / Substitutions will be approved only if the Owner, Architect/Engineer deems the product is of equal quality.

C. Document each request with complete data substantiating compliance of proposed Substitution with Contract Documents.

D. A request constitutes a representation that the Contractor:
   1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product.
   2. Will provide the same warranty for the Substitution as for the specified product.
   3. Will coordinate installation and make changes to other Work which may be required for the Work to be complete with no additional cost to Owner
   4. Waives claims for additional costs or time extension which may subsequently become apparent.

E. Substitutions will not be considered when they are indicated or implied on shop drawing or product data submittals, without separate written request, or when acceptance will require revision to the Contract Documents.

F. Substitution Submittal Procedure:
   1. Submit six copies of request for Substitution for consideration. Limit each request to one proposed Substitution.
   2. Submit shop drawings, Product data, and certified test results attesting to the proposed product equivalence.
   3. The Architect/Engineer will notify Contractor, in writing, of decision to accept or reject request.

PART 2 PRODUCTS

-- NOT APPLICABLE --

PART 3 EXECUTION

-- NOT APPLICABLE --

END OF SECTION

SECTION 01 7000
EXECUTION REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Examination, preparation, and general installation procedures.

B. Pre-installation meetings.

C. Cutting and patching.

D. Surveying for laying out the work.

E. Cleaning and protection.

F. Starting of systems and equipment.

G. Demonstration and instruction of Owner personnel.

H. General requirements for maintenance service.

1.02 RELATED REQUIREMENTS

A. Section 01 3000 - Submittals: Submittal procedures.

B. Section 01 4500 - Quality Control: Testing and inspection procedures.

C. Individual Product Specification Sections:
   1. Advance notification to other sections of openings required in work of those sections.
   2. Limitations on cutting structural members.

1.03 SUBMITTALS

A. See Section 01 3000 - "Submittals", for submittal procedures.

B. Survey work: Submit name, address, and telephone number of Surveyor before starting survey work.

1.04 QUALIFICATIONS

A. For survey work, employ a land surveyor registered in the State of California and acceptable to Architect. Submit evidence of Surveyor's Errors and Omissions insurance coverage in the form of an Insurance Certificate.

1.05 PROJECT CONDITIONS

A. Ventilate enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.

B. Dust Control: Execute work by methods to minimize raising dust from construction operations. Provide positive means to prevent air-borne dust from dispersing into atmosphere and over adjacent property.

1.06 COORDINATION

A. Coordinate scheduling, submittals, and requirements of Section 01 31 00 - "Coordination" to ensure efficient and orderly sequence of installation of interdependent construction elements.

B. Notify affected utility companies and comply with their requirements.

C. Verify that utility requirements and characteristics of new operating equipment are compatible with building utilities. Coordinate work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.

D. Coordinate space requirements, supports, and installation of mechanical and electrical work that are indicated diagrammatically on drawings. Follow routing indicated for pipes, ducts, and conduit, as closely as practicable; place runs parallel with lines of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.

E. After Owner occupancy of premises, coordinate access to site for correction of defective work and work not in accordance with Contract Documents, to minimize disruption of Owner's activities.

PART 2 PRODUCTS

-- NOT APPLICABLE --

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that existing site conditions and substrate surfaces are acceptable for subsequent work. Start of work means acceptance of existing conditions.

B. Verify that existing substrate is capable of structural support or attachment of new work being applied or attached.

C. Examine and verify specific conditions described in individual specification sections.

D. Take field measurements before confirming product orders or beginning fabrication, to minimize waste due to over-ordering or misfabrication.

E. Verify that utility services are available, of the correct characteristics, and in the correct locations.

3.02 PREPARATION

A. Clean substrate surfaces prior to applying next material or substance.

B. Seal cracks or openings of substrate prior to applying next material or substance.

C. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying any new material or substance in contact or bond.

3.03 PREINSTALLATION MEETINGS

A. When required in individual specification sections, convene a preinstallation meeting at the site prior to commencing work of the section.

B. Require attendance of parties directly affecting, or affected by, work of the specific section.

C. Notify Architect four days in advance of meeting date.

D. Prepare agenda and preside at meeting:
   1. Review conditions of examination, preparation and installation procedures.
   2. Review coordination with related work.

E. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.

3.04 LAYING OUT THE WORK

A. Verify locations of survey control points prior to starting work.

B. Promptly notify Architect of any discrepancies discovered.

C. Protect survey control points prior to starting site work; preserve permanent reference points during construction.

D. Promptly report to Architect the loss or destruction of any reference point or relocation required because of changes in grades or other reasons.

E. Replace dislocated survey control points based on original survey control. Make no changes without prior written notice to Architect.

F. Utilize recognized engineering survey practices.

G. Establish elevations, lines and levels. Locate and lay out by instrumentation and similar appropriate means:
   1. Site improvements including pavements; stakes for grading, fill and topsoil placement; utility locations, slopes, and invert elevations.
   2. Grid or axis for structures.
   3. Building foundation, column locations, ground floor elevations.

3.05 GENERAL INSTALLATION REQUIREMENTS

A. Install products as specified in individual sections, in accordance with manufacturer's instructions and recommendations, and so as to avoid waste due to necessity for replacement.

B. Make vertical elements plumb and horizontal elements level, unless otherwise indicated.

C. Install equipment and fittings plumb and level, neatly aligned with adjacent vertical and horizontal lines, unless otherwise indicated.

D. Make consistent texture on surfaces, with seamless transitions, unless otherwise indicated.

E. Make neat transitions between different surfaces, maintaining texture and appearance.

3.06 CUTTING AND PATCHING

A. Whenever possible, execute the work by methods that avoid cutting or patching.

B. Execute work by methods that avoid damage to other work and that will provide appropriate surfaces to receive patching and finishing. In existing work, minimize damage and restore to original condition.

C. Employ original installer to perform cutting for weather exposed and moisture resistant elements, and sight exposed surfaces.

D. Cut rigid materials using masonry saw or core drill. Pneumatic tools not allowed without prior approval.

E. Restore work with new products in accordance with requirements of Contract Documents.

F. Fit work air tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.

G. Patching:
   1. Finish patched surfaces to match finish that existed prior to patching. On continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.
   2. Match color, texture, and appearance.
   3. Repair patched surfaces that are damaged, lifted, discolored, or showing other imperfections due to patching work. If defects are due to condition of substrate, repair substrate prior to repairing finish.

3.07 PROGRESS CLEANING

A. Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition.

B. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to enclosing the space.

C. Broom and vacuum clean interior areas prior to start of surface finishing, and continue cleaning to eliminate dust.

D. Collect and remove waste materials, debris, and trash/rubbish from site periodically and dispose off-site; do not burn or bury.

3.08 PROTECTION OF INSTALLED WORK

A. Protect installed work from damage by construction operations.

B. Provide special protection where specified in individual specification sections.

C. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.

D. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.

E. Prohibit traffic or storage upon waterproofed or roofed surfaces. If traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.

F. Remove protective coverings when no longer needed; reuse or recycle coverings if possible.

3.09 SYSTEM STARTUP

A. Coordinate schedule for start-up of various equipment and systems.

B. Notify Architect and Owner seven days prior to start-up of each item.

C. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, and for conditions that may cause damage.

D. Verify tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.

E. Execute start-up under supervision of applicable Contractor personnel and manufacturer's representative in accordance with manufacturers' instructions.

F. When specified in individual specification Sections, require manufacturer to provide authorized representative to be present at site to inspect, check, and approve equipment or system installation prior to start-up, and to supervise placing equipment or system in operation.

3.10 DEMONSTRATION AND INSTRUCTION

A. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment at scheduled time, at equipment location.

B. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.

C. Provide a qualified person who is knowledgeable about the Project to perform demonstration and instruction of Owner's personnel.

3.11 ADJUSTING

A. Adjust operating products and equipment to ensure smooth and unhindered operation.

3.12 MAINTENANCE

A. Provide service and maintenance of components indicated in specification sections.

B. Maintenance Period: As indicated in specification sections or, if not indicated, not less than one year from the Date of Substantial Completion or the length of the specified warranty, whichever is longer.

C. Examine system components at a frequency consistent with reliable operation. Clean, adjust, and lubricate as required.

D. Include systematic examination, adjustment, and lubrication of components. Repair or replace parts whenever required. Use parts produced by the manufacturer of the original component.

E. Maintenance service shall not be assigned or transferred to any agent or subcontractor without prior written consent of the Owner.

END OF SECTION

SECTION 01 7700
CLOSEOUT PROCEDURES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. This section includes administrative and procedural requirements for contract closeout including, but not limited to, the following:
   1. Inspection procedures for Completion Reviews.
   2. Final adjustments of accounts and payment.
   3. As-built drawings.
   4. Project record document submittal.
   5. Operation and maintenance manual submittal.
   6. Submittals and warranties.
   7. Final cleaning.

B. Closeout requirements for specific construction activities are included in the appropriate individual sections.

1.02 SUBSTANTIAL COMPLETION

A. Preliminary Procedures: Before requesting inspections for certification of Substantial Completion, complete the following:
   1. Conduct inspection to substantiate basis for request that Work is substantially complete. Create comprehensive list (initial punch list) indicating items to be completed or corrected, value of incomplete or non-conforming work, reason for being incomplete, and date of anticipated completion for each item.
   2. Advise the Owner of pending insurance changeover requirements.
   3. Submit specific warranties, workmanship bonds, maintenance agreements, final certifications and similar documents.
   4. Obtain and submit releases enabling the Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates and similar releases.
   5. Submit record drawings, maintenance manuals, damage or settlement surveys, property surveys and similar final record information.
   6. Deliver tools, spare parts, extra stock and similar items.
   7. Make final changeover of permanent locks and transmit keys to the Owner. Advise the Owner's personnel of changeover in security provisions.
   8. Complete startup testing of systems and instructions of the Owner's operation and maintenance personnel. Discontinue and remove temporary facilities from the site, along with mockups, construction tools and similar elements.
   9. Complete final cleanup requirements, including touchup painting.
   10. Touch up and otherwise repair and restore marred, exposed finishes.

1.03 FINAL COMPLETION REVIEW

A. Within 7 days after receipt of request for final review, Architect will make site review to determine whether Work is complete following procedures indicated in Conditions of the Contract.

B. Should Architect consider Work to be incomplete or defective:
   1. Architect will promptly notify Contractor listing incomplete or defective work.

C. Contractor shall take immediate steps to remedy stated deficiencies and send second written request to Architect the Work is complete.
   1. Architect will reinspect the Work.
   2. Revisits for Site Reviews:
      a. Should Architect have to re-perform site reviews due to failure of work to comply with claims of completion made by Contractor, Owner will reimburse Architect for such

additional services and will deduct amount of compensation from final payment to Contractor.

1.04 EVIDENCE OF PAYMENTS AND RELEASE OF LIENS

A. Submit Contractor's affidavit of Payment of Debts and Claims on AIA Document G706.

B. Submit Contractor's affidavit of Release of Liens on AIA Document G706A with:
   1. Consent of Surety to Final Payment: AIA G707.
   2. Contractor's Release of Waiver of Liens.
   3. Separate releases or waivers of liens from subcontractors, suppliers and others with lien rights against property of Owner, together with list of those parties.

C. Execute Submittals before delivery to Owner.

1.05 FINAL ADJUSTMENTS OF ACCOUNTS

A. Submit final statement of accounting to Architect.

B. Show adjustments to Contract Sum:
   1. Original Contract Sum.
   2. Additions and deductions resulting from:
      a. Previous Change Orders.
      b. Allowances.
      c. Unit prices.
      d. Deductions for uncorrected work.
      e. Deductions for inspection payments.
      f. Other adjustments.
   3. Total Contract Sum.
   4. Previous Payments.
   5. Retainage.
   6. Sum remaining due.

C. Architect will prepare final Change Order reflecting approved adjustments to Contract Sum which are not included in Change Orders previously processed.

1.06 FINAL APPLICATION FOR PAYMENT

A. Submit final Application for Payment in accordance with procedures and requirements stated in Conditions of the Contract.

1.07 RECORD DOCUMENT SUBMITTALS (AS-BUILTS)

A. Record Drawings: Maintain a clean, undamaged set of blue or black line white-prints of Contract Drawings. Mark the set to show the actual installation where installation varies substantially from the work as originally shown. Mark which drawing is most capable of showing conditions fully and accurately. Give particular attention to concealed elements that would be difficult to measure and record at a later date.
   1. Mark record sets with red ink. Use other colors to distinguish between variations in separate categories of the work.
   2. Mark new information that is important to the Owner but was not shown on Contract Drawings.

B. Maintenance Manuals: Organize operation and maintenance data into suitable sets of manageable size. Bind properly indexed data in individual, heavy-duty, 2-inch, 3-ring, vinyl-covered binders, with pocket folders for folded sheet information. Furnish Architect with five (5) complete sets within 30 calendar days of initial Certificate of Occupancy. Mark appropriate identification on front and spine of each binder. Include the following types of information:
   1. Emergency instructions.
   2. Spare parts list.

3. Copies of warranties.
4. Wiring diagrams.
5. Recommended "turn-around" cycles.
6. Inspection procedures.
7. Product data.
8. Fixture lamping schedule.

C. Spare Parts and Extra Stock Inventory: Transmit spare parts and extra stock to the Owner with an inventory checklist for review by the Owner. Checklist shall include an itemized listing of each type of item and quantity, a method for the Owner to check off each item accepted, and a receipt for the Owner to sign and return to the Contractor accepting the entire inventory.

PART 2 PRODUCTS

-- NOT APPLICABLE --

PART 3 EXECUTION

3.01 CLOSEOUT PROCEDURES

A. Operation and Maintenance Instructions: Arrange for each installer of equipment that requires regular maintenance to meet with the Owner's personnel to provide instruction in proper operation and maintenance. Provide instructions by manufacturer's representatives if installers are not experienced in operation and maintenance procedures.
   1. Include a detailed review of the following items:
      a. Maintenance manuals.
      b. Record documents.
      c. Spare parts and manuals.
      d. Tools.
      e. Lubricants.
      f. Fuels.
      g. Identification systems.
      h. Control sequences.
      i. Hazards.
      j. Cleaning.
      k. Warranties and bonds.
      l. Maintenance agreements and similar continuing commitments.
   2. As part of the instructions for operating equipment, demonstrate the following procedures:
      a. Startup.
      b. Shutdown.
      c. Emergency operations.
      d. Noise and vibration adjustments.
      e. Safety procedures.
      f. Economy and efficiency adjustments.
      g. Effective energy utilization.

B. Delivery of Spare Parts and Extra Stock: Deliver spare parts and extra stock to storage location designated by the Owner.

3.02 FINAL CLEANING

A. General: The General Conditions require general cleaning during construction. Regular site cleaning is included in Section 01 7000 - "Execution Requirements".

B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to the condition expected in a normal, commercial building cleaning and maintenance program. Comply with manufacturer's instructions.

C. Removal of Protection: Remove temporary protection and facilities installed for protection of the work during construction.

D. Compliance: Comply with regulations of authorities having jurisdiction and safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on the Owner's property. Do not discharge volatile, harmful or dangerous materials into drainage systems. Remove waste materials from the site as directed by the Owner.
   1. Where extra materials of value remain after completion of associated work, they become the Owner's property. Dispose of these materials as directed by the Owner.

END OF SECTION

SECTION 02 4100
DEMOLITION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Selective demolition of built site elements.

B. Selective demolition of building elements for alteration purposes.

C. Disposal of materials.

1.02 RELATED REQUIREMENTS

A. Section 01 5713 - Temporary Erosion Control.

B. Section 01 7000 - Execution Requirements: Project conditions; protection of bench marks, survey control points, and existing construction to remain; reinstallation of removed products; temporary bracing and shoring.

C. Section 31 1000 - Site Clearing: Vegetation and existing debris removal.

D. Section 31 2200 - Grading: Topsoil removal.

E. Section 31 2323 - Fill and Backfill: Filling holes, pits, and excavations generated as a result of removal operations.

1.03 REFERENCE STANDARDS

A. NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations; 2013.

PART 2 EXECUTION

2.01 GENERAL PROCEDURES AND PROJECT CONDITIONS

A. Comply with applicable codes and regulations for demolition operations and safety of adjacent structures and the public.
   1. Obtain required permits.
   2. Take precautions to prevent catastrophic or uncontrolled collapse of structures to be removed; do not allow worker or public access within range of potential collapse of unstable structures.
   3. Provide, erect, and maintain temporary barriers and security devices.
   4. Conduct operations to minimize effects on and interference with adjacent structures and occupants.
   5. Do not close or obstruct roadways or sidewalks without permit.
   6. Conduct operations to minimize obstruction of public and private entrances and exits; do not obstruct required exits at any time; protect persons using entrances and exits from removal operations.
   7. Obtain written permission from owners of adjacent properties when demolition equipment will traverse, infringe upon or limit access to their property.

B. Do not begin removal until receipt of notification to proceed from Owner.

C. Protect existing structures and other elements that are not to be removed.
   1. Provide bracing and shoring.
   2. Prevent movement or settlement of adjacent structures.
   3. Stop work immediately if adjacent structures appear to be in danger.

2.02 SELECTIVE DEMOLITION FOR ALTERATIONS

A. Drawings showing existing construction and utilities are based on casual field observation and existing record documents only.
   1. Verify that construction and utility arrangements are as indicated.
   2. Report discrepancies to Architect before disturbing existing installation.
   3. Beginning of demolition work constitutes acceptance of existing conditions that would be apparent upon examination prior to starting demolition.

B. Remove existing work as indicated and as required to accomplish new work.
   1. Remove items indicated on drawings.

C. Services (Including but not limited to HVAC, Plumbing, Fire Protection, Electrical, and Telecommunications): Remove existing systems and equipment as indicated.
   1. Maintain existing active systems that are to remain in operation; maintain access to equipment and operational components.
   2. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.
   3. Verify that abandoned services serve only abandoned facilities before removal.
   4. Remove abandoned pipe, ducts, conduits, and equipment, including those above accessible ceilings; remove back to source of supply where possible, otherwise cap stub and tag with identification.

D. Protect existing work to remain.
   1. Prevent movement of structure; provide shoring and bracing if necessary.
   2. Perform cutting to accomplish removals neatly and as specified for cutting new work.
   3. Repair adjacent construction and finishes damaged during removal work.
   4. Patch as specified for patching new work.

2.03 DEBRIS AND WASTE REMOVAL

A. Remove debris, junk, and trash from site.

B. Remove from site all materials not to be reused on site; comply with requirements of Section 01 7419 - Waste Management.

C. Leave site in clean condition, ready for subsequent work.

D. Clean up spillage and wind-blown debris from public and private lands.

END OF SECTION

SECTION 04 0511
MORTAR AND MASONRY GROUT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Mortar for masonry.

B. Grout for masonry.

1.02 RELATED REQUIREMENTS

A. Section 01 4500 - Quality Control.

B. Section 04 2000 - Unit Masonry System: Installation of mortar and grout.

C. Section 08 1100 - Standard Steel Doors and Frames: Products and execution for grouting steel door frames installed in masonry.

1.03 REFERENCE STANDARDS

A. ASTM C5 - Standard Specification for Quicklime for Structural Purposes; 2010.

B. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2015.

C. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar; 2011.

D. ASTM C150/C150M - Standard Specification for Portland Cement; 2015.

E. ASTM C207 - Standard Specification for Hydrated Lime for Masonry Purposes; 2006 (Reapproved 2011).

F. ASTM C270 - Standard Specification for Mortar for Unit Masonry; 2014a.

G. ASTM C404 - Standard Specification for Aggregates for Masonry Grout; 2011.

H. ASTM C476 - Standard Specification for Grout for Masonry; 2010.

I. ASTM C780 - Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry; 2012.

J. ASTM C1019 - Standard Test Method for Sampling and Testing Grout; 2013.

1.04 SUBMITTALS

A. See Section 01 3000 - "Submittals", for submittal procedures.

B. Product Data: Include design mix and indicate whether the Proportion or Property specification of ASTM C270 is to be used. Also include required environmental conditions and admixture limitations.

C. Samples: Submit two samples of mortar, illustrating mortar color and color range.

D. Reports: Submit reports on mortar indicating compliance of mortar to property requirements of ASTM C270 and test and evaluation reports per ASTM C780.

E. Reports: Submit reports on grout indicating conformance of component grout materials to requirements of ASTM C476 and test and evaluation reports to requirements of ASTM C 1019.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Maintain packaged materials clean, dry, and protected against dampness, freezing, and foreign matter.

1.06 FIELD CONDITIONS

A. Maintain materials and surrounding air temperature to minimum 50 degrees F prior to, during, and 48 hours after completion of masonry work.

1.07 MIX TEST

A. Testing of Mortar Mix: In accordance with ASTM C780.

B. Test mortar mix for compressive strength.

C. Testing of Grout Mix: In accordance with ASTM C1019.

D. Test grout mix for compressive strength.

PART 2 PRODUCTS

2.01 MORTAR AND GROUT APPLICATIONS

A. Mortar Mix Designs: ASTM C270, Property Specification.

2.02 MATERIALS

A. Portland Cement: ASTM C150, Type II - Moderate; standard gray color.

B. Hydrated Lime: ASTM C207, Type S.

C. Quicklime: ASTM C5, non-hydraulic type.

D. Mortar Aggregate: ASTM C144.

E. Grout Aggregate: ASTM C404.

F. Water: Clean and potable.

2.03 MORTAR MIXES

A. Mortar for Reinforced Masonry: ASTM C270, utilizing the Proportion Method to achieve 1800 psi strength.

2.04 MORTAR MIXING

A. Thoroughly mix mortar ingredients using mechanical batch mixer, in accordance with ASTM C270 and in quantities needed for immediate use.

B. Maintain sand uniformly damp immediately before the mixing process.

C. Do not use anti-freeze compounds to lower the freezing point of mortar.

D. If water is lost by evaporation, re-temper only within two hours of mixing.

E. Use mortar within two hours after mixing at temperatures of 80 degrees F, or 2-1/2 hours at temperatures under 50 degrees F.

2.05 GROUT MIXES

A. Grout: 2000 psi strength at 28 days; 10 inches slump.

2.06 GROUT MIXING

A. Mix grout in accordance with ASTM C94/C 94M.

B. Thoroughly mix grout ingredients in quantities needed for immediate use in accordance with ASTM C476 for fine and coarse grout.

PART 3 EXECUTION

3.01 EXAMINATION

A. Request inspection of spaces to be grouted.

3.02 INSTALLATION

A. Install mortar and grout to requirements of section(s) in which masonry is specified.

B. Work grout into masonry cores and cavities to eliminate voids.

C. Do not displace reinforcement while placing grout.

D. Remove excess mortar from grout spaces.

3.03 GROUTING

A. Use either high-lift or low-lift grouting techniques, at Contractor's option, subject to other limitations of Contract Documents.

B. Low-Lift Grouting:
   1. Limit height of pours to 12 inches.
   2. Limit height of masonry to 16 inches above each pour.

3. Pour grout only after vertical reinforcing is in place; place horizontal reinforcing as grout is poured. Prevent displacement of bars as grout is poured.
4. Place grout for each pour continuously and consolidate immediately; do not interrupt pours for more than 1-1/2 hours.

C. High-Lift Grouting:
1. Verify that horizontal and vertical reinforcement is in proper position and adequately secured before beginning pours.
2. Place grout for spanning elements in single, continuous pour.

END OF SECTION

SECTION 04 2000
UNIT MASONRY SYSTEM

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Concrete masonry units.

B. Reinforcement, anchorage and accessories.

1.02 RELATED REQUIREMENTS

A. Section 01 4500 - Quality Control.

B. Section 04 0511 - Mortar and Masonry Grout: Mortar and grout.

1.03 REFERENCE STANDARDS

A. ASTM A615/615M - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement; '09.

B. ASTM C90 - Hollow Load Bearing Concrete Masonry Units; '09.

C. CBC - 2019 California Building Code, based on 2018 International Building Code (IBC), with California Amendments.

1.04 SUBMITTALS

A. See Section 01 3000 - "Submittals", for submittal procedures.

B. Submit product data for masonry units.

C. Samples: Provide sample.

1.05 QUALITY ASSURANCE

A. Installer: Company specializing in performing the work of this section with minimum 3 years of experience.

1.06 REGULATORY REQUIREMENTS

A. Conform to California Building Code (CBC), current edition, requirements for masonry construction.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store and protect products under provisions of Section 01 6000 - "Product Requirements".

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Orco Block Co.
   1. Products: Precision CMU.
      a. Color: To be selected by Architect from standard color range.

B. Or approved equal.

C. Substitutions and Product Options: Under provisions of Section 01 6000 - "Product Requirements".

2.02 CONCRETE MASONRY UNITS

A. Hollow Load Bearing Block Units: ASTM C90, Grade N, Type I - Moisture Controlled; medium weight.

B. Masonry Units: 8x8x16, 8x6x16 & 8x4x16 (COMBINATION OF SPLIT-ACE, FLUTED & PRECISION) GROUT ALL CELLS. COLOR & BLOCK COMBINATION TO MATCH EXISTING - FIELD VERIFY.

C. Wall Caps: 8 x 2 x 16 Precision to match CMU.

2.03 REINFORCEMENT AND ANCHORAGE

A. Reinforcing Steel: ASTM A615, deformed billet bars of yield strength indicated on the Structural Drawings.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive work.

B. Verify items provided by other Sections of work are properly sized and located.

C. Verify that built-in items are in proper location, and ready for roughing into masonry work.

D. Beginning of installation means installer accepts existing conditions.

3.02 PREPARATION

A. Direct and coordinate placement of metal anchors supplied to other Sections.

B. Provide temporary bracing during installation of masonry work. Maintain in place until building structure provides permanent bracing.

3.03 COURSING

A. Establish lines, levels and coursing indicated. Protect from displacement.

B. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.

C. Lay concrete masonry units in running bond. Course one unit and one mortar joint to equal 8 inches. Form concave mortar joints.

3.04 PLACING AND BONDING

A. Lay solid masonry units in full bed of mortar, with full head joints, uniformly jointed with other work.

B. Lay hollow masonry units with face shell bedding on head and bed joints.

C. Buttering corners of joints or excessive furrowing of mortar joints are not permitted.

D. Remove excess mortar as work progresses.

E. Interlock intersections and external corners.

F. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.

G. Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.

3.05 CONTROL JOINT

A. Install preformed control joint device every 20' - 0", in continuous lengths. Seal butt and corner joints in accordance with manufacturer's instructions.

B. Size control joint in accordance with Section 07 92 00 - "Joint Sealers" for sealant performance.

3.06 BUILT-IN WORK

A. As work progresses, build-in metal door frames and other items furnished by other Sections.

B. Build-in items plumb and level.

C. Bed anchors of metal door frames in adjacent mortar joints. Fill frame voids solid with grout.

3.07 ERECTION TOLERANCES

A. Maximum variation from unit to adjacent unit: 1/32-inch.

B. Maximum variation from plane of wall: 1/4-inch in 10 feet and 1/2-inch in 20 feet or more.

C. Maximum variation from plumb: 1/4-inch per story non-cumulative.

D. Maximum variation from level coursing: 1/8-inch in 3 feet; 1/4-inch in 10 feet and 1/2-inch in 30 feet.

E. Maximum variation of joint thickness: 1/8-inch in 3 feet.

F. Maximum variation from cross sectional thickness of walls: 1/4-inch.

3.08 CUTTING AND FITTING

A. Cut and fit for pipes, conduit and sleeves. Coordinate with other sections of work to provide correct size, shape and location.

B. Obtain Architect/Engineer approval prior to cutting or fitting masonry work not indicated or where appearance or strength of masonry work may be impaired.

3.09 CLEANING

A. Clean work under provisions of the General Conditions.

B. Remove excess mortar and mortar smears.

C. Replace defective mortar. Match adjacent work.

D. Clean soiled surfaces with cleaning solution.

E. Use non-metallic tools in cleaning operations.

3.10 PROTECTION OF FINISHED WORK

A. Protect finished installation.

B. Without damaging completed work, provide protective boards at exposed external corners which may be damaged by construction activities.

END OF SECTION

SECTION 05 5000
METAL FABRICATIONS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Shop fabricated ferrous metal items, galvanized and prime painted.

1.02 RELATED REQUIREMENTS

A. Section 32 3119 - Ornamental Fences and Gates.

1.03 REFERENCE STANDARDS

A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; '08.

B. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-coated Welded and Seamless; '07.

C. ASTM A123A123M - Standard Specification for Zinc (Hot-Galvanized) Coatings on Iron and Steel Products; '09.

D. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; '09.

E. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates; '03 (2007).

F. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength; '07b.

G. AWS A2.0 - Standard Welding Symbols.

H. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2015.

1.04 SUBMITTALS

A. See Section 01 3000 - "Submittals", for submittal procedures.

B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.

C. Indicate welded connections using standard AWS A2.0 welding symbols. Indicate net weld lengths.

1.05 FIELD MEASUREMENTS

A. Verify that field measurements are as indicated on Drawings.

PART 2 PRODUCTS

2.01 MATERIALS

A. Steel Sections: ASTM A36.

B. Plates: ASTM A283.

C. Pipe: ASTM A53, Grade B Schedule 40.

D. Bolts, Nuts, and Washers: ASTM A307 galvanized to ASTM A153 for galvanized components.

E. Welding Materials: AWS D1.1; type required for materials being welded.

F. Shop and Touch-Up Primer: SSPC 15, Type 1, red oxide.

2.02 FABRICATION

A. Fit and shop assemble items in largest practical sections, for delivery to site.

B. Fabricate items with joints tightly fitted and secured.

C. Continuously seal joined members by continuous welds.

D. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

E. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.

F. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

2.03 FINISHES

A. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.

B. Do not prime surfaces in direct contact with concrete or where field welding is required.

C. Prime paint items with one coat.

D. Galvanize in accordance with ASTM A123, structural steel members.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive work.

B. Beginning of installation means erector accepts existing conditions.

3.02 PREPARATION

A. Clean and strip primed steel items to bare metal where site welding is required.

B. Supply setting templates to the appropriate entities for steel items required to be cast into concrete or embedded in masonry.

3.03 INSTALLATION

A. Install items plumb and level, accurately fitted, free from distortion or defects.

B. Provide for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.

C. Field weld components as indicated on drawings.

D. Perform field welding in accordance with AWS D1.1/D1.1M.

E. Obtain Architect/Engineer approval prior to site cutting or making adjustments not scheduled.

3.04 TOLERANCES

A. Maximum Variation From Plumb: 1/4-inch per story, non-cumulative.

B. Maximum Offset From Plumb: 1/4-inch.

3.05 SCHEDULE

A. The Schedule is a list of principal items only. Refer to drawing details for items not specifically scheduled.

B. Bollards: Steel pipe, concrete filled, crowned cap, as detailed; galvanized finish.

C. Trash Enclosure Gates: As detailed.

D. Metal fence panels and metal personnel gates.

E. Metal panel rolling gate.

F. Trash Enclosure Metal Canopy

G. Fuel Tank Metal Canopy

END OF SECTION

SECTION 06 1119
FRAMING AND SHEATHING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Structural wall and roof framing.

B. Wall and roof sheathing.

1.02 RELATED REQUIREMENTS

A. Section 06 1753 - Shop-Fabricated Wood Trusses.

1.03 REFERENCE STANDARDS

A. APA - American Plywood Association.

B. WCLIB - West Coast Lumber Inspection Bureau: Standard Grading Rules for West Coast Lumber.

1.04 SUBMITTALS

A. See Section 01 3000 - "Submittals", for submittal procedures.

1.05 QUALITY ASSURANCE

A. Plywood Grading Agency: Certified by APA.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Store and protect products under provisions of Section 01 60 00 - "Product Requirements".

PART 2 PRODUCTS

2.01 LUMBER MATERIALS

A. Lumber Grading Rules: WCLIB.

B. Douglas Fir-Larch species, 19 percent maximum moisture content.

C. See Structural drawings for lumber grades.

2.02 PLYWOOD MATERIALS

A. Roof Sheathing: APA, Grade CDX, unsanded.

B. Wall Sheathing: APA, Grade CDX, unsanded.

2.03 ACCESSORIES

A. Fasteners: Electro-galvanized steel for exterior, high humidity, and treated wood locations; plain finish elsewhere; size and type to suit condition.

PART 3 EXECUTION

3.01 SHEATHING

A. Secure roof sheathing perpendicular to framing members with ends staggered. Secure sheet edges over firm bearing. Use sheathing clips between sheets between roof framing members. Provide solid edge blocking between sheets where noted on roof plan.

B. Secure wall sheathing vertically, with ends staggered, over firm bearing.

END OF SECTION

SECTION 06 1119
FRAMING AND SHEATHING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Structural wall and roof framing.

B. Wall and roof sheathing.

1.02 RELATED REQUIREMENTS

A. Section 06 1753 - Shop-Fabricated Wood Trusses.

1.03 REFERENCE STANDARDS

A. APA - American Plywood Association.

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1.04 SUBMITTALS

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A. Fasteners: Electro-galvanized steel for exterior, high humidity, and treated wood locations; plain finish elsewhere; size and type to suit condition.

PART 3 EXECUTION

3.01 SHEATHING

A. Secure roof sheathing perpendicular to framing members with ends staggered. Secure sheet edges over firm bearing. Use sheathing clips between sheets between roof framing members. Provide solid edge blocking between sheets where noted on roof plan.

B. Secure wall sheathing vertically, with ends staggered, over firm bearing.

END OF SECTION

SECTION 07 4113
STANDING SEAM METAL ROOF PANELS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Prefinished, prefabricated structural standing seam roof system with continuous interlocking seams.

B. Trim.

1.02 RELATED REQUIREMENTS

A. Section 01 6000 - Product Requirements: Fundamental product requirements, substitutions and product options, delivery, storage, and handling.

B. Section 06 1119 - Framing and Sheathing: Plywood roof sheathing substrate.

C. Section 07 6200 - Sheet Metal Flashing and Trim

D. Section 07 9200 - Joint Sealants.

1.03 REFERENCE STANDARDS

A. ASTM A792/A792M - Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process; '09.

B. ASTM D523 - Standard Test Method for Specular Gloss; '08.

C. ASTM D2244 - Standard Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates; '07e1.

D. ASTM D6695 - Standard Practice for Xenon-Arc Exposures of Paint and Related Coatings; '08.

E. UL 90 - Wind Uplift Class.

F. UL 580 - Standards for Tests for Uplift Resistance of Roof Assemblies.

1.04 SUBMITTALS

A. See Section 01 3000 - "Submittals", for submittal procedures.

B. Product Data: Provide manufacturer's specifications, standard detail drawings and installation instructions.

C. Shop Drawings:
   1. Submit shop drawings indicating thickness and dimensions of parts, fastenings and anchoring methods, details and locations of seams, transitions and other provisions necessary for thermal expansion and contraction
   2. Indicate roof terminations, clearly showing flashings and change of direction caps.
   3. Clearly indicate locations of field applied sealant.
   4. Show locations and types of hold-down clips and fasteners.
   5. Provide plan showing layout of entire roof.

D. Samples:
   1. Submit two (2) samples, 12" long x full width panel showing proposed metal gauge, seam profile and required finish.
   2. Submit standard color samples on metal for Architect's selection.

E. Test Reports:
   1. Submit test reports prepared by UL (Underwriters Laboratories, Inc) indicating wind uplift rating of proposed roof system.

F. Certification:
   1. Submit manufacturer's certification that materials and finishes meet specified requirements.

G. Applicator's Experience:
   1. Submit a list of completed projects and name of Architect.

1.05 QUALITY ASSURANCE

A. Manufacturer's Qualifications:
   1. Ten (10) years minimum experience in factory fabrication of standing seam roofs.
   2. Products listed in this specification section are as manufactured by AEP Span.
   3. Substitution requests must be submitted in writing minimum ten days prior to bid date accompanied by product literature, technical information and product sample. Approved substitutions will be set forth in an addendum.
   4. No substitutions will be permitted after bid date.

B. Applicator Qualifications:
   1. Three (3) years minimum experience in application of metal roofing.
   2. Minimum of five (5) satisfactory projects on similar types of roofs.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Protect products and accessories from damage and discoloration during transit and at project site. Store sheets and components in dray storage area to prevent condensation.

B. Do not overload roof structure with stored materials. Do not permit material storage or traffic on completed roof surfaces.

1.07 WARRANTY

A. Furnish manufacturer's standard 20-year warranty stating architectural fluorocarbon finish will be:
   1. Free of fading or color change in excess of 5 NBS units as measured per ASTM D2244.
   2. Will not chalk in excess of numerical rating of 7 when measured in accordance with standard procedures specified in ASTM D6695.
   3. Will not peel, crack, chip or delaminate.

B. Furnish written warranty signed by applicator for two (2) year period from date of Substantial Completion of building covering repairs required to maintain roof and flashings in watertight condition.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Atas International, Inc.:

   6612 Snowdrift Rd.

   Allentown, PA 18106 / Ph: 800-468-1441

B. Substitutions:
   1. Substitutions must fully comply with specified requirements.
   2. Under provisions of Section 01 6000 - "Product Requirements".

2.02 SYSTEM DESCRIPTION

A. Design Requirements:
   1. Provide UL 90 rated roofing system that has been tested in accordance with UL 580 test procedure.
   2. Provide factory preformed panel system which had been certified by manufacturer to comply with specified requirements under installed conditions.
      a. Press broken or field formed panel systems will not be acceptable.
   3. Provide one piece, single length roof panel where possible.
   4. Provide continuous integral standing seam.
   5. Provide clips and other accessories as required by specific job conditions for complete installation.

B. Substrate Criteria:
   1. Solid 5/8" minimum thickness plywood substrate.

2.03 CONCEALED-FASTENER, STANDING SEAM METAL ROOF PANELS

A. General: Provide factory-formed metal roof panels designed to be field assembled by lapping and interconnecting raised side edges of adjacent panels with joint type indicated and mechanically attaching panels to supports using concealed clips in side laps. Include clips, cleats, pressure plates, and accessories required for weathertight installation. Unless more stringent requirements are indicated, comply with ASTM E 1514.

B. Integral-Standing-Seam Metal Roof Panels: Formed with integral ribs at panel edges and flat pan between ribs; designed for sequential installation by mechanically attaching panels to supports using concealed clips located under one side of panels and lapping and interconnecting side edges of adjacent panels.
   1. Basis-of-Design Product: ATAS International, Inc.; Dutch Seam™; MRD194 or a comparable product.
   2. Manufacturer:
      a. ATAS International, Inc.
   3. Material: 24 gauge metallic coated Steel.
      a. Texture: Smooth.
      b. Pan Coverage: 19-1/4".
      c. Seam Height: 1-1/2".
      d. KYNAR 5000® PDVF or HYLAR 5000® Finish.
      e. Color: To match existing adjacent building's roof - field verify.

C. Accessories:
   1. Provide manufacturer's standard accessories and other items essential to completeness of standing seam roof installation including anchor clips, trim, ridge and hip caps, closures, flashing and fascia.
   2. Form flashings from same gauge and finish as roof panels.
   3. Provide transition rib covers for changes in roof slope.

D. Field Sealants:
   1. Color coordinated primerless silicone or high grade, nondrying butyl as recommended by panel manufacturer.
   2. Do not use sealant containing asphalt.

E. Underlayment:
   1. Grace Ultra, as manufactured by Grace Construction Products.
      a. Composed of two waterproofing materials - butyl rubber based adhesive backed by a layer of high density cross laminated polyethylene.

2.04 FABRICATION

A. Panels:
   1. Provide factory formed panel widths of 16", with 1-1/2" high standing seam.
   2. Provide panels in full length from ridge to eave where possible.

B. Seams:
   1. Panel seams shall interlock without use of field seaming machines. Compression ribs and/or button punching will not be allowed.
   2. Engineer standing seam to lock up and resist joint disengagement during design wind uplift conditions as calculated according to local building codes.

C. Engineer panels to use concealed anchors that permit expansion and contraction, except at eaves, end laps, ridges, valleys, hips and gables.

D. Provide factory eave notch for eave termination (to be utilized with joggle cleat detail).

2.05 FINISH

A. Fluorocarbon Coating:
   1. Full strength 70% Kynar 500 coating baked on for 15 minutes at 450-deg F to dry-film thickness of 1.0 mil.
   2. 20% reflective gloss (ASTM D523). Low Gloss.

3. 0.3 mil baked-on epoxy primer.
4. Color: As selected by Architect from manufacturer's range of standard colors.

PART 3 EXECUTION

3.01 EXAMINATION

A. Plywood Deck:
   1. Examine decking to ensure substrate is properly secured and prepared to receive metal roofing.
   2. Ensure decking is installed flat, free from objectionable warp, wave, and buckle.
   3. Refer to Section 07 2100 - "Batt and Blanket Insulation" for roof insulation.
   4. Do not proceed with installation until unsatisfactory conditions have been corrected.

B. Installer's Examination:
   1. Have installer examine conditions under which construction activities of this section are to be performed, then submit written notification if such conditions are unacceptable.
   2. Transmit two copies of installer's report to Architect within 24 hours of receipt.
   3. Beginning construction activities of this section before unacceptable conditions have been corrected is prohibited.
   4. Beginning construction activities of this section indicates installer's acceptance of conditions.

3.02 PREPARATION

A. Underlayment:
   1. Apply Grace Ultra only in fair weather when the air, roof deck, and membrane are at temperatures of 40-deg F or higher.
   2. Cut the membrane into 10-15 ft lengths and re-roll loosely. Tack/secure end of roll with nail or other appropriate method approved by the manufacturer of membrane.
   3. Peel back 1-2 ft of release liner, align the membrane, and continue to peel the release liner from the membrane. Press the membrane in place with heavy hand pressure.
   4. Side laps must be a minimum of 3-1/2 inches and end laps a minimum of 6 inches.
   5. Consistent with good roofing practice, install the membrane such that all laps shed water. Always work from the low point to the high point of the roof.

3.03 INSTALLATION

A. Comply with manufacturer's instructions for assembly, installation, and erection in order to achieve weathertight installation. Install in accordance with approved Shop Drawings.

B. Anchor component parts securely in place allowing for expansion and contraction resulting from thermal and structural movement. Provide expansion joints in sheet metal work at necessary intervals.

C. Standing Seam System:
   1. Install panels in accordance with manufacturer's instructions and recommendations.
   2. Anchor securely in place using clips and fasteners spaced in accordance with manufacturer's recommendations for design wind load criteria.
   3. Fully seat adjacent panel to achieve continuous engagement of standing seam joint.
   4. Make end cuts and install sealant with flashings to achieve weathertight installation.

D. Dissimilar Metals:
   1. Where sheet metal is in contact with dissimilar metals, execute juncture to facilitate drainage and minimize possibility of galvanic action.
   2. At point of contact with dissimilar metal, coat metal with protective paint or tape which can be placed between metals.

E. Field apply sealant to penetrations, transitions and other locations necessary (not standing seam) for airtight, waterproof installation.

3.04 CLEANING

A. Clean exposed surfaces of work promptly after completion of installation.

B. Clean roofs in accordance with manufacturer's recommendations.

3.05 PROTECTION

A. Protect work as required to ensure roofing will be without damage at time of final completion.

END OF SECTION

SECTION 07 6200
SHEET METAL FLASHING AND TRIM

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Fabricated sheet metal items, including flashings, counterflashings, gutters, downspouts, sheet metal roofing, exterior penetrations, _____, and other items indicated in Schedule.

B. Roof flashings.

C. Flashings, counterflashings, sheet metal roofing, and fabricated sheet metal items.

1.02 RELATED WORK

A. Section 07 41 13 - Standing Seam Metal Roof Panels.

B. Section 07 9200 - Joint Sealants: Sealing non-lap joints between sheet metal fabrications and adjacent construction.

C. Section 09 9000 - Painting and Coating: Prime and finish painting.

1.03 REFERENCE STANDARDS

A. ASTM A525 - Steel Sheet, Zinc Coated, (Galvanized) by the Hot-Dip Process

B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.

C. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2014.

D. FS O-F-506 - Flux, Soldering, Paste and Liquid.

E. FS QQ-S-571 - Solder, Tin Alloy.

F. FS SS-C-153 - Cement, Bituminous, Plastic.

G. CDA A4050 - Copper in Architecture - Handbook; current edition.

H. SMACNA (ASMM) - Architectural Sheet Metal Manual; 2012.

1.04 SYSTEM DESCRIPTION

A. Flashings and counter-flashings shall be installed at the junction of roofs with vertical surfaces and at all points as shown or as necessary to make work watertight.

1.05 QUALITY ASSURANCE

A. Perform work in accordance with SMACNA (ASMM) and CDA A4050 requirements and standard details, except as otherwise indicated.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Store products under provisions of Section 01 60 00 - "Product Requirements".

B. Stack preformed and pre-finished material to prevent twisting, bending, and abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.

C. Prevent contact with materials during storage which may cause discoloration or staining, or damage.

PART 2 PRODUCTS

2.01 SHEET MATERIALS

A. Galvanized Steel: ASTM A653/A653M, with G90/Z275 zinc coating; minimum 24 gauge, (0.0239 inch) thick base metal.

2.02 ACCESSORIES

A. Fastener: Galvanized steel with soft neoprene washers at exposed fasteners

B. Underlayment: Polyethylene, 6 mils thick.

C. Sealant to be Concealed in Completed Work: Non-curing butyl sealant.

D. Sealant to be Exposed in Completed Work: ASTM C920; elastomeric sealant, 100 percent silicone with minimum movement capability of plus/minus 25 percent and recommended by manufacturer for substrates to be sealed; clear.

E. Sealant: Type specified in Section 07900 - "Joint Sealers".

F. Plastic Cement: FS SS-C-153, Type I-asphaltic base cement.

G. Reglets: Surface mounted galvanized steel.

H. Solder: FS QQ-S-571.

I. Flux: FS O-F-506.

2.03 FABRICATION

A. Form sections true to shape, accurate in size, square, and free from distortion or defects.

B. Fabricate cleats and starter strips of same material as sheet, interlockable with sheet.

C. Form pieces in longest possible lengths.

D. Hem exposed edges on underside 1/2-inch miter and seam corners.

E. Form material with flat lock seam.

F. Solder and seal metal joints. After soldering, remove flux. Wipe and wash solder joints clean.

G. Fabricate corners from one piece with minimum 18-inch long legs; seam for rigidity, seal with sealant.

H. Fabricate vertical faces with bottom edge formed outward 1/4-inch and hemmed to form drip.

2.04 FINISH

A. Shop prepare and prime exposed ferrous metal surfaces.

B. Backpaint concealed metal surfaces with protective backing paint to a minimum dry film thickness of 15-mil.

C. Gutters and Downspouts; powder coated, color selected by architect.

2.05 GUTTER FABRICATION

A. Gutters: SMACNA (ASMM), Rectangular profile.

B. Form gutters of profiles and size indicated.
   1. Fabricate with required connection pieces.
   2. Form sections square, true, and accurate in size, in maximum possible lengths, free of distortion or defects detrimental to appearance or performance. Allow for expansion at joints.
   3. Hem exposed edges of metal.
   4. Fabricate gutter and accessories; seal watertight.

C. Gutters and Downspouts: Design for future removal and replacement without disturbing the roof tile system.

D. Accessories: Profiled to suit gutters.
   1. Anchorage Devices: In accordance with SMACNA (ASMM) requirements.

PART 3 EXECUTION

3.01 INSPECTION

A. Verify roof openings, curbs, pipes, sleeves, ducts, and vents through roof are solidly set, cant strips and reglets in place, and nailing strips located.

B. Verify roofing termination and base flashings are in place, sealed, and secure.

C. Beginning of installation means acceptance of existing conditions.

3.02 PREPARATION

A. Field measure site conditions prior to fabricating work.

B. Install starter and edge strips, and cleats before starting installation.

C. Install surface mounted reglets true to lines and levels, and seal top of reglets with sealant.

D. Insert flashings into reglets to form tight fit. Secure in place with plastic wedges. Seal flashings into reglets with sealant.

E. Lap and seal all joints.

F. Solder metal joints watertight for full metal surface contact. After soldering, wash metal clean with neutralizing solution and rinse with water.

3.03 INSTALLATION

A. Conform to drawing details included in SMACNA manual:

B. Secure flashings in place using concealed fasteners, and use exposed fasteners only where permitted..

C. Apply plastic cement compound between metal flashings and felt flashings.

D. Fit flashings tight in place; make corners square, surfaces true and straight in planes, and lines accurate to profiles.

E. Secure gutters in place using concealed fasteners.

F. Slope gutters 1/4 inch per foot minimum.

END OF SECTION

SECTION 07 9200
JOINT SEALANTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Nonsag gunnable joint sealants.

B. Self-leveling pourable joint sealants.

C. Joint backings and accessories.

1.02 RELATED REQUIREMENTS

A. Section 32 1313 - Portland Cement Concrete Paving.

1.03 REFERENCE STANDARDS

A. ASTM C834 - Standard Specification for Latex Sealants; 2014.

B. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2014.

C. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2013.

D. ASTM C1248 - Standard Test Method for Staining of Porous Substrate by Joint Sealants; 2008 (Reapproved 2012).

E. ASTM C1311 - Standard Specification for Solvent Release Sealants; 2014.

F. SCAQMD 1168 - South Coast Air Quality Management District Rule No.1168; current edition.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data for Sealants: Submit manufacturer's technical data sheets for each product to be used, that includes the following.
   1. Physical characteristics, including movement capability, VOC content, hardness, cure time, and color availability.
   2. List of backing materials approved for use with the specific product.
   3. Substrates that product is known to satisfactorily adhere to and with which it is compatible.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Non-Sag Sealants: Permits application in joints on vertical surfaces without sagging or slumping.
   1. Adhesives Technology Corporation; _____: www.atcepoxy.com/#sle.
   2. QUIKRETE Companies; _____: www.quikrete.com/#sle.
   3. Sherwin-Williams Company; _____: www.sherwin-williams.com/#sle.
   4. Substitutions: See Section 01 6000 - PRODUCT REQUIREMENTS.

B. Self-Leveling Sealants: Pourable or self-leveling sealant that has sufficient flow to form a smooth, level surface when applied in a horizontal joint.
   1. Adhesives Technology Corporation; _____: www.atcepoxy.com/#sle.
   2. QUIKRETE Companies; _____: www.quikrete.com/#sle.
   3. Sherwin-Williams Company; _____: www.sherwin-williams.com/#sle.
   4. Substitutions: See Section 01 6000 - PRODUCT REQUIREMENTS.

2.02 JOINT SEALANTS - GENERAL

A. Sealants and Primers: Provide products having lower volatile organic compound (VOC) content than indicated in SCAQMD 1168.

B. Silicone Sealant: FS TT-S-01543, Class A, low modulus type; color as selected; manufactured by Dow Corning, General Electric, Sonneborn or approved equal.

2.03 ACCESSORIES

A. Backer Rod: Cylindrical cellular foam rod with surface that sealant will not adhere to, compatible with specific sealant used, and recommended by backing and sealant manufacturers for specific application.

B. Backing Tape: Self-adhesive polyethylene tape with surface that sealant will not adhere to and recommended by tape and sealant manufacturers for specific application.

C. Masking Tape: Self-adhesive, nonabsorbent, non-staining, removable without adhesive residue, and compatible with surfaces adjacent to joints and sealants.

D. Joint Cleaner: Non-corrosive and non-staining type, type recommended by sealant manufacturer; compatible with joint forming materials.

E. Primers: Type recommended by sealant manufacturer to suit application; non-staining.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that joints are ready to receive work.

B. Verify that backing materials are compatible with sealants.

C. Verify that backer rods are of the correct size.

3.02 PREPARATION

A. Remove loose materials and foreign matter that could impair adhesion of sealant.

B. Clean joints, and prime as necessary, in accordance with manufacturer's instructions.

C. Perform preparation in accordance with manufacturer's instructions and ASTM C1193.

D. Mask elements and surfaces adjacent to joints from damage and disfigurement due to sealant work; be aware that sealant drips and smears may not be completely removable.

3.03 INSTALLATION

A. Perform work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.

B. Perform installation in accordance with ASTM C1193.

C. Install bond breaker backing tape where backer rod cannot be used.

D. Install sealant free of air pockets, foreign embedded matter, ridges, and sags, and without getting sealant on adjacent surfaces.

E. Do not install sealant when ambient temperature is outside manufacturer's recommended temperature range, or will be outside that range during the entire curing period, unless manufacturer's approval is obtained and instructions are followed.

F. Nonsag Sealants: Tool surface concave, unless otherwise indicated; remove masking tape immediately after tooling sealant surface.

3.04 FIELD QUALITY CONTROL

A. Perform field quality control inspection/testing as specified in PART 1 under QUALITY ASSURANCE article.

B. Remove and replace failed portions of sealants using same materials and procedures as indicated for original installation.

END OF SECTION

SECTION 08 1100
STANDARD STEEL DOORS AND FRAMES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Non-rated rolled steel doors and frames.

1.02 RELATED REQUIREMENTS

A. Section 04 0511 - Mortar and Masonry Grout: Grouting of steel frames in masonry.

B. Section 08 7100 - Door Hardware.

C. Section 09 9000 - Painting and Coating: Field painting of doors and frames.

1.03 REFERENCE STANDARDS

A. ANSI A250.11 - Recommended Erection Instructions for Steel Frames; '01.

B. DHI - Door Hardware Institute: The Installation of Commercial Steel Doors and Steel Frames, Insulated Steel Doors in Wood Frames and Builders' Hardware.

C. NFPA 80 - Standard for Fire Doors and Windows; '95.

D. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; '95.

E. SDI 100 - Recommended Specifications for Standard Steel Doors and Frames; Steel Door Institute; '91.

1.04 SUBMITTALS

A. See Section 01 3000 - "Submittals", for submittal procedures.

B. Product Data: Provide door configurations, location of cut-outs or hardware reinforcement.

C. Shop Drawings: Indicate door elevations, internal reinforcement, closure method, cut-outs for glazing, and finishes.

D. Manufacturer's Installation Instructions: Indicate special installation instructions.

1.05 QUALITY ASSURANCE

A. Conform to SDI-100.

B. Fire rated frame construction to conform to NFPA 252.

C. Installed frame and door assembly to conform to NFPA 80 for fire rated class indicated on drawings.

1.06 REGULATORY REQUIREMENTS

A. Conform to applicable code for fire rated frames.

B. Fire Rated Door Construction: Conform to NFPA 252.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Protect products under provisions of Section 01 60 00 - "Product Requirements".

B. Protect frames with resilient packaging sealed with heat shrunk plastic.

C. Break seal on site to permit ventilation.

PART 2 PRODUCTS

2.01 DOORS AND FRAMES

A. Doors: SDI-100 Grade I.

B. Frames:

1. Exterior: Amweld, Steelcraft, Republic or approved equal, 16-gauge thick material, core thickness. To suit grade and model of door.

2.02 DOOR CORE

A. Core: Impregnated cardboard honeycomb.

2.03 ACCESSORIES

A. Rubber Silencers: Resilient rubber.

2.04 FABRICATION

A. Fabricate frames as welded unit type.

B. Fabricate frames and doors with hardware reinforcement plates welded in place.

C. Reinforce frames wider than 48-inches with roll formed steel channels fitted tightly into frame head, flush with top.

D. Prepare frame for silencers. Provide three single rubber silencers for single doors on strike side, and two single silencers on frame head at double doors without mullions.

E. Attach fire rated label to each frame unit.

F. Close top edge of exterior doors flush with inverted steel channel closure. Seal joints watertight.

2.05 FINISH

A. Primer: Air dried.

B. Finish: Paint of color selected.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install frames in accordance with ANSI 250.11.

C. Install doors in accordance with DHI.

D. Coordinate with wallboard wall construction for anchor placement.

3.02 ERECTION TOLERANCES

A. Maximum Diagonal Distortion: 1/16-inch measured with straight edge, corner to corner.

3.03 ADJUSTING

A. Adjust doors for smooth and balanced door movement.

END OF SECTION

SECTION 08 7100
DOOR HARDWARE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Hardware for wood and hollow metal doors.

B. Hardware for fire-rated doors.

1.02 RELATED REQUIREMENTS

A. Section 08 1100 - Standard Steel Doors and Frames.

B. Section 08 1423 - Laminate Faced Wood Doors.

1.03 REFERENCE STANDARDS

A. CBC - 2013 California Building Code, based on 2012 International Building Code (IBC), with California Amendments.

B. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2016.

C. SDI - Steel Door Institute.

D. UL (DIR) - Online Certifications Directory; current listings at database.ul.com.

1.04 COORDINATION

A. Coordinate the manufacture, fabrication, and installation of products that door hardware will be installed upon.

B. Coordinate work of this section with other directly affected sections involving manufacturer of any internal reinforcement for door hardware.

1.05 REGULATORY REQUIREMENTS

A. Conform to applicable code for requirements to fire rated doors and frames.

B. Accessibility Requirements.

1. Conform to CBC:
    a. Section 1132A.6, Closer-Effort to Operate Doors.
        1) Maximum effort to operate doors shall not exceed 8-1/2 pounds for exterior doors and 5 pounds for interior doors, such pull or push effort being applied at right angles to hinged doors and at the center plane of sliding or folding doors. Compensating devices or automatic door operators may be utilized to meet these standards. When fire doors are required, the maximum effort to operate the door may be increased to the minimum allowable by the appropriate enforcement agency, not to exceed 15 pounds.
    b. Section 1132A.8, Hand-Activated Door Hardware.
        1) Hand-activated door latching, locking and opening hardware shall be centered between 30 inches and 44 inches above the floor. Latching and locking doors that are hand-activated and on an accessible route shall be operable with a single effort by lever-type hardware, panic bars, push-pull activating bars or other hardware designed to provide passage without requiring the ability to grasp the opening hardware. Locked exit doors shall operate consistent with Section 1132A.6 in direction of egress.
    c. Section 1126A.4.1, Door Closer.
        1) If the door has a closer, then the sweep period of the closer shall be adjusted so that from an open position of 70 degrees, the door will take at least 3 seconds to move to a point 3 inches from the latch, measured to the leading edge of the door.

1.06 SUBMITTALS

A. See Section 01 3000 - "Submittals", for submittal procedures.

B. Product Data: Manufacturer's catalog literature for each type of hardware, marked to clearly show products to be furnished for this project.

C. Indicate locations and mounting heights of each type of hardware.

D. Submit Schedule of Hardware.

E. Provide product data on specified hardware.

F. Submit manufacturer's parts lists, templates and installation instructions.

1.07 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data.

B. Include data on operating hardware, lubrication requirements, and inspection procedures related to preventive maintenance.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store and protect products under provisions of Section 01 6000 - "Product Requirements"

B. Package hardware items individually; label and identify each package with door opening code to match hardware schedule.

C. Deliver keys to Owner by security shipment direct from hardware supplier.

D. Protect hardware from theft by cataloging and storing in secure area.

1.09 MAINTENANCE PRODUCTS

A. Provide special wrenches and tools applicable to each different or special hardware component.

B. Provide maintenance tools and accessories supplied by hardware component manufacturer.

1.10 WARRANTY

A. Provide five year warranty.

PART 2 PRODUCTS

2.01 MANUFACTURERS - BASIS OF DESIGN

A. As specified in this section for other products.

B. Substitutions: See Section 01 6000 - PRODUCT REQUIREMENTS.

2.02 GENERAL REQUIREMENTS

A. Provide door hardware specified, or as required to make doors fully functional, compliant with applicable codes, and secure to the extent indicated.

B. Provide items of a single type of the same model by the same manufacturer.

C. Provide products that comply with the following:
   1. Applicable provisions of federal, state, and local codes.
   2. Fire-Rated Doors: NFPA 80.
   3. Hardware on Fire-Rated Doors, Except Hinges: Listed and classified by UL (DIR) as suitable for the purpose specified and indicated.
   4. Hardware for Smoke and Draft Control Doors (Indicated as "S" on Drawings): Provide hardware that enables door assembly to comply with air leakage requirements of the applicable code.

2.03 LOCKS AND LATCHES

A. Locks: Provide a lock for every door, unless specifically indicated as not requiring locking.
   1. If no hardware set is indicated for a swinging door provide an office lockset.
   2. Trim: Provide lever handle or pull trim on outside of all locks unless specifically stated to have no outside trim.
   3. Lock Cylinders: Provide key access on outside of all locks unless specifically stated to have no locking or no outside trim.

B. Lock Cylinders: Manufacturer’s standard tumbler type, six-pin standard core.

1. Provide cams and/or tailpieces as required for locking devices required.

C. Keying: Grand master keyed.

D. Latches: Provide a latch for every door that is not required to lock, unless specifically indicated "push/pull" or "not required to latch".

2.04 HINGES

A. Refer to Hardware Sets at end of section.

B. Hinges: Provide hinges on every swinging door.
1. Provide five-knuckle full mortise butt hinges unless otherwise indicated.
2. Provide ball-bearing hinges at all doors having closers.
3. Provide hinges in the quantities indicated.
4. Provide non-removable pins on exterior outswinging doors.
5. Where electrified hardware is mounted in door leaf, provide power transfer hinges.

2.05 LOCKS AND LATCHES

A. Locks: Provide a lock for every door, unless specifically indicated as not requiring locking.
1. Hardware Sets indicate locking functions required for each door.
2. If no hardware set is indicated for a swinging door provide an office lockset.
3. Trim: Provide lever handle or pull trim on outside of all locks unless specifically stated to have no outside trim.
4. Lock Cylinders: Provide key access on outside of all locks unless specifically stated to have no locking or no outside trim.

B. Lock Cylinders: Manufacturer’s standard tumbler type, six-pin standard core.
1. Provide cams and/or tailpieces as required for locking devices required.

C. Keying: Grand master keyed.

D. Latches: Provide a latch for every door that is not required to lock, unless specifically indicated "push/pull" or "not required to latch".

2.06 KEYING

A. Door Locks: Construction keying only. The Owner to provide key system compatible with the 5 pin system after acceptance of the building.

B. Supply two (2) keys for each lock.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that doors and frames are ready to receive work; labeled, fire-rated doors and frames are present and properly installed, and dimensions are as indicated on shop drawings.

B. Verify that electric power is available to power operated devices and of the correct characteristics.

C. Beginning of installation means acceptance of existing conditions.

3.02 INSTALLATION

A. Install hardware in accordance with manufacturer's instructions, requirements of SDI and applicable codes.

B. Use templates provided by hardware item manufacturer.

C. Install hardware on fire-rated doors and frames in accordance with code and NFPA 80.

D. Conform to ANSI A117.1 for positioning requirements for the handicapped.

3.03 CLEANING

A. Clean adjacent surfaces soiled by hardware installation. Clean finished hardware per manufacturer's instructions after final adjustments has been made. Replace items that cannot be cleaned to manufacturer's level of finish quality at no additional cost.

3.04 SCHEDULE

A. Numbers have been taken from the following:

IVE -	Ives	SCH -	Schlage
PMK -	Pemko	LCN -	LCN
VD -	Von Duprin		

HDG #1

DRS #1, 2

EACH DOOR TO HAVE:

3 Ea	Hinge	5BB1	4-1/2 x 4-1/2 NRP	652	IVE
1 Ea	Lockset	ND 70 PD RHO		626	SCH
1 Ea	Kick Plate	8400	10 x 34	630	IVE
1 Ea	Stop	FS 444		626	IVE
1 Ea	Threshold	171 A			PMK
1 Set	Seal	S88D			PMK
1 Set	Weather Strip		S88W		PMK

END OF SECTION

SECTION 09 9000
PAINTING AND COATING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Surface preparation.

B. Field application of paints, stains, varnishes, and other coatings.

C. Do Not Paint or Finish the Following Items:
   1. Items fully factory-finished unless specifically so indicated; materials and products having factory-applied primers are not considered factory finished.
   2. Items indicated to receive other finishes.
   3. Items indicated to remain unfinished.
   4. Fire rating labels, equipment serial number and capacity labels, and operating parts of equipment.
   5. Floors, unless specifically so indicated.
   6. Glass.
   7. Concealed pipes, ducts, and conduits.

D. See Surface Finish Schedule.

1.02 RELATED REQUIREMENTS

A. Section 05 5000 - Metal Fabrications: Shop-primed items.

B. Section 26 0553 - Identification for Electrical Systems: Painted identification.

1.03 DEFINITIONS

A. Conform to ASTM D16 for interpretation of terms used in this section.

1.04 REFERENCE STANDARDS

A. ASTM D2016 - Test Method for Moisture Content of Wood.

B. ASTM D16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications; 2014.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide complete list of all products to be used, with the following information for each:
   1. Manufacturer's name, product name and/or catalog number, and general product category (e.g. "alkyd enamel").
   2. MPI product number (e.g. MPI #47).
   3. Cross-reference to specified paint system(s) product is to be used in; include description of each system.

C. Samples: Submit two samples, 8 x 10 inch in size, illustrating range of colors and textures available for each surface finishing product scheduled.

D. Submit manufacturer's application instructions.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified, with minimum three years documented experience.

B. Applicator Qualifications: Company specializing in commercial painting and finishing approved by product manufacturer.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.

B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.

C. Paint Materials: Store at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

1.08 FIELD CONDITIONS

A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.

B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.

C. Provide lighting level of 80 ft candles measured mid-height at substrate surface.

1.09 EXTRA MATERIALS

A. Supply 1 gallon (4L) of each color, texture, and type; store where directed.

B. Label each container with color, texture and room locations, in addition to the manufacturer's label.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Provide all paint and coating products used in any individual system from the same manufacturer; no exceptions.

B. Provide all paint and coating products from the same manufacturer to the greatest extent possible.
   1. In the event that a single manufacturer cannot provide all specified products, minor exceptions will be permitted provided approval by Architect is obtained using the specified procedures for substitutions.
   2. Substitution of other products by the same manufacturer is preferred over substitution of products by a different manufacturer.
   3. Substitution of a different paint system using MPI-approved products by the same manufacturer will be considered.

C. Paints:
   1. Vista Paint: www.vistapaint.com.
   2. Benjamin Moore & Co: www.benjaminmoore.com/#sle.
   3. Dunn-Edwards Paints: www.dunnedwards.com.

D. Transparent Finishes:
   1. Behr Process Corporation: www.behr.com/#sle.
   2. Sherwin-Williams Company: www.sherwin-williams.com/#sle.

E. Stains:
   1. Behr Process Corporation: www.behr.com/#sle.
   2. Sherwin-Williams Company: www.sherwin-williams.com/#sle.

F. Primer Sealers: Same manufacturer as top coats.

G. Block Fillers: Same manufacturer as top coats.

H. Elastomeric Paint: Vista Paint or approved equal.

I. Substitutions: See Section 01 6000 - PRODUCT REQUIREMENTS.

2.02 PAINTS AND COATINGS - GENERAL

A. Paints and Coatings: Ready mixed, unless intended to be a field-catalyzed coating.
   1. Provide paints and coatings of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.

2. Supply each coating material in quantity required to complete entire project's work from a single production run.
3. Do not reduce, thin, or dilute coatings or add materials to coatings unless such procedure is specifically described in manufacturer's product instructions.

B. Primers: As follows unless other primer is required or recommended by manufacturer of top coats; where the manufacturer offers options on primers for a particular substrate, use primer categorized as "best" by the manufacturer.

C. Volatile Organic Compound (VOC) Content:
1. Provide coatings that comply with the most stringent requirements specified in the following:
a. 40 CFR 59, Subpart D--National Volatile Organic Compound Emission Standards for Architectural Coatings.
2. Determination of VOC Content: Testing and calculation in accordance with 40 CFR 59, Subpart D (EPA Method 24), exclusive of colorants added to a tint base and water added at project site; or other method acceptable to authorities having jurisdiction.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces are ready to receive work as instructed by the product manufacturer.

B. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.

C. Test shop-applied primer for compatibility with subsequent cover materials.

3.02 PREPARATION

A. Clean surfaces thoroughly and correct defects prior to coating application.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.

D. Seal surfaces that might cause bleed through or staining of topcoat.

E. Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.

3.03 APPLICATION

A. Apply products in accordance with manufacturer's instructions.

B. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.

C. Apply each coat to uniform appearance.

D. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.

E. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.04 CLEANING

A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

3.05 PROTECTION

A. Protect finished coatings until completion of project.

B. Touch-up damaged coatings after Substantial Completion.

3.06 SCHEDULE - EXTERIOR SURFACES

A. Wood - Transparent:

1. One coat stain - Olympic Stain, Semi-Transparent.
2. One coat sealer - As directed.

B. Steel - Unprimed:
1. One coat zinc chromate primer - Vista Paint 4800 Metal Pro or Carbomastic 90.
2. Two coats acrylic enamel, semi-gloss - Vista Paint 8400 Semi-Gloss or 7900 Premogloss or Carboline 133 VOC.

C. Steel - Shop Primed:
1. Touch-up with zinc chromate primer - Vista Paint 4800 Metal Pro or Carbomastic 90.
2. Two coats alkyd enamel, semi-gloss - Vista Paint 8400 Semi-Gloss or 7900 Premogloss or Carboline 133 VOC.

D. Steel - Galvanized (where indicated).
1. Pretreatment - Jasco Prep N Prime.
2. One coat zinc chromate primer - Vista Paint 4800 Metal Pro or Carbomastic 90.
3. Two coats acrylic enamel, semi-gloss - Vista Paint 8400 Semi-Gloss or 7900 Premogloss or Carboline 133 VOC.

END OF SECTION

SECTON 22 0000
GENERAL PLUMBING REQUIREMENTS

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

A. The General conditions, supplementary conditions, special Requirements, and applicable portions of Division 1 of the specification are a part of this Division and the requirements contained herein are supplementary to them.

B. This Division is an integrated whole comprising interrelated and interdependent sections and shall be considered in its entirety in determining requirements.

C. Refer to other sections of this Division for additional requirements or information regarding the subjects of this Section.

1.02 ABBREVIATIONS AND DEFINITIONS (as used on Division 23 Drawings and herein)

A. This Division is abbreviated and includes incomplete sentences. Supply omitted words by inference.

B. Symbols: "S" means submittals are required; "M/O" means Maintenance/Operating data is required; see paragraphs hereinafter.

C. "Provide" means furnish, install and connect unless otherwise described in specific instances.

D. "Piping" means pipes, fittings, valves and all like pipe accessories connected thereto.

E. "Extend", "Submit", "Repair", "Abandon", "Replace", "Remove" and similar words mean that the Contractor (or his designated subcontractor) shall accomplish the action described.

F. "Codes" or "Code" means all codes, laws, statutes, rules, regulations, ordinances, orders, decrees, and other requirements of all legally constructed authorities and public utility franchise holders having jurisdiction.

G. "Products", "Materials" and "Equipment" are used interchangeably and mean materials, fixtures, equipment, accessories, etc.

H. "Utility Areas" are defined as mechanical, electrical, janitorial, and similar rooms or spaces which are normally used or occupied only by custodial or maintenance personnel. "Public Areas" are defined as the rooms or spaces which are not included in the utility areas definition.

I. "Building Boundary" includes concrete walkways immediately adjacent to the building structure.

J. "Below Grade" means buried in the ground, unless noted otherwise.

K. "Substantial Plumbing Completion" means all components of all systems are functioning but lacking in final adjustment.

L. Pressure rating specified (such as for valves and the like) means design working pressure for and with references to the fluid which the device will serve.

1.03 DESCRIPTION

A. Provide a complete and operable installation, including all labor, supervision, materials, equipment, tools, apparatus, transportation, warehousing, rigging, scaffolding and other equipment and services necessary to accomplish the work in accordance with the intent and meaning of these drawings and specifications.

1.04 RELATED WORK

A. Coordination: Refer to Architectural, Civil, Structural, Mechanical and Electrical Drawings for the construction details and coordinate the work of this Division with that of other Divisions. Order the work of this Division so that progress will harmonize with that of other Divisions and all work will proceed expeditiously. The work of this Division shall include direct responsibility for the correct placing and connection of plumbing work in relation to the work of other Divisions.

B. Examine other Divisions for work related to the work of this Division especially Division 23 – MECHANICAL and Division 26 - ELECTRICAL.

1.05 EXISTING CONDITIONS

A. Visit the site prior to bidding and investigate the existing conditions which affect or will be affected by the work of this Division. Become thoroughly familiar with the working conditions and take into account any special or unusual features peculiar to this job. By the act of submitting a Bid, the Contractor will be deemed to have complied with the forgoing, to have accepted such conditions, and to have made allowance therefore in preparing his Bid.

B. The location of existing concealed utility lines are shown in accordance with reference data received by the Architect. The Architect does not guarantee the accuracy of such data. The points of connection are therefore approximate and the Bidder shall include adequate funds in his bid to cover costs of connection regardless of their exact location.

C. Exercise extreme caution during trenching operations. Repair the damage caused by such operations to existing utility lines at no cost to the Owner, whether the lines are shown on drawings or not.

1.06 DRAWINGS AND SPECIFICATIONS

A. Drawings and specifications are intended to complement each other. Where a conflict exists between the requirements of the drawings and/or the specifications, request clarification.

B. The Architect shall interpret the drawings and the specifications, and his decision as to the true intent and meaning thereof and the quality, quantity, and sufficiency of the materials and workmanship furnished there under shall be accepted as final and conclusive.

C. In case of conflict not clarified prior to Bidding deadline, use the most costly alternative (better quality, greater quantity, or larger size) in preparing the Bid. A clarification will be issued to the successful bidder as soon as feasible after the Award and if appropriate a deductive change order will be issued.

D. All provisions shall be deemed mandatory except as expressly indicated as optional by the word "may" or "option".

1.07 WATER (DOMESTIC AND FIRE), SANITARY (AND STORM) SEWERS AND NATURAL GAS SERVICE

A. Within 5 days after award of contract, notify the serving utilities that the project is under construction and apply for permanent service in the name of the Owner. Furnish pertinent load and location information to them including the required dates for permanent service. Verify service locations and conform to utility company requirements. Contractor shall pay charges for permanent service connections levied by the utilities for which he will be reimbursed by the Owner. The reimbursement shall be limited to the actual amount of the utility service charges and a copy of the billing from the utility company shall accompany the Contractor's invoice.

1.08 PERMITS AND INSPECTIONS

A. Obtain, schedule and pay for permits, licenses, approvals, tests, and inspections required by legally constituted authorities and public utility franchise holders having jurisdiction over the work.

B. Afford the Architect's representative every facility for evaluating the skill and competence of the mechanics and to examine the materials. Concealed work shall be reopened when so directed during his periodic visits.

1.09 CODES AND REGULATIONS

A. By submitting a bid, Contractor is deemed to represent himself as competent to accomplish the work of this Division in conformance with applicable Codes. In case of conflict between the Contract documents and the Code requirements, the Codes shall take precedence. Should such conflicts appear, cease work on the parts of the contract affected and immediately notify the Architect in writing. It shall be the Contractor's responsibility to correct, at no cost to the Owner, any work he executes in violation of Code requirements. Specify references to codes elsewhere in this Division are either to aid the Contractor in locating applicable information or to deny him permission to use options which are permitted by Codes.

B. Applicable Codes: (Current editions unless otherwise noted)
   1. All local codes; city and/or County as applicable
   2. OSHA requirements
   3. Uniform Building Code
   4. Uniform Mechanical Code
   5. Uniform Plumbing Code
   6. California Building Code
   7. California Mechanical Code
   8. California Plumbing Code
   9. California Code of Regulations (CCR) Titles
   10. Fire Marshal Regulations
   11. Regulations of all other authorities having jurisdiction.

C. Where conflict or variation exists among codes, the most stringent shall govern.

D. Certificates of Conformance or Compliance: Submit original and not pre-printed certifications. Do not make statements in the certifications that could be interpreted to imply that the product does not meet all requirements specified, such as "as good as", "achieve the same end use and results as materials formulated in accordance with the referenced publications", "equal or exceed the services and performance of the specified material". Simply state that the product conforms to the requirements specified.

E. Certified Test Reports: Certified Test Reports are reports of tests conducted on previously manufactured materials or equipment identical to that proposed for use. Before delivery of materials and equipment, submit certified copies of test reports specified in the individual sections.

F. Factory Tests: Factory tests are tests which are required to be performed on the actual materials or equipment proposed for use. Submit results of the tests in accordance with the requirements for laboratory test results of this Contract.

G. Permits and Certificates of Inspection: Furnish the originals.

H. Testing procedures and test results required in this and other sections. Furnish 2 copies.

I. Other data required by other sections of this Division. Furnish 2 copies.

1.10 RECORD AND DOCUMENTATION

A. Accumulate the following and deliver to the Owner's representative prior to final acceptance of the work:
   1. Record (As-Built) Drawings:
      a. Maintain in good order in the field office a complete set of prints for all work being done under Division 23. Update the drawings daily with neat and legible annotations in red ink showing the work as actually installed.
      b. The actual size, location and elevation of all buried lines, valve boxes, manholes, monuments, and stub-outs shall be accurately located and dimensioned from building walls or other permanent landmarks.
      c. Furnish the originals.
   2. Operation and Maintenance Manual: Furnish an operation and maintenance manual covering the stipulated plumbing systems and equipment. Seven copies of the manual, bound in hardback binders or an approved equivalent, shall be provided to the Architect in accordance with the Division 1 section on Maintenance and Operation Manuals. Furnish one complete manual prior to the time that system or equipment tests are performed. Furnish the remaining manuals before the contract is completed. The following identification shall be inscribed on the cover:

      OPERATION AND MAINTENANCE MANUAL
      PROJECT TITLE.....
      CONTRACTOR.....

      Provide a table of contents. Insert tab sheets to identify discrete subjects. Instruction sheets shall be legible and easily understood, with large sheets of drawings folded in. The manual

shall be complete in all respects for all materials, piping, valves, devices and equipment, controls, accessories and appurtenances stipulated. Include as a minimum the following:

a. Updated approved materials list, shop drawings and catalog information of all items indicated by symbol "M/O" at titles or beginning of paragraphs.
b. System layout showing piping, valves and controls.
c. Wiring and control diagrams with data to explain detailed operation and control of each component.
d. A control sequence describing start-up, operation and shutdown.
e. Detailed description of the function of each principal component of the system.
f. Procedure for starting.
g. Procedure for operation.
h. Shut-down instruction.
i. Installation instructions.
j. Adjustments, maintenance and overhaul instructions.
k. Lubrication schedule including type, grade, temperature range and frequency.
l. Safety precautions, diagrams and illustrations.
m. Test procedures.
n. Performance data.
o. Parts lists, with manufacturer's names and catalog numbers.
p. Preventive maintenance schedule.
q. Service organization with name, address and telephone number.
r. Valve identification chart and schedule.
s. ASME certification

B. Standard Compliance: Where equipment or materials are specified to conform with requirements of standards of recognized technical or industrial organizations such as American National Standards (ANSI), American Society of Mechanical Engineers (ASME), American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE), Underwriters Laboratories (UL), American Refrigeration Institute (ARI), American Gas Association (AGA), or National Electrical Manufacturer's Association (NEMA), that use a label or published listing as a method of indicating compliance, proof of such conformance shall be submitted and approved. The label or listing of the specified organization will be acceptable evidence.

C. Certificates of Conformance or Compliance: Submit original and not pre-printed certifications. Do not make statements in the certifications that could be interpreted to imply that the product does not meet all requirements specified, such as "as good as", "achieve the same end use and results as materials formulated in accordance with the referenced publications", "equal or exceed the services and performance of the specified material". Simply state that the product conforms to the requirements specified.

D. Certified Test Reports: Certified Test Reports are reports of tests conducted on previously manufactured materials or equipment identical to that proposed for use. Before delivery of materials and equipment, submit certified copies of test reports specified in the individual sections.

E. Factory Tests: Factory tests are tests which are required to be performed on the actual materials or equipment proposed for use. Submit results of the tests in accordance with the requirements for laboratory test results of this Contract.

F. Permits and Certificates of Inspection: Furnish the originals.

G. Testing procedures and test results required in this and other sections. Furnish 2 copies.

H. Other data required by other sections of this Division. Furnish 2 copies.

1.11 TOOLS

A. Provide all special tools needed for proper operation and routine adjustment and maintenance of systems and equipment. Deliver tools to Owner's representative and request a receipt for same.

1.12 CONSTRUCTION COST BREAKDOWN

A. To assist the Architect and Engineer in evaluation of the construction cost, the Contractor shall

prepare and submit for review a construction cost breakdown for the major subdivisions of the plumbing work.

B. Subdivide each item on the breakdown into two headings: labor and materials. Include overhead and profit in each entry.

C. Cost breakdowns shall be submitted and approved prior to the first payment request. Send one copy of the breakdown directly to the Engineer and the remaining copies sent through regular channels.

PART 2 PRODUCTS

2.01 MATERIALS AND EQUIPMENT

A. Standard Products: Materials and equipment shall be essentially the standard cataloged products of manufacturers regularly engaged in production of such materials or equipment and shall be their latest standard designs that comply with the specification requirements. Materials and equipment shall duplicate items that have been in satisfactory commercial or industrial use at least two years prior to bid opening. Where two or more units of the same type of equipment are required, these units shall be products of a single manufacturer. The components thereof, however, are not required to be exclusively of the same manufacturer. Each major component of equipment shall have manufacturer's name, address, model, and serial number on a nameplate securely affixed in a conspicuous place. The nameplate of the distributing agent will not be acceptable.

B. Whenever on the plans, or in these specifications, products are identified by the name of one manufacturer, it is intended that equivalent products of other manufacturers are acceptable, unless otherwise indicated, if accepted as a substitution by the Architect. Where three or more manufacturers are listed as "acceptable manufacturers" however, then the products furnished shall be the product of one of the manufacturers listed. Manufacturers listed as "acceptable manufacturers" shall meet quality and performance of a particular one specified by both name and catalog number.

2.02 SUBSTITUTIONS

A. General: Should the Contractor desire to substitute for specified products, he shall submit with the Material List a complete list of the requested substitutions. The request shall contain complete descriptive information of the products. Samples for evaluation shall also be submitted upon the Architect's request. If in the Architect's opinion the products as presented in this first submittal are in variance with the specified products, or if the information submitted is not sufficiently complete to allow proper evaluation, the substitution will be disallowed from consideration and the specified products shall be furnished. By proposing a substitution, it is deemed that the Contractor shall bear the cost of any changes (whether architectural, structural, electrical or mechanical) necessary to accommodate the substitution.

B. Specific: Refer to other sections of this Division for additional requirements.

2.03 SUBMITTALS

A. General:

1. Provide for all items indicated with the symbol "S" at titles or beginning of paragraphs in accordance with the Division 1 section covering submittals and as herein specified. Where warranty of longer than one year is specified, include such warranty with submittal. Architect's review of the submittal is only for general conformance with design compliance with the information given in the contract documents. The submittal procedure is required as an effort to minimize the problems which occur due to the discovery of Contractor non-compliance at the construction site. The Contractor is responsible for conformation and correlation of the dimensions, quantities and sizes, for information that pertains to fabrication methods or construction techniques, and for coordination of work of all Divisions of the work. Deviations, if any, from Contract documents shall be clearly and completely indicated (by a separate letter if deviations are extensive) in the submittals, and the lack of such is deemed complete compliance with Contract Documents without any deviations. Submittals favorably processed will not relieve the Contractor of responsibility for deviations not so reported nor

for errors in the submittal.

2. In addition to the above, upon permission to proceed after review of submittal and prior to the installation of work, submit dimensioned and scaled drawings (not less than 1/4-inch equal to one foot) of all mechanical equipment rooms and areas. Such layouts shall indicate, but not be limited to, all plumbing equipment, control panels, piping, housekeeping pads, ductwork, tube pull, access and maintenance clearances, and other like items. The layout shall also indicate major equipment to be provided under other Sections of work.
3. Contractor Stamp: All submittals shall be stamped with the following text and signed by the Contractors representative:

   "IT IS HEREBY CERTIFIED THAT THE PRODUCTS SHOWN AND MARKED IN THIS SUBMITTAL ARE IN COMPLIANCE WITH THE CONTRACT DOCUMENTS AND CAN BE INSTALLED IN THE ALLOCATED SPACES EXCEPT WHERE NOTED AS DEVIATIONS.

   CERTIFIED BY:---------- DATE:----------
4. All submittals shall be complete and with catalog data and information properly marked to show, among other things, equality of material (where substitution is allowed and desired), adequacy in capacity and performance to meet minimum capacities of performance as specified or indicated. Arrange the submittals in the same sequence as these specifications, and reference (at the upper right-hand corner) the particular specification provision for which each submittal is intended. Incomplete submittals will be rejected.
5. For all work under Division 23, the notations by the Contractor or Supplier on submittal documents "Per Plans and Specifications", or "As Specified", or similar wording or phrasing is not acceptable and will be cause of rejection. Complete descriptive submittals are required for all Division 23 work.
6. Refer to the other sections of this Division for specific requirements.

B. Material List: Within 15 days after award of Contract, submit for approval a complete list of materials proposed for use. Furnish names and addresses of manufacturers, catalog numbers (where applicable) types and trade names. For purposes of uniformity, only one manufacturer will be accepted for each class or type of material. This list is in addition to Shop Drawings.

C. Shop Drawings: Submit shop drawings with such promptness as to cause no delay in the work. Do not commence fabrication of the equipment until the approved drawings are received from the Owner's representative.

D. Other Submittals: As required by other sections of this Division.

PART 3 EXECUTION

3.01 WORKMANSHIP AND INSTALLATION METHODS

A. Workmanship shall be in the best standard practice of the trade.

B. Execute the work so as to contribute to ease of operation and maintenance, maximum accessibility and best appearance. Execute it so that the installation will conform and adjust itself to the building structure, its equipment and its usage. The work shall be symmetrical, plumb, uniform, properly aligned, and firmly secured in place.

C. Install equipment in accordance with the manufacturer's instructions and recommendations unless otherwise noted or specified.

3.02 TESTS

A. General:
   1. Demonstrate that all components of the work of this Division have been provided and that they operate in accordance with the Contract Documents.
   2. Provide instruments and personnel for tests and demonstrations. Submit signed test results.

B. Specific: Refer to the other sections of this Division for test requirements.

3.03 DELIVERY, HANDLING, STORAGE OF MATERIALS AND PROTECTION OF WORK

A. Protect materials against dirt, water, chemical and mechanical damage both while in storage and during construction.

B. Cover materials in such a manner that no finished surfaces will be damaged, marred or splattered with plaster or paint, and all moving parts will be kept clean and dry.

C. Replace or refinish any damaged materials including fronts of control panels, ductwork fittings, and shop fabricated ductwork.

D. Keep cabinets and other openings closed to prevent entry of foreign matter.

3.04 CLEANUP AND HOUSEKEEPING

A. Cleaning shall be done as the work proceeds. Periodically remove waste and debris to keep the site as clean as is practical.

B. Leave exposed parts of the plumbing work in a neat, clean and usable condition, with painted surfaces unblemished and plated metal surfaces polished.

3.05 PROJECT CONDITIONS

A. Site Examinations and Conditions:
   1. Regard information relative to existing conditions, services and structure as approximate only. Verify dimensions and locations, and be knowledgeable of all working conditions before submitting Bid. Verify pressure, location, size, and elevation of existing services (to which points of connection are to be made or crossed) as soon as possible and prior to commencement of any new work.
   2. Make minor deviations necessary to conform to actual locations and conditions. Submission of Bid presumes proper examination of Site, locations, dimensions and conditions, and no additional cost will be honored for lack of such examinations.

B. Existing Services: Examine the Contract Drawings and visit the project site to ascertain the extent of the existing services. Where existing equipment/services serving existing structures and/or existing structures to be demolished are to remain in service, reroute, relocate, or extend such existing equipment and/or services to accommodate this project without additional cost.

C. Interruption of Existing Services: Where it is necessary to reroute existing services or utilities, or to make connections of new work to existing services or utilities, give timely written notice of such intent to the Owner and secure written approval before proceeding. Make all such interruptions at such time as permitted by the Owner. Anticipate such interruptions to be made outside of normal working hours or normal working days; therefore, no additional cost will be permitted for such work. Except in a case of emergency involving life, limb or health, do not operate any existing equipment (including valves). Where such operations are necessary, they shall be performed by the Owner's personnel.

D. Access and Placement of Work:
   1. Check and coordinate for clearance, accessibility and placement of equipment either by going through openings provided or by placing equipment during construction. Ordering of equipment to be shipped, disassembled, or disassembly of equipment at Project Site and re-assembly of equipment to accomplish this requirement shall be executed without additional cost. Where provided openings are inadequate to accommodate equipment, provide new openings and restoration of same, all at no additional cost. Obtain written approval for new openings before proceeding.
   2. Verify location of all plumbing fixtures and equipment within finished spaces with the Architectural Drawings. In the event that Plumbing Drawings do not indicate exact locations, or are in conflict with the Architectural Drawings, obtain information regarding proper locations. Installation of work without proper instruction under such circumstances will result in relocation of work, when directed, without additional cost.

E. Verification and Coordination: Drawings indicating suggested distribution routes are diagrammatic only, and all scaled and figured dimensions are approximate and are indicated for estimating purposes only. The Drawings do not indicate necessary offsets and like items. Do not construe Contract Drawings as fabrication drawings. Prior to fabrication and installation of work,

verify all dimensions, sizes and distribution routes with actual conditions, and prepare submittal and fabrication drawings. Coordinate to avoid possible conflicts and resolve same where such exist. Install work to conform to structure, avoid obstruction, preserve headroom, and keep openings and passageway clear. Changes necessary, resulting from such verification and coordination, shall not be a cause for additional cost.

F. See Drawings for extent of demolition.

3.06 WARRANTY

A. Guarantee, in writing, all work against fault of any product or workmanship for a period of not less than one year after formal acceptance by the Owner; except, where longer periods are specified in the Specifications, such longer periods shall govern. However, when any component fails at any time during this period, the warranty period for such component and all other components that are inactive because of said failure shall be suspended. The warranty period for such component shall resume running for the remaining portion of the warranty period when failed component is completely repaired and in operation; however, in no case shall the resumed portion of the warranty period be less than 3 months in duration.

B. Neither payments for work, nor total or partial occupancy of work by the Owner, within or prior to the warranty period specified, shall be construed as acceptance of faulty work or shall condone any negligence of omission of Contractor in doing the work.

3.07 SAFETY REQUIREMENTS

A. Enclose and guard belts, pulleys, chains, gears, couplings, projecting setscrews, keys and other rotating parts in accordance with the OSHA 1910.219. Insulate, guard, and cover any high-temperature equipment and piping so located as to endanger personnel or creature a fire hazard.

3.08 MANUFACTURER'S RECOMMENDATIONS

A. Where installation procedures or any part thereof are required to be in accordance with the recommendations of the manufacturer of the material or equipment being installed, furnish printed copies of these recommendations to the installing Contractor and Architect prior to installation. Do not proceed with the installation of the item until the recommendations are received. Failure to furnish these recommendations can be cause for rejection of the material.

END OF SECTION

SECTION 22 0500
COMMON WORK RESULTS FOR PLUMBING

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
1. Piping materials and fittings.
2. Joining materials.
3. Dielectric fittings.
4. Mechanical sleeve seals.
5. Piping Specialties
6. Grouting
7. Piping Insulation.
8. Equipment Installation.
9. Concrete Bases.
10. Erection of Metal Supports.
11. Erection of Wood Supports
12. Cutting and Patching

B. Related Sections:
1. Section 01 81 13 - Sustainable Design Requirements
2. Section 01 31 00 - Project Management and Coordination
3. Section 01 73 29 - Cutting and Patching
4. Section 01 78 43 - Spare Parts and Materials
5. Section 01 79 00 - Training
6. Section 01 78 23 - Operating and Maintenance Data
7. Section 03 30 00 - Cast-in-Place Concrete
8. Section 06 10 00 - Rough Carpentry
9. Section 07 62 00 - Sheet Metal Flashing and Trim
10. Section 07 84 00 - Firestopping
11. Section 08 31 00 - Access Doors
12. Section 09 90 00 - Painting
13. Section 22 05 53 – Identification for Plumbing Piping and Equipment: Labeling and identifying plumbing systems and equipment.
14. Section 31 20 00 – Earth Moving

1.02 REFERENCES

A. The American Society of Mechanical Engineers (ASME) Publications:
1. B1.20.1 "Pipe Threads, General Purpose, Inch"
2. B16.21 "Nonmetallic Flat Gaskets for Pipes Flanges"
3. B18.2.1 "Square and Hex Bolts and Screws, Inch Series"

B. ASTM International (ASTM) Publications: (Former American Society for Testing and Materials)
1. A53 "Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless"
2. A536 "Standard Specification for Ductile Iron Castings"
3. B32 "Standard Specification for Solder Metal"
4. C1107 "Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)"
5. D2235 "Standard Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings"
6. D2657 "Standard Practice for Heat Fusion Joining of Polyolefin Pipe and Fittings"
7. D2672 "Standard Specification for Joints for IPS PVC Pipe Using Solvent Cement"
8. D2846 "Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Hot- and Cold-Water Distribution Systems"

9. D2855 "Standard Practice for Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings"
10. D3138 "Standard Specification for Solvent Cements for Transition Joints Between Acrylonitrile-Butadiene-Styrene (ABS) and Poly(Vinyl Chloride) (PVC) Non-Pressure Piping Components"
11. F402 "Standard Practice for Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings"
12. F477 "Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe"
13. F493 "Standard Specification for Solvent Cements for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe and Fittings"
14. F656 "Standard Specification for Primers for Use in Solvent Cement Joints of Poly(Vinyl Chloride) (PVC) Plastic Pipe and Fittings"

C. American Welding Society (AWS) Publications:
1. BRH "Brazing Handbook"
2. A5.8 "Specification for Filler Metals For Brazing And Braze Welding"
3. D1.1 "Structural Welding Code - Steel"
4. D10.12 "Guide for Welding Mild Steel Pipe"

D. American Water Works Association (AWWA) Publications:
1. C110/ANSI A21.10 " Standard for Ductile-Iron and Gray-Iron Fittings, 3 In.-48 In. (76 mm-1,219 mm), for Water "
2. C111/ANSI A21.11 "Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings"

E. Copper Development Association (CDA) Publications:
1. "Copper Tube Handbook"

1.03 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawl spaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors, or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.

E. Concealed, Exterior 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.

F. The following are industry abbreviations for plastic materials:
1. ABS: Acrylonitrile-butadiene-styrene plastic.
2. CPVC: Chlorinated polyvinyl chloride plastic.
3. PVC: Polyvinyl chloride plastic.

1.04 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections:

B. Submit “Letter of Conformance” in accordance with Section 01 33 00 (01330) indicating specified items selected for use in project with the following supporting data.
1. Product Data: For dielectric fittings, flexible connectors, plumbing sleeve seals, and identification materials and devices.
2. Coordination Drawings: Detail major elements, components, and systems of plumbing equipment and materials in relationship with other systems, installations, and building components. Show space requirements for installation and access. Indicate if sequence

and coordination of installations are important to efficient flow of the Work. Include the following:

a. Planned piping layout, including valve and specialty locations and valve-stem movement.
b. Clearances for installing and maintaining insulation.
c. Clearances for servicing and maintaining equipment, accessories, and specialties, including space for disassembly required for periodic maintenance.
d. Equipment and accessory service connections and support details.
e. Exterior wall and foundation penetrations.
f. Fire-rated wall and floor penetrations.
g. Sizes and location of required concrete pads and bases.
h. Scheduling, sequencing, movement, and positioning of large equipment into building during construction.
i. Floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.

1.05 QUALITY ASSURANCE

A. Equipment Selection: Equipment of higher electrical characteristics, physical dimensions, capacities, and ratings may be furnished provided such proposed equipment is approved in writing and connecting plumbing and electrical services, circuit breakers, conduit, motors, bases, and equipment spaces are increased. Additional costs shall be approved in advance by appropriate Contract Modification for these increases.
   1. If minimum energy ratings or efficiencies of equipment are specified, equipment must meet design requirements. See drawings for equipment schedules and requirements.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and prevent entrance of dirt, debris, and moisture.

B. Protect stored pipes and tubes from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor, if stored inside.

C. Protect flanges, fittings, and piping specialties from moisture and dirt.

D. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.07 SEQUENCING AND SCHEDULING

A. Coordinate plumbing equipment installation with other building components.

B. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction to allow for plumbing installations.

C. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components, as they are constructed.

D. Sequence, coordinate, and integrate installations of plumbing materials and equipment for efficient flow of the Work. Coordinate installation of large equipment requiring positioning before closing in building.

E. Coordinate connection of plumbing systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies.

F. Coordinate requirements for access panels and doors if plumbing items requiring access are concealed behind finished surfaces. Access panels and doors are specified in Section 08 31 13 - "Access Doors and Frames."

G. Coordinate installation of identifying devices after completing covering and painting, if devices are applied to surfaces. Install identifying devices before installing acoustical ceilings and similar concealment.

1.08 POSTED OPERATING INSTRUCTIONS

A. Provide and post operating instructions for all plumbing systems.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Approved Manufacturers:
   1. Dielectric Unions:
      a. Hart Industries, International, Inc.
      b. Watts Water Technologies, Inc.
      c. Zurn Plumbing Products Group of Jacuzzi Brands, Inc
   2. Dielectric Flanges:
      a. Capitol Manufacturing Company, A member of The Phoenix Forge Group
      b. Central Plastics Co.
      c. Watts Water Technologies, Inc.
   3. Dielectric-Flange Insulating Kits:
      a. Central Plastics Co.
   4. Dielectric Couplings:
      a. Lochinvar Corp.
   5. Dielectric Nipples:
      a. Grinnell Mechanical Products, A Tyco International
      b. Perfection Corporation
      c. Victaulic Co. of America
   6. Plumbing Sleeve Seals:
      a. Metraflex Inc.
      b. PSI-Thunderline/Link-Seal

2.02 PIPE AND PIPE FITTINGS

A. Refer to individual Divisions 22 piping Sections for pipe and fitting materials and joining methods.
   1. Section 22 11 16 - Domestic Water Piping.
   2. Section 22 13 16 – Sanitary Waste and Vent Piping.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.03 JOINING MATERIALS

A. Refer to individual Division 22 piping Sections for special joining materials not listed below.

B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
   1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness, unless thickness or specific material is indicated.
      a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
      b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
   2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

E. Solder Filler Metals: ASTM B32.
   1. Alloy Sn95 or Alloy Sn94: Approximately 95 percent tin and 5 percent silver, with 0.10 percent lead content.

F. Brazing Filler Metals: AWS A5.8.
   1. BCuP Series: Copper-phosphorus alloys.
   2. BAg1: Silver alloy.

3. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

G. Flanged, Ductile-Iron Pipe Gasket, Bolts, and Nuts: AWWA C110, rubber gasket, carbon-steel bolts and nuts.

H. Couplings: Iron-body sleeve assembly, fabricated to match OD of plain-end, pressure pipes.
1. Sleeve: ASTM A126, Class B, gray iron.
2. Followers: ASTM A47 malleable iron or ASTM A536 ductile iron.
3. Gaskets: Rubber.
4. Bolts and Nuts: AWWA C111.
5. Finish: Enamel paint.

2.04 DIELECTRIC FITTINGS

A. General: Assembly or fitting with insulating material isolating joined dissimilar metals, to prevent galvanic action and stop corrosion.
1. Description: Combination of copper alloy and ferrous; threaded, solder, plain, and weld-neck end types and matching piping system materials.
2. Insulating Material: Suitable for system fluid, pressure, and temperature.

B. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.

C. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150-psig minimum working pressure as required to suit system pressures.

D. 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-psig minimum working pressure as required to suit system pressures.

E. Dielectric Couplings: Galvanized-steel coupling with inert and non-corrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.

2.05 PLUMBING SLEEVES

A. Sleeves: The following materials are for wall, floor, slab, and roof penetrations:
1. Steel Sheet Metal: 0.0239-inch minimum thickness, galvanized, round tube closed with welded longitudinal joint.
2. Steel Pipe: ASTM A53, Type E, Grade A, Schedule 40, galvanized, plain ends.
3. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral water stop, unless otherwise indicated.
4. 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.

2.06 PLUMBING SLEEVE SEALS

A. Description: Modular design, with interlocking rubber links shaped to continuously fill annular space between pipe and sleeve. Include connecting bolts and pressure plates.

2.07 PIPING SPECIALTIES

A. Escutcheons: Manufactured wall, ceiling, and floor plates; deep-pattern type if required to conceal protruding fittings and sleeves.
1. ID: Closely fit around pipe, tube, and insulation of insulated piping.
2. OD: Completely cover opening.
3. Cast Brass: Split casting, with concealed hinge and set screw.
a. Finish: Polished chrome-plate.
4. Cast-Iron Floor Plate: One-piece casting.

B. Grout:
1. Non-shrink, Nonmetallic Grout: ASTM C1107, Grade B.

a. Characteristics: Post-hardening, volume-adjusting, dry, hydraulic-cement grout, non-staining, non-corrosive, nongaseous, and recommended for interior and exterior applications.
b. Design Mix: 5000-psig, 28-day compressive strength.
c. Packaging: Premixed and factory packaged.

PART 3 EXECUTION

3.01 PIPING SYSTEMS - COMMON REQUIREMENTS

A. General: Install piping as described below, unless piping Sections specifies otherwise. Individual Division 22 piping Sections specifies unique piping installation requirements.

B. General Locations and Arrangements: 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 Coordination Drawings as required by Division 01 Sections and as outlined in Part 1 of this section.

C. Install piping at indicated slope.

D. Install components with pressure rating equal to or greater than system operating pressure.

E. Install piping in concealed interior and exterior locations, except in equipment rooms and service areas.

F. Install piping free of sags and bends.

G. Install exposed interior and exterior piping at right angles or parallel to building walls. Diagonal runs are prohibited, unless otherwise indicated.

H. Install piping tight to slabs, beams, joists, columns, walls, and other building elements. Allow sufficient space above removable ceiling panels to allow for ceiling panel removal.

I. Install piping to allow application of insulation plus 1-inch clearance around insulation.

J. Locate groups of pipes parallel to each other, spaced to permit valve servicing.

K. Install fittings for changes in direction and branch connections.

L. Install couplings according to manufacturer's written instructions.

M. Install pipe escutcheons for pipe penetrations of concrete and masonry walls, wall board partitions, and suspended ceilings according to the following:
1. Chrome-Plated Piping: Cast brass, one piece, with set screw, and polished chrome-plated finish.
2. Uninsulated Piping Wall Escutcheons: Cast brass or stamped steel, with set screw.
3. Uninsulated Piping Floor Plates in Utility Areas: Cast-iron floor plates.
4. Insulated Piping: Cast brass with concealed hinge, set screws, and chrome-plated finish.
5. Piping in Utility Areas: Cast brass or stamped steel, with set-screw or spring clips.

N. Install sleeves for pipes passing through concrete and masonry walls, and concrete floor and roof slabs.
1. Cut sleeves to length for mounting flush with both surfaces.
a. Exception: Extend sleeves installed in floors of plumbing equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping rings where required.
2. Build sleeves into walls and slabs as work progresses.
3. Install sleeves large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
a. Steel Pipe Sleeves: For pipes smaller than 6-inch NPS (DN150).
b. Steel, Sheet-Metal Sleeves: For pipes 6-inch NPS (DN150) and larger, penetrating gypsum-board partitions.

4. 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 above finished floor level. Refer to Section 07 62 00 "Sheet Metal Flashing and Trim" for flashing.
    a. Seal space outside of sleeve fittings with non-shrink, nonmetallic grout.
5. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using elastomeric joint sealant. Refer to Section 07 92 00 "Joint Sealants" for materials.
6. Use Type S, Grade NS, Class 25, Use O, neutral-curing silicone sealant, unless otherwise indicated.

O. Aboveground, Exterior-Wall, Pipe Penetrations: Seal penetrations using sleeves and plumbing sleeve seals. Size sleeve for 1-inch annular clear space between pipe and sleeve for installing plumbing sleeve seals.
1. Install steel pipe for sleeves smaller than 6 inches in diameter.
2. Install cast-iron "wall pipes" for sleeves 6 inches in diameter and larger.
3. Assemble and install plumbing sleeve seals according to manufacturer's written instructions. Tighten bolts that cause rubber sealing elements to expand and make watertight seal.

P. Underground, Exterior-Wall, Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using plumbing sleeve seals. Size sleeve for 1-inch annular clear space between pipe and sleeve for installing plumbing sleeve seals.
1. Assemble and install plumbing sleeve seals according to manufacturer's written instructions. Tighten bolts that cause rubber sealing elements to expand and make watertight seal.

Q. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire stopping materials. Refer to Section 07 84 00 - "Firestopping" for materials.

R. Verify final equipment locations for roughing-in.

S. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

T. Piping Joint Construction: Join pipe and fittings as follows and as specifically required in individual piping specification Sections:
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. Soldered Joints: Construct joints according to CDA's "Copper Tube Handbook."
4. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."
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. Note internal length of threads in fittings or valve ends, and proximity of internal seat or wall, to determine how far pipe should be threaded into joint.
    b. Apply appropriate tape or thread compound to external pipe threads, unless dry seal threading is specified.
    c. Align threads at point of assembly.
    d. Tighten joint with wrench. Apply wrench to valve end into which pipe is being threaded.
    e. 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. Welded Joints: Construct joints according to AWS D10.12, "Recommended Practices and Procedures for Welding Low Carbon Steel Pipe," using qualified processes and welding operators according to "Quality Assurance" Article.

7. Flanged Joints: Align flange surfaces parallel. Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly using torque wrench.

U. Piping Connections: Make connections according to the following, unless otherwise indicated:
1. Install unions, in piping 2-inch NPS (DN50) and smaller, adjacent to each valve and at final connection to each piece of equipment with 2-inch NPS (DN50) or smaller threaded pipe connection.
2. Install flanges, in piping 2-1/2-inch NPS (DN65) and larger, adjacent to flanged valves and at final connection to each piece of equipment with flanged pipe connection.
3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.02 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to provide maximum possible headroom, if mounting heights is not indicated.

B. Install equipment according to approved submittal data. Portions of the Work are shown only in diagrammatic form. Refer conflicts to Owner’s Representative.

C. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

D. Install plumbing equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

E. Install equipment giving right of way to piping installed at required slope as specified in other Division 22 sections.

F. Clearance from Electrical Equipment: Piping is prohibited in electric rooms and closets, elevator machine rooms and installation over transformers, switchboards and motor control centers.

3.03 CONCRETE BASES

A. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit. Follow supported equipment manufacturer's setting templates for anchor bolt and tie locations. Use 3000-psig 28-day compressive-strength concrete and reinforcement as specified in Section 03 30 00 - "Cast-in-Place Concrete."

3.04 ERECTION OF METAL SUPPORTS AND ANCHORAGE

A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor plumbing materials and equipment.

B. Field Welding: Comply with AWS D1.1, "Structural Welding Code--Steel."

C. Prime and paint all metal supports per Section 09 90 00 requirements.

3.05 ERECTION OF WOOD SUPPORTS AND ANCHORAGE

A. Cut, fit, and place wood grounds, nailers, blocking, and anchorage to support and anchor plumbing materials and equipment.

B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.

C. Attach to substrates as required to support applied loads.

3.06 CUTTING AND PATCHING

A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces necessary for plumbing installations. Perform cutting by skilled mechanics of trades involved.

B. Repair cut surfaces to match adjacent surfaces.

C. Refer to Division 01 Sections for additional requirements.

3.07 GROUTING

A. Install nonmetallic, non-shrink, grout for plumbing equipment base bearing surfaces, pump and other equipment base plates, and anchors. Mix grout according to manufacturer's written instructions.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placing of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases to provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout according to manufacturer's written instructions.

END OF SECTION

SECTION 22 0523
GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Brass ball valves.

B. Related Sections:
   1. Division 22 plumbing piping Sections for specialty valves applicable to those Sections only.

1.02 SUBMITTALS

A. Product Data: For each type of valve indicated.

1.03 QUALITY ASSURANCE

A. ASME Compliance: ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.

B. NSF Compliance: NSF 61 for valve materials for potable-water service.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS FOR VALVES

A. Refer to valve schedule articles for applications of valves.

B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

C. Valve Sizes: Same as upstream piping unless otherwise indicated.

D. Valve Actuator Types:
   1. Handlever: For quarter-turn valves NPS 6 and smaller.

E. Valves in Insulated Piping: With 2-inch stem extensions and the following features:
   1. Gate Valves: With rising stem.
   2. 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.

F. Valve-End Connections:
   1. Solder Joint: With sockets according to ASME B16.18.

2.02 BRASS BALL VALVES

A. Two-Piece, Full-Port, Brass Ball Valves with Brass Trim:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      a. Crane Co.; Crane Valve Group; Crane Valves.
      b. DynaQuip Controls.
      c. Flow-Tek, Inc.; a subsidiary of Bray International, Inc.
      d. Milwaukee Valve Company.
      e. NIBCO INC.
   2. Description:
      a. Standard: MSS SP-110.
      b. SWP Rating: 150 psig.
      c. CWP Rating: 600 psig.
      d. Body Design: Two piece.
      e. Body Material: Forged brass.
      f. Ends: Threaded.
      g. Seats: PTFE or TFE.

h. Stem: Brass.
i. Ball: Chrome-plated brass.
j. Port: Full.

PART 3 EXECUTION

3.01 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

3.02 ADJUSTING

A. 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.

3.03 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valve applications are not indicated, use the following:
   1. Shutoff Service: Ball, or gate valves.
   2. Throttling Service: Ball valves.

B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP class or CWP ratings may be substituted.

C. Select valves, except wafer types, with the following end connections:
   1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
   2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.

3.04 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:
   1. Brass Valves: May be provided with solder-joint ends instead of threaded ends.
   2. Bronze Angle Valves: Class 125, bronze disc.
   3. Ball Valves: One piece, full port, brass with brass trim.
   4. Bronze Swing Check Valves: Class 125, bronze disc.
   5. Bronze Gate Valves: Class 125, NRS.

B. Pipe NPS 2-1/2 and Larger:
   1. Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
   2. Iron Gate Valves: Class 125, NRS.
   3. Iron Globe Valves: Class 125.

END OF SECTION

SECTION 22 0529
HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Metal pipe hangers and supports.
   2. Trapeze pipe hangers.
   3. Fastener systems.
   4. Pipe positioning systems.

1.02 PERFORMANCE REQUIREMENTS

A. 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.

B. 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.
   1. Design supports for multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.
   2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
   3. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

1.03 SUBMITTALS

A. Product Data: For each type of product indicated.

B. 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:
   1. Trapeze pipe hangers.
   2. Equipment supports.

C. 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.

D. Welding certificates.

1.04 QUALITY ASSURANCE

A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 PRODUCTS

2.01 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:
   1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
   2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
   3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
   4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
   5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

2.02 TRAPEZE PIPE HANGERS

A. 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.

2.03 FASTENER SYSTEMS

A. 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.

B. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated 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.

2.04 PIPE POSITIONING SYSTEMS

A. Description: IAPMO PS 42, positioning system of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.

2.05 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
   1. Properties: Nonstaining, noncorrosive, and nongaseous.
   2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

PART 3 EXECUTION

3.01 HANGER AND SUPPORT INSTALLATION

A. 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.

B. 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.
   1. 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.
   2. 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.

C. Fastener System Installation:
   1. 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.
   2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

D. Pipe Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture. See Division 22 plumbing fixture Sections for requirements for pipe positioning systems for plumbing fixtures.

E. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

F. 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.

G. Install lateral bracing with pipe hangers and supports to prevent swaying.

H. 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.

I. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

J. 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.

3.02 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. 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:
   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. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.03 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches (40 mm).

3.04 PAINTING

A. 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.
   1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils (0.05 mm).

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.05 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use carbon-steel pipe hangers and supports and metal trapeze pipe hangers and attachments for general service applications.

F. Use padded hangers for piping that is subject to scratching.

G. Use thermal-hanger shield inserts for insulated piping and tubing.

H. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. 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).
   2. 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.
   3. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8 (DN 15 to DN 200).
   4. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30 (DN 15 to DN 750).
   5. 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.
   6. 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.
   7. 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.
   8. 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.

I. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24 (DN 24 to DN 600).
   2. 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.

J. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches (150 mm) for heavy loads.
   2. Steel Clevises (MSS Type 14): For 120 to 450 deg F (49 to 232 deg C) piping installations.

K. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
   2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
   3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
   4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
   5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
   6. C-Clamps (MSS Type 23): For structural shapes.
   7. 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:
      a. Light (MSS Type 31): 750 lb (340 kg).
      b. Medium (MSS Type 32): 1500 lb (680 kg).
      c. Heavy (MSS Type 33): 3000 lb (1360 kg).
   8. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
   9. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.

L. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches (32 mm).
   2. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
   3. 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.

M. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

N. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

O. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION

SECTION 22 0553
IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Equipment labels.
   2. Warning signs and labels.
   3. Pipe labels.

1.02 SUBMITTAL

A. Product Data: For each type of product indicated.

PART 2 PRODUCTS

2.01 EQUIPMENT LABELS

A. Metal Labels for Equipment:
   1. Material and Thickness: Aluminum, 0.032-inch (0.8-mm) minimum thickness, and having predrilled or stamped holes for attachment hardware.
   2. 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).
   3. 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.
   4. Fasteners: Stainless-steel self-tapping screws.
   5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. 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.

C. 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.

2.02 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

B. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

C. 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.
   1. 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.
   2. Lettering Size: At least 1-1/2 inches (38 mm) high.

PART 3 EXECUTION

3.01 PREPARATION

A. 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.

3.02 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.03 PIPE LABEL INSTALLATION

A. 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:
   1. Near each valve and control device.
   2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
   3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
   4. At access doors, manholes, and similar access points that permit view of concealed piping.
   5. Near major equipment items and other points of origination and termination.
   6. 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.
   7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

B. Pipe Label Color Schedule:

1. Domestic Water Piping:
   a. Background Color: White.
   b. Letter Color: Black.
2. Sanitary Waste and Storm Drainage Piping:
   a. Background Color: White.
   b. Letter Color: Black.

END OF SECTION

SECTION 22 1116
DOMESTIC WATER PIPING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Under-building slab and aboveground domestic water pipes, tubes, fittings, and specialties inside the building.
   2. Specialty valves.
   3. Flexible connectors.
   4. Water meters furnished by utility company for installation by Contractor.

1.02 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Domestic water piping and support and installation shall withstand effects of earthquake motions determined according to ASCE/SEI 7.

1.03 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Field quality-control reports.

1.04 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF 61 for potable domestic water piping and components.

PART 2 PRODUCTS

2.01 PIPING MATERIALS

A. 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.

2.02 COPPER TUBE AND FITTINGS

A. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.
   1. Wrought-Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
   2. 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.

2.03 PIPING JOINING MATERIALS

A. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

B. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

2.04 DIELECTRIC FITTINGS

A. 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.

B. Dielectric Unions:
   1. Description:
      a. Pressure Rating: 250 psig at 180 deg F.
      b. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Flanges:
   1. Description:
      a. Factory-fabricated, bolted, companion-flange assembly.
      b. Pressure Rating: 300 psig.

c. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Kits:
1. Description:
a. Nonconducting materials for field assembly of companion flanges.
b. Pressure Rating: 150 psig.
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.
b. Pressure Rating: 300 psig at 225 deg F.
c. End Connections: Male threaded or grooved.
d. Lining: Inert and noncorrosive, propylene.

2.05 FLEXIBLE CONNECTORS

A. Stainless-Steel-Hose Flexible Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.
1. Working-Pressure Rating: Minimum 250 psig.
2. End Connections NPS 2 and Smaller: Threaded steel-pipe nipple.
3. End Connections NPS 2-1/2 and Larger: Flanged steel nipple.

PART 3 EXECUTION

3.01 EARTHWORK

A. Comply with requirements in Division 32 Section "Sitework Concrete" for excavating, trenching, and backfilling.

3.02 PIPING INSTALLATION

A. 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.

B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."

C. Install ductile-iron piping under building slab with restrained joints according to AWWA C600 and AWWA M41.

D. Install shutoff valve, hose-end drain valve, strainer, and test tee with valve, inside the building at each domestic water service entrance. Comply with Division 22 Section "Domestic Water Piping Specialties" for drain valves and strainers.

E. Install shutoff valve immediately upstream of each dielectric fitting.

F. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements in Division 22 Section "General–Duty Valves for Plumbing Piping" for pressure-reducing valves.

G. Install domestic water piping level without pitch and plumb.

H. Rough-in domestic water piping for water-meter installation according to utility company's requirements.

I. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

J. 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.

K. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.

L. Install piping adjacent to equipment and specialties to allow service and maintenance.

M. Install piping to permit valve servicing.

N. 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.

O. Install piping free of sags and bends.

P. Install fittings for changes in direction and branch connections.

Q. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.

3.03 JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

C. 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:
   1. Apply appropriate tape or thread compound to external pipe threads.
   2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

D. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Brazed Joints" Chapter.

E. 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."

F. Pressure-Sealed Joints: Join copper tube and pressure-seal fittings with tools recommended by fitting manufacturer.

G. 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.

H. 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.

I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
   1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements. Apply primer.
   2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
   3. PVC Piping: Join according to ASTM D 2855.

J. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.04 VALVE INSTALLATION

A. General-Duty Valves: Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping" for valve installations.

B. 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 and smaller. Use butterfly or gate valves for piping NPS 2-1/2 and larger.

C. 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."
   1. Hose-End Drain Valves: At low points in water mains, risers, and branches.
   2. Stop-and-Waste Drain Valves: Instead of hose-end drain valves where indicated.

D. 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 and smaller and butterfly valves for piping NPS 2-1/2 and larger. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for balancing valves.

3.05 TRANSITION FITTING INSTALLATION

A. Install transition couplings at joints of dissimilar piping.

B. Transition Fittings in Underground Domestic Water Piping:
   1. NPS 1-1/2and Smaller: Fitting-type coupling.
   2. NPS 2and Larger: Sleeve-type coupling.

C. Transition Fittings in Aboveground Domestic Water Piping NPS 2 and Smaller: Plastic-to-metal transition unions.

3.06 DIELECTRIC FITTING INSTALLATION

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

B. Dielectric Fittings for NPS 2 Smaller: Use dielectric unions.

C. Dielectric Fittings for NPS 2-1/2 to NPS 4Use dielectric nipples.

D. Dielectric Fittings for NPS 5 to NPS 6: Use dielectric flange kits.

3.07 FLEXIBLE CONNECTOR INSTALLATION

A. Install stainless-steel-hose flexible connectors in steel domestic water piping.

3.08 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment and machines to allow service and maintenance.

C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.

D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:
   1. Domestic Water Booster Pumps: Cold-water suction and discharge piping.
   2. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
   3. 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 plumbing fixture Sections for connection sizes.
   4. 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 2-1/2and larger.

3.09 IDENTIFICATION

A. Identify system components. Comply with requirements in Division 22 Section "Identification for Plumbing Piping and Equipment" for identification materials and installation.

B. Label pressure piping with system operating pressure.

3.10 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Piping Inspections:

1. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
2. 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:
   a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
   b. Final Inspection: Arrange final inspection for authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
3. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

C. Piping Tests:
1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
2. 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.
3. 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.
4. Cap and subject piping to static water pressure of 50 psig 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.
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 for corrective action required.

D. Domestic water piping will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.11 CLEANING

A. Clean and disinfect potable water piping as follows:
1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. 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:
   a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
   b. Fill and isolate system according to either of the following:
      1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
      2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.
   c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
   d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

B. Prepare and submit reports of purging and disinfecting activities.

C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.12 PIPING SCHEDULE

A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.

C. Under-building-slab, domestic water piping, NPS 2and smaller, shall be the following:
   1. Hard copper tube, ASTM B 88, Type K; wrought-copper solder-joint fittings; and brazed joints.

D. Aboveground domestic water piping, NPS 2and smaller, shall be the following:
   1. Hard copper tube, ASTM B 88, Type L cast-copper solder-joint fittings; and soldered joints.

3.13 VALVE SCHEDULE

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
   1. Shutoff Duty: Use ball or gate valves for piping NPS 2and smaller. Use butterfly, ball, or gate valves with flanged ends for piping NPS 2-1/2and larger.
   2. Throttling Duty: Use ball or globe valves for piping NPS 2and smaller. Use butterfly or ball valves with flanged ends for piping NPS 2-1/2and larger.
   3. Hot-Water Circulation Piping, Balancing Duty: Memory-stop balancing valves.
   4. Drain Duty: Hose-end drain valves.

B. Use check valves to maintain correct direction of domestic water flow to and from equipment.

END OF SECTION

SECTION 22 1119
DOMESTIC WATER PIPING SPECIALTIES

PART 1 GENERAL

1.01 SUMMARY

A. This Section includes the following domestic water piping specialties:
   1. Hose bibbs.
   2. Trap-seal primer valves.

B. See Division 22 Section "Domestic Water Piping" for water meters.

C. See Division 22 Section "Domestic Water Filtration Equipment" for water filters in domestic water piping.

1.02 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping Specialties: 60 psig, unless otherwise indicated.

1.03 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Field quality-control test reports.

C. Operation and maintenance data.

1.04 QUALITY ASSURANCE

A. NSF Compliance:
   1. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic domestic water piping components.
   2. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9."

PART 2 PRODUCTS

2.01 HOSE BIBBS

A. Hose Bibbs:
   1. Standard: ASME A112.18.1 for sediment faucets.
   2. Body Material: Bronze.
   3. Seat: Bronze, replaceable.
   4. Supply Connections: NPS 3/4 threaded or solder-joint inlet.
   5. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
   6. Pressure Rating: 125 psig.
   7. Vacuum Breaker: Integral or field-installation, nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
   8. Finish for Equipment Rooms: Rough bronze, or chrome or nickel plated.
   9. Finish for Service Areas: Chrome or nickel plated.
   10. Finish for Finished Rooms: Chrome or nickel plated.
   11. Operation for Equipment Rooms: Wheel handle or operating key.
   12. Operation for Service Areas: Operating key.
   13. Operation for Finished Rooms: Operating key.
   14. Include operating key with each operating-key hose bibb.
   15. Include integral wall flange with each chrome- or nickel-plated hose bibb.

2.02 TRAP-SEAL PRIMER VALVES

A. Supply-Type, Trap-Seal Primer Valves:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. MIFAB, Inc.

b. PPP Inc.
c. Sioux Chief Manufacturing Company, Inc.
d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
e. Watts Industries, Inc.; Water Products Div.

2. Standard: ASSE 1018.
3. Pressure Rating: 125 psig minimum.
4. Body: Bronze.
5. Inlet and Outlet Connections: NPS 1/2 threaded, union, or solder joint.
6. Gravity Drain Outlet Connection: NPS 1/2 threaded or solder joint.
7. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

PART 3 EXECUTION

3.01 INSTALLATION

A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.

B. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping and specialties.

C. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
1. Supply-type, trap-seal primer valves.

D. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

3.02 FIELD QUALITY CONTROL

A. Perform the following tests and prepare test reports:
1. Test each reduced-pressure-principle backflow preventer according to authorities having jurisdiction and the device's reference standard.

B. Remove and replace malfunctioning domestic water piping specialties and retest as specified above.

3.03 ADJUSTING

A. Set field-adjustable pressure set points of water pressure-reducing valves.

B. Set field-adjustable flow of balancing valves.

C. Set field-adjustable temperature set points of temperature-actuated water mixing valves.

END OF SECTION

SECTION 22 1316
SANITARY WASTE AND VENT PIPING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:
   1. Pipe, tube, and fittings.
   2. Specialty pipe fittings.
   3. Encasement for underground metal piping.

B. Related Sections:
   1. Division 22 Section "Facility Sanitary Sewers" for sanitary sewerage piping and structures outside the building.

1.03 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:
   1. Soil, Waste, and Vent Piping: 10-foot head of water (30 kPa).

B. Seismic Performance: Soil, waste, and vent piping and support and installation shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1.04 SUBMITTALS

A. Product Data: For each type of product indicated.

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.

1.05 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF/ANSI 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping and "NSF-sewer" for plastic sewer piping.

C. All cast iron soil pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute (CISPI) and be listed by NSF International.

D. All couplings for hubless cast iron soil pipe and fittings shall meet the latest requirements of CISPI 310 including Annex A1 and be certified by NSF International.

PART 2 PRODUCTS

2.01 PIPING MATERIALS

A. 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.

2.02 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 888 and CISPI 301.

B. CISPI, Hubless-Piping Couplings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Charlotte Pipe.
   b. MIFAB, Inc.
   c. Tyler Pipe.
2. Standards: ASTM C 1277 and CISPI 310.
3. Description: Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.03 ABS PIPE AND FITTINGS

A. Solid-Wall ABS Pipe: ASTM D 2661, Schedule 40.

B. ABS Socket Fittings: ASTM D 2661, made to ASTM D 3311, drain, waste, and vent patterns.

C. Solvent Cement: ASTM D 2235.
   1. ABS solvent cement shall have a VOC content of 325 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.04 SPECIALTY PIPE FITTINGS

A. Transition Couplings:
   1. 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.
   2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
   3. Unshielded, Nonpressure Transition Couplings:
      a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
         1) Dallas Specialty & Mfg. Co.
         2) Fernco Inc.
         3) Mission Rubber Company; a division of MCP Industries, Inc.
         4) Plastic Oddities; a division of Diverse Corporate Technologies, Inc.
      b. Standard: ASTM C 1173.
      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. Sleeve Materials:
         1) For Cast-Iron Soil Pipes: ASTM C 564, rubber.
         2) For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
         3) For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.
   4. Shielded, Nonpressure Transition Couplings:
      a. Manufacturers: Subject to compliance with requirements, provide products by the following:
      b. Cascade Waterworks Mfg. Co.
         1) Mission Rubber Company; a division of MCP Industries, Inc.
      c. Standard: ASTM C 1460.
      d. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Capitol Manufacturing Company.
2) Central Plastics Company.
3) Jomar International Ltd.
4) Watts Regulator Co.; a division of Watts Water Technologies, Inc.
5) Wilkins; a Zurn company.

b. Description:
1) Standard: ASSE 1079.
2) Pressure Rating: 125 psig (860 kPa) minimum at 180 deg F (82 deg C)
3) End Connections: Solder-joint copper alloy and threaded ferrous.

3. Dielectric Flanges:
a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1) Capitol Manufacturing Company.
2) Central Plastics Company.
3) Matco-Norca, Inc.
4) Watts Regulator Co.; a division of Watts Water Technologies, Inc.
5) Wilkins; a Zurn company.

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).
4) End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

4. Dielectric-Flange Insulating Kits:
a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1) Advance Products & Systems, Inc.
2) Calpico, Inc.
3) Central Plastics Company.
4) Pipeline Seal and Insulator, Inc.

b. 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 Nipples:
a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1) Grinnell Mechanical Products.
2) Matco-Norca, Inc.
3) Precision Plumbing Products, Inc.
4) Victaulic Company.

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).
4) End Connections: Male threaded or grooved.
5) Lining: Inert and noncorrosive, propylene.

PART 3 EXECUTION

3.01 EARTH MOVING

A. Comply with requirements for excavating, trenching, and backfilling specified in Division 31 Section "Earth Moving."

3.02 PIPING INSTALLATION

A. 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 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 Division 22 Section "Vibration and Seismic 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. 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. 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. Straight tees, elbows, and crosses may be used on vent lines. 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.

L. Lay buried building 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.

M. Install soil and waste drainage and vent piping at the following minimum slopes unless otherwise indicated:
   1. Building Sanitary Drain: 2 percent downward in direction of flow for piping NPS 3 (DN 80) and smaller; 2 percent downward in direction of flow for piping NPS 4 (DN 100) and larger.
   2. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.
   3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.

N. 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."

O. Install steel piping according to applicable plumbing code.

P. Install aboveground copper tubing according to CDA's "Copper Tube Handbook."

Q. Install aboveground ABS piping according to ASTM D 2661.

R. Install underground ABS piping according to ASTM D 2321.

S. Plumbing Specialties:
   1. Install backwater valves in sanitary waster gravity-flow piping. Comply with requirements for backwater valves specified in Division 22 Section "Sanitary Waste Piping Specialties."
   2. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary drainage gravity-flow piping. Install cleanout fitting with closure

plug inside the building in sanitary drainage force-main piping. Comply with requirements for cleanouts specified in Division 22 Section "Sanitary Waste Piping Specialties."

3. Install drains in sanitary drainage gravity-flow piping. Comply with requirements for drains specified in Division 22 Section "Sanitary Waste Piping Specialties."

T. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

U. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 22 Section "Sleeves and Sleeve Seals for Plumbing Piping."

V. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 22 Section "Sleeves and Sleeve Seals for Plumbing Piping."

W. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 22 Section "Escutcheons for Plumbing Piping."

3.03 JOINT CONSTRUCTION

A. Join hubless, cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.

B. Join copper tube and fittings with soldered joints according to ASTM B 828. Use ASTM B 813, water-flushable, lead-free flux and ASTM B 32, lead-free-alloy solder.

C. Plastic, Nonpressure-Piping, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
3. PVC Piping: Join according to ASTM D 2855 and ASTM D 2665 Appendixes.

3.04 SPECIALTY PIPE FITTING INSTALLATION

A. Transition Couplings:

1. Install transition couplings at joints of piping with small differences in OD's.
2. In Drainage Piping: Shielded, nonpressure 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) and Smaller: Use dielectric nipples.
3. Dielectric Fittings for NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Use dielectric nipples.
4. Dielectric Fittings for [NPS 5 (DN 125) and Larger: Use dielectric flange kits.

3.05 VALVE INSTALLATION

A. General valve installation requirements are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."

B. Backwater Valves: Install backwater valves in piping subject to backflow.

1. Horizontal Piping: Horizontal backwater valves.
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 Division 22 Section "Sanitary Waste Piping Specialties."

3.06 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for seismic-restraint devices specified in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."

B. Comply with requirements for pipe hanger and support devices and installation specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."
   1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
   2. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
   3. Vertical Piping: MSS Type 8 or Type 42, clamps.
   4. Install 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.
      c. Longer Than 100 Feet (30 m) if Indicated: MSS Type 49, spring cushion rolls.
   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.

C. Support horizontal piping and tubing within 12 inches (300 mm) of each fitting and coupling.

D. Support vertical piping and tubing at base and at each floor.

E. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch (10-mm) minimum rods.

F. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
   1. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 60 inches (1500 mm) with 3/8-inch (10-mm) rod.
   2. NPS 3 (DN 80): 60 inches (1500 mm) with 1/2-inch (13-mm) rod.
   3. NPS 4 and NPS 5 (DN 100 and DN 125): 60 inches (1500 mm) with 5/8-inch (16-mm) rod.
   4. 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).

G. Install supports for vertical cast-iron soil piping every 15 feet (4.5 m).

H. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
   1. NPS 1-1/4 (DN 32): 84 inches (2100 mm) with 3/8-inch (10-mm) rod.
   2. NPS 1-1/2 (DN 40): 108 inches (2700 mm) with 3/8-inch (10-mm) rod.
   3. NPS 2 (DN 50): 10 feet (3 m) with 3/8-inch (10-mm) rod.
   4. NPS 2-1/2 (DN 65): 11 feet (3.4 m) with 1/2-inch (13-mm) rod.
   5. NPS 3 (DN 80): 12 feet (3.7 m) with 1/2-inch (13-mm) rod.
   6. NPS 4 and NPS 5 (DN 100 and DN 125): 12 feet (3.7 m) with 5/8-inch (16-mm) rod.

I. Install supports for vertical steel piping every 15 feet (4.5 m).

J. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
   1. NPS 1-1/4 (DN 32): 72 inches (1800 mm) with 3/8-inch (10-mm) rod.
   2. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 96 inches (2400 mm) with 3/8-inch (10-mm) rod.

K. Install supports for vertical copper tubing every 10 feet (3 m).

L. Install hangers for ABS piping with the following maximum horizontal spacing and minimum rod diameters:
   1. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 48 inches (1200 mm) with 3/8-inch (10-mm) rod.
   2. NPS 3 (DN 80): 48 inches (1200 mm) with 1/2-inch (13-mm) rod.
   3. NPS 4 and NPS 5 (DN 100 and DN 125): 48 inches (1200 mm) with 5/8-inch (16-mm) rod.

M. Install supports for vertical ABS piping every 48 inches (1200 mm).

N. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.07 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 drainage and vent piping to the following:
   1. Plumbing Fixtures: Connect drainage 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 drainage 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.
   6. Comply with requirements for backwater valves, cleanouts, and drains specified in Division 22 Section "Sanitary Waste Piping Specialties."

D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

E. Make connections according to 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

3.08 IDENTIFICATION

A. Identify exposed sanitary waste and vent piping. Comply with requirements for identification specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

3.09 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 drainage and vent piping according to 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. 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 drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
   3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping except outside leaders 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.
   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. 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). Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. 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 according to 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. 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. Isolate test source and allow to stand for four hours. 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 drains 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 Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.

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 shall be the following:
1. Hubless, cast-iron soil pipe and fittings CISPI hubless-piping couplings; and coupled joints.
2. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

C. Aboveground, vent piping NPS 4 (DN 100) and smaller shall be the following:
1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Hubless, cast-iron soil pipe and fittings; CISPI hubless-piping couplings; and coupled joints.
3. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

D. Underground, soil, waste, and vent piping NPS 4 (DN 100) and smaller shall be the following:
1. Solid wall ABS pipe, ABS socket fittings, and solvent-cemented joints.
2. Dissimilar Pipe- Material Couplings: Shielded, nonpressure transition couplings.

END OF SECTION

SECTION 22 1319
SANITARY WASTE PIPING SPECIALTIES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes the following sanitary drainage piping specialties:
   1. Cleanouts.
   2. Roof flashing assemblies.
   3. Miscellaneous sanitary drainage piping specialties.
   4. Flashing materials.

1.03 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. FOG: Fats, oils, and greases.

C. FRP: Fiberglass-reinforced plastic.

D. HDPE: High-density polyethylene plastic.

E. PE: Polyethylene plastic.

F. PP: Polypropylene plastic.

G. PVC: Polyvinyl chloride plastic.

1.04 SUBMITTALS

A. Shop Drawings: Show fabrication and installation details for frost-resistant vent terminals.
   1. Wiring Diagrams: Power, signal, and control wiring.

B. Field quality-control test reports.

C. Operation and Maintenance Data: For drainage piping specialties to include in emergency, operation, and maintenance manuals.

1.05 QUALITY ASSURANCE

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

B. 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.

C. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic sanitary piping specialty components.

1.06 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Coordinate size and location of roof penetrations.

1.07 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Cultures: Provide 1-gal. (3.8-L) bottles of bacteria culture recommended by manufacturer of FOG disposal systems equal to 200 percent of amount installed, but no fewer than 2 1-gal. (3.8-L) bottles.

PART 2 PRODUCTS

2.01 CLEANOUTS

A. Exposed Metal Cleanouts
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Josam Company; Josam Div.
      b. MIFAB, Inc.
      c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
      d. Tyler Pipe; Wade Div.
      e. Watts Drainage Products Inc.
      f. Zurn Plumbing Products Group; Specification Drainage Operation.
      g. Josam Company; Blucher-Josam Div.
   2. Standard: ASME A112.36.2M for cast iron for cleanout test tee.
   3. Size: Same as connected drainage piping
   4. Body Material: Hubless, cast-iron soil pipe test tee as required to match connected piping.
   5. Closure: Countersunk or raised-head plug.
   6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
   7. Closure: Stainless-steel plug with seal.

B. Metal Floor Cleanouts:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Josam Company; Josam Div.
      b. Oatey.
      c. Sioux Chief Manufacturing Company, Inc.
      d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
      e. Tyler Pipe; Wade Div.
      f. Watts Drainage Products Inc.
      g. Zurn Plumbing Products Group; Light Commercial Operation.
      h. Zurn Plumbing Products Group; Specification Drainage Operation.
      i. Josam Company; Josam Div.
      j. Kusel Equipment Co.
      k. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
      l. Josam Company; Blucher-Josam Div.
   2. Standard: ASME A112.36.2M for adjustable housing cleanout.
   3. Size: Same as connected branch.
   4. Type: Adjustable housing
   5. Body or Ferrule: Cast iron
   6. Clamping Device: Required.
   7. Outlet Connection: Inside calk
   8. Closure: Brass plug with tapered threads
   9. Adjustable Housing Material: Cast iron with set-screws or other device.
   10. Frame and Cover Material and Finish: Nickel-bronze, copper alloy
   11. Frame and Cover Shape: Round
   12. Top Loading Classification: Medium Duty.
   13. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.
   14. Standard: ASME A112.3.1.
   15. Size: Same as connected branch.
   16. Housing: Stainless steel.
   17. Closure: Stainless steel with seal.
   18. Riser: Stainless-steel drainage pipe fitting to cleanout.

C. Cast-Iron Wall Cleanouts
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Josam Company; Josam Div.
b. MIFAB, Inc.
c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
d. Tyler Pipe; Wade Div.
e. Watts Drainage Products Inc.
f. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.36.2M. Include wall access.
3. Size: Same as connected drainage piping.
4. Body: Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Countersunk or raised-head plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Wall Access: Round, flat, chrome-plated brass or stainless-steel cover plate with screw.
8. Wall Access: Round, nickel-bronze, copper-alloy, or stainless-steel wall-installation frame and cover.

2.02 FLOOR DRAINS

A. Cast-Iron Floor Drains:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Commercial Enameling Co.
b. Josam Company; Josam Div.
c. MIFAB, Inc.
d. Prier Products, Inc.
e. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
f. Tyler Pipe; Wade Div.
g. Watts Drainage Products Inc.
h. Zurn Plumbing Products Group; Light Commercial Operation.
i. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.6.3.
3. Pattern: Floor drain.
4. Body Material: Cast iron
5. Seepage Flange: Required.
6. Anchor Flange: Required.
7. Clamping Device: Required.
8. Outlet: Bottom
9. Backwater Valve: Not required.
10. Coating on Interior and Exposed Exterior Surfaces: Not required.
11. Sediment Bucket: Not required
12. Top or Strainer Material**:** Nickel bronze
13. Top of Body and Strainer Finish: Nickel bronze
14. Top Shape: Round
15. Inlet Fitting: Gray iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
16. Trap Material: Cast iron
17. Trap Pattern: Standard P-trap.
18. Trap Features: Trap-seal primer valve drain connection.

2.03 ROOF FLASHING ASSEMBLIES

A. Roof Flashing Assemblies:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Acorn Engineering Company; Elmdor/Stoneman Div.
b. Thaler Metal Industries Ltd.

B. Description: Manufactured assembly made of 4.0-lb/sq. ft. (20-kg/sq. m), 0.0625-inch- (1.6-mm-) from pipe, with galvanized-steel boot reinforcement and counterflashing fitting.
   1. Open-Top Vent Cap: Without cap.
   2. Low-Silhouette Vent Cap: With vandal-proof vent cap.
   3. Extended Vent Cap: With field-installed, vandal-proof vent cap.

2.04 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Floor-Drain, Trap-Seal Primer Fittings:
   1. Description: Cast iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
   2. Size: Same as floor drain outlet with NPS 1/2 (DN 15) side inlet.

B. Air-Gap Fittings :
   1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
   2. Body: Bronze or cast iron.
   3. Inlet: Opening in top of body.
   4. Outlet: Larger than inlet.
   5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

C. Sleeve Flashing Device:
   1. Description: Manufactured, cast-iron fitting, with clamping device, that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend **2 inches (51 mm)** above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
   2. Size: As required for close fit to riser or stack piping.

D. Stack Flashing Fittings:
   1. Description: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
   2. Size: Same as connected stack vent or vent stack.

2.05 FLASHING MATERIALS

A. Lead Sheet: ASTM B 749, Type L51121, copper bearing, with the following minimum weights and thicknesses, unless otherwise indicated:
   1. General Use: 4.0-lb/sq. ft. (20-kg/sq. m), 0.0625-inch (1.6-mm) thickness.
   2. Vent Pipe Flashing: 3.0-lb/sq. ft. (15-kg/sq. m), 0.0469-inch (1.2-mm) thickness.
   3. Burning: 6-lb/sq. ft. (30-kg/sq. m), 0.0938-inch (2.4-mm) thickness.

B. Copper Sheet: ASTM B 152/B 152M, of the following minimum weights and thicknesses, unless otherwise indicated:
   1. General Applications: 12 oz./sq. ft. (3.7 kg/sq. m or 0.41-mm) thickness.
   2. Vent Pipe Flashing: 8 oz./sq. ft. (2.5 kg/sq. m or 0.27-mm) thickness.

C. 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.

D. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil (1.01-mm) minimum thickness.

E. Fasteners: Metal compatible with material and substrate being fastened.

F. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.

G. Solder: ASTM B 32, lead-free alloy.

H. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

PART 3 EXECUTION

3.01 INSTALLATION

A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.

B. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
   1. Size same as drainage piping up to NPS 4 (DN 100). Use NPS 4 (DN 100) for larger drainage piping unless larger cleanout is indicated.
   2. Locate at each change in direction of piping greater than 45 degrees.
   3. Locate at minimum intervals of 50 feet (15 m) for piping NPS 4 (DN 100) and smaller and 100 feet (30 m) for larger piping.
   4. Locate at base of each vertical soil and waste stack.

C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

E. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
   1. Position floor drains for easy access and maintenance.
   2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:
      a. Radius, 30 Inches (750 mm) or Less: Equivalent to 1 percent slope, but not less than 1/4-inch (6.35-mm) total depression.
      b. Radius, 30 to 60 Inches (750 to 1500 mm): Equivalent to 1 percent slope.
      c. Radius, 60 Inches (1500 mm) or Larger: Equivalent to 1 percent slope, but not greater than 1-inch (25-mm) total depression.
   3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
   4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.

F. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.

G. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.

H. Assemble open drain fittings and install with top of hub 2 inches (51 mm) above floor.

I. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.
   1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
   2. Size: Same as floor drain inlet.

J. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.

K. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.

L. Install vent caps on each vent pipe passing through roof.

M. Install frost-resistant vent terminals on each vent pipe passing through roof. Maintain 1-inch (25-mm) clearance between vent pipe and roof substrate.

N. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.

O. Install frost-proof vent caps on each vent pipe passing through roof. Maintain 1-inch (25-mm) clearance between vent pipe and roof substrate.

P. Install wood-blocking reinforcement for wall-mounting-type specialties.

Q. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

3.02 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

3.03 FLASHING INSTALLATION

A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:
   1. Lead Sheets: Burn joints of lead sheets 6.0-lb/sq. ft. (30-kg/sq. m), 0.0938-inch (2.4-mm) thickness or thicker. Solder joints of lead sheets 4.0-lb/sq. ft. (20-kg/sq. m), 0.0625-inch (1.6-mm) thickness or thinner.
   2. Copper Sheets: Solder joints of copper sheets.

B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
   1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches (250 mm), and skirt or flange extending at least 8 inches (200 mm) around pipe.
   2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches (200 mm) around sleeve.
   3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches (200 mm) around specialty.

C. Set flashing on floors and roofs in solid coating of bituminous cement.

D. Secure flashing into sleeve and specialty clamping ring or device.

E. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Division 07 Section "Sheet Metal Flashing and Trim."

F. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.

G. Fabricate and install flashing and pans, sumps, and other drainage shapes.

3.04 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

B. Tests and Inspections:
   1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
   2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.05 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION

SECTION 23 0000
GENERAL MECHANICAL REQUIREMENTS

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

A. The General conditions, supplementary conditions, special Requirements, and applicable portions of Division 1 of the specification are a part of this Division and the requirements contained herein are supplementary to them.

B. This Division is an integrated whole comprising interrelated and interdependent sections and shall be considered in its entirety in determining requirements.

C. Refer to other sections of this Division for additional requirements or information regarding the subjects of this Section.

1.02 ABBREVIATIONS AND DEFINITIONS (as used on Division 23 Drawings and herein)

A. This Division is abbreviated and includes incomplete sentences. Supply omitted words by inference.

B. Symbols: "[S]" means submittals are required; "[M/O]" means Maintenance/Operating data is required; see paragraphs hereinafter.

C. "Provide" means furnish, install and connect unless otherwise described in specific instances.

D. "Piping" means pipes, fittings, valves and all like pipe accessories connected thereto.

E. "Ductwork" means ducts, plenums, compartments, casings or any like devices, including the building structure, which are used to convey or contain air.

F. "Extend", "Submit", "Repair", "Abandon", "Replace", "Remove" and similar words mean that the Contractor (or his designated subcontractor) shall accomplish the action described.

G. "Codes" or "Code" means all codes, laws, statutes, rules, regulations, ordinances, orders, decrees, and other requirements of all legally constructed authorities and public utility franchise holders having jurisdiction.

H. "Products", "Materials" and "Equipment" are used interchangeably and mean materials, fixtures, equipment, accessories, etc.

I. "Utility Areas" are defined as mechanical, electrical, janitorial, and similar rooms or spaces which are normally used or occupied only by custodial or maintenance personnel. "Public Areas" are defined as the rooms or spaces which are not included in the utility areas definition.

J. "Building Boundary" includes concrete walkways immediately adjacent to the building structure.

K. "Below Grade" means buried in the ground.

L. "Substantial Mechanical Completion" means all components of all systems are functioning but lacking in final adjustment.

M. Pressure rating specified (such as for valves and the like) means design working pressure for and with references to the fluid which the device will serve.

1.03 DESCRIPTION

A. Provide a complete and operable installation, including all labor, supervision, materials, equipment, tools, apparatus, transportation, warehousing, rigging, scaffolding and other equipment and services necessary to accomplish the work in accordance with the intent and meaning of these drawings and specifications.

1.04 RELATED WORK

A. Coordination: Refer to Architectural, Civil, Structural, and Electrical Drawings for the construction details and coordinate the work of this Division with that of other Divisions. Order the work of this Division so that progress will harmonize with that of other Divisions and all work will proceed expeditiously. The work of this Division shall include direct responsibility for the

correct placing and connection of mechanical work in relation to the work of other Divisions.

B. Examine other Divisions for work related to the work of this Division especially Division 26 - ELECTRICAL.

1.05 DRAWINGS AND SPECIFICATIONS

A. Drawings and specifications are intended to complement each other. Where a conflict exists between the requirements of the drawings and/or the specifications, request clarification.

B. The Architect shall interpret the drawings and the specifications, and his decision as to the true intent and meaning thereof and the quality, quantity, and sufficiency of the materials and workmanship furnished there under shall be accepted as final and conclusive.

C. In case of conflict not clarified prior to Bidding deadline, use the most costly alternative (better quality ,greater quantity, or larger size) in preparing the Bid. A clarification will be issued to the successful bidder as soon as feasible after the Award and if appropriate a deductive change order will be issued.

D. All provisions shall be deemed mandatory except as expressly indicated as optional by the word "may" or "option".

1.06 PERMITS AND INSPECTIONS

A. Obtain, schedule and pay for permits, licenses, approvals, tests, and inspections required by legally constituted authorities and public utility franchise holders having jurisdiction over the work.

B. Afford the Architect's representative every facility for evaluating the skill and competence of the mechanics and to examine the materials. Concealed work shall be reopened when so directed during his periodic visits.

1.07 CODES AND REGULATIONS

A. By submitting a bid, Contractor is deemed to represent himself as competent to accomplish the work of this Division in conformance with applicable Codes. In case of conflict between the Contract documents and the Code requirements, the Codes shall take precedence. Should such conflicts appear, cease work on the parts of the contract affected and immediately notify the Architect in writing. It shall be the Contractor's responsibility to correct, at no cost to the Owner, any work he executes in violation of Code requirements. Specify references to codes elsewhere in this Division are either to aid the Contractor in locating applicable information or to deny him permission to use options which are permitted by Codes.

B. Applicable Codes: (Current editions unless otherwise noted)
   1. All local codes; city and/or County as applicable
   2. OSHA requirements
   3. California Building Code with California Amendments
   4. California Mechanical Code with California Amendments
   5. California Plumbing Code with California Amendments
   6. California Code of Regulations (CCR) Titles
   7. Fire Marshal Regulations
   8. Regulations of all other authorities having jurisdiction.

C. Where conflict or variation exists among codes, the most stringent shall govern.

D. Certificates of Conformance or Compliance: Submit original and not pre-printed certifications. Do not make statements in the certifications that could be interpreted to imply that the product does not meet all requirements specified, such as "as good as", "achieve the same end use and results as materials formulated in accordance with the referenced publications", "equal or exceed the services and performance of the specified material". Simply state that the product conforms to the requirements specified.

E. Certified Test Reports: Certified Test Reports are reports of tests conducted on previously manufactured materials or equipment identical to that proposed for use. Before delivery of materials and equipment, submit certified copies of test reports specified in the individual

sections.

F. Factory Tests: Factory tests are tests which are required to be performed on the actual materials or equipment proposed for use. Submit results of the tests in accordance with the requirements for laboratory test results of this Contract.

G. Permits and Certificates of Inspection: Furnish the originals.

H. Testing procedures and test results required in this and other sections. Furnish 2 copies.

I. Other data required by other sections of this Division. Furnish 2 copies.

1.08 RECORD AND DOCUMENTATION

A. Accumulate the following and deliver to the Owner's representative prior to final acceptance of the work:

1. Record (As-Built) Drawings:
   a. Maintain in good order in the field office a complete set of prints for all work being done under Division 23. Update the drawings daily with neat and legible annotations in red ink showing the work as actually installed.
   b. The actual size, location and elevation of all buried lines, valve boxes, manholes, monuments, and stub-outs shall be accurately located and dimensioned from building walls or other permanent landmarks.
   c. Furnish the originals.
2. Operation and Maintenance Manual: Furnish an operation and maintenance manual covering the stipulated mechanical systems and equipment. Seven copies of the manual, bound in hardback binders or an approved equivalent, shall be provided to the Architect in accordance with the Division 1 section on Maintenance and Operation Manuals. Furnish one complete manual prior to the time that system or equipment tests are performed. Furnish the remaining manuals before the contract is completed. The following identification shall be inscribed on the cover:

   OPERATION AND MAINTENANCE MANUAL
   PROJECT TITLE.....
   CONTRACTOR.....

   Provide a table of contents. Insert tab sheets to identify discrete subjects. Instruction sheets shall be legible and easily understood, with large sheets of drawings folded in. The manual shall be complete in all respects for all materials, piping, valves, devices and equipment, controls, accessories and appurtenances stipulated. Include as a minimum the following:

   a. Updated approved materials list, shop drawings and catalog information of all items indicated by symbol "[M/O]" at titles or beginning of paragraphs.
   b. System layout showing piping, valves and controls.
   c. Wiring and control diagrams with data to explain detailed operation and control of each component.
   d. A control sequence describing start-up, operation and shutdown.
   e. Detailed description of the function of each principal component of the system.
   f. Procedure for starting.
   g. Procedure for operation.
   h. Shut-down instruction.
   i. Installation instructions.
   j. Adjustments, maintenance and overhaul instructions.
   k. Lubrication schedule including type, grade, temperature range and frequency.
   l. Safety precautions, diagrams and illustrations.
   m. Test procedures.
   n. Performance data.
   o. Parts lists, with manufacturer's names and catalog numbers.
   p. Preventive maintenance schedule.
   q. Service organization with name, address and telephone number.
   r. Valve identification chart and schedule.

s. ASME certification
t. Air Balance report.

B. Standard Compliance: Where equipment or materials are specified to conform with requirements of standards of recognized technical or industrial organizations such as American National Standards (ANSI), American Society of Mechanical Engineers (ASME), American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE), Underwriters Laboratories (UL), American Refrigeration Institute (ARI), American Gas Association (AGA), or National Electrical Manufacturer's Association (NEMA), that use a label or published listing as a method of indicating compliance, proof of such conformance shall be submitted and approved. The label or listing of the specified organization will be acceptable evidence.

C. Certificates of Conformance or Compliance: Submit original and not pre-printed certifications. Do not make statements in the certifications that could be interpreted to imply that the product does not meet all requirements specified, such as "as good as", "achieve the same end use and results as materials formulated in accordance with the referenced publications", "equal or exceed the services and performance of the specified material". Simply state that the product conforms to the requirements specified.

D. Certified Test Reports: Certified Test Reports are reports of tests conducted on previously manufactured materials or equipment identical to that proposed for use. Before delivery of materials and equipment, submit certified copies of test reports specified in the individual sections.

E. Factory Tests: Factory tests are tests which are required to be performed on the actual materials or equipment proposed for use. Submit results of the tests in accordance with the requirements for laboratory test results of this Contract.

F. Permits and Certificates of Inspection: Furnish the originals.

G. Testing procedures and test results required in this and other sections. Furnish 2 copies.

H. Other data required by other sections of this Division. Furnish 2 copies.

1.9 TOOLS

A. Provide all special tools needed for proper operation and routine adjustment and maintenance of systems and equipment. Deliver tools to Owner's representative and request a receipt for same.

1.10 CONSTRUCTION COST BREAKDOWN

A. To assist the Architect and Engineer in evaluation of the construction cost, the Contractor shall prepare and submit for review a construction cost breakdown for the major subdivisions of the mechanical work.

B. Subdivide each item on the breakdown into two headings: labor and materials. Include overhead and profit in each entry.

C. Cost breakdowns shall be submitted and approved prior to the first payment request. Send one copy of the breakdown directly to the Engineer and the remaining copies sent through regular channels.

PART 2 PRODUCTS

2.01 MATERIALS AND EQUIPMENT

A. Standard Products: Materials and equipment shall be essentially the standard cataloged products of manufacturers regularly engaged in production of such materials or equipment and shall be their latest standard designs that comply with the specification requirements. Materials and equipment shall duplicate items that have been in satisfactory commercial or industrial use at least two years prior to bid opening. Where two or more units of the same type of equipment are required, these units shall be products of a single manufacturer. The components thereof, however, are not required to be exclusively of the same manufacturer. Each major component of equipment shall have manufacturer's name, address, model, and serial number on a nameplate securely affixed in a conspicuous place. The nameplate of the distributing agent will

not be acceptable.

B. Whenever on the plans, or in these specifications, products are identified by the name of one manufacturer, it is intended that equivalent products of other manufacturers are acceptable, unless otherwise indicated, if accepted as a substitution by the Architect. Where three or more manufacturers are listed as "acceptable manufacturers" however, then the products furnished shall be the product of one of the manufacturers listed. Manufacturers listed as "acceptable manufacturers" shall meet quality and performance of a particular one specified by both name and catalog number.

2.02 SUBSTITUTIONS

A. General: Should the Contractor desire to substitute for specified products, he shall submit with the Material List a complete list of the requested substitutions. The request shall contain complete descriptive information of the products. Samples for evaluation shall also be submitted upon the Architect's request. If in the Architect's opinion the products as presented in this first submittal are in variance with the specified products, or if the information submitted is not sufficiently complete to allow proper evaluation, the substitution will be disallowed from consideration and the specified products shall be furnished. By proposing a substitution, it is deemed that the Contractor shall bear the cost of any changes (whether architectural, structural, electrical or mechanical) necessary to accommodate the substitution.

B. Specific: Refer to other sections of this Division for additional requirements.

2.03 SUBMITTALS

A. General:

1. Provide for all items indicated with the symbol "[S]" at titles or beginning of paragraphs in accordance with the Division 1 section covering submittals and as herein specified. Where warranty of longer than one year is specified, include such warranty with submittal. Architect's review of the submittal is only for general conformance with design compliance with the information given in the contract documents. The submittal procedure is required as an effort to minimize the problems which occur due to the discovery of Contractor non-compliance at the construction site. The Contractor is responsible for conformation and correlation of the dimensions, quantities and sizes, for information that pertains to fabrication methods or construction techniques, and for coordination of work of all Divisions of the work. Deviations, if any, from Contract documents shall be clearly and completely indicated (by a separate letter if deviations are extensive) in the submittals, and the lack of such is deemed complete compliance with Contract Documents without any deviations. Submittals favorably processed will not relieve the Contractor of responsibility for deviations not so reported nor for errors in the submittal.
2. In addition to the above, upon permission to proceed after review of submittal and prior to the installation of work, submit dimensioned and scaled drawings (not less than 1/4-inch equal to one foot) of all mechanical equipment rooms and areas. Such layouts shall indicate, but not be limited to, all mechanical equipment, control panels, piping, housekeeping pads, ductwork, tube pull, access and maintenance clearances, and other like items. The layout shall also indicate major equipment to be provided under other Sections of work.
3. Contractor Stamp: All submittals shall be stamped with the following text and signed by the Contractors representative:

   "IT IS HEREBY CERTIFIED THAT THE PRODUCTS SHOWN AND MARKED IN THIS SUBMITTAL ARE IN COMPLIANCE WITH THE CONTRACT DOCUMENTS AND CAN BE INSTALLED IN THE ALLOCATED SPACES EXCEPT WHERE NOTED AS DEVIATIONS.

   CERTIFIED BY:---------- DATE:----------
4. All submittals shall be complete and with catalog data and information properly marked to show, among other things, equality of material (where substitution is allowed and desired), adequacy in capacity and performance to meet minimum capacities of performance as specified or indicated. Arrange the submittals in the same sequence as these specifications, and reference (at the upper right-hand corner) the particular specification

provision for which each submittal is intended. Incomplete submittals will be rejected.

5. For all work under Division 23, the notations by the Contractor or Supplier on submittal documents "Per Plans and Specifications", or "As Specified", or similar wording or phrasing is not acceptable and will be cause of rejection. Complete descriptive submittals are required for all Division 23 work.
6. Refer to the other sections of this Division for specific requirements.

B. Material List: Within 15 days after award of Contract, submit for approval a complete list of materials proposed for use. Furnish names and addresses of manufacturers, catalog numbers (where applicable) types and trade names. For purposes of uniformity, only one manufacturer will be accepted for each class or type of material. This list is in addition to Shop Drawings.

C. Shop Drawings: Submit shop drawings with such promptness as to cause no delay in the work. Do not commence fabrication of the equipment until the approved drawings are received from the Owner's representative.

D. Other Submittals: As required by other sections of this Division.

PART 3 EXECUTION

3.01 WORKMANSHIP AND INSTALLATION METHODS

A. Workmanship shall be in the best standard practice of the trade.

B. Execute the work so as to contribute to ease of operation and maintenance, maximum accessibility and best appearance. Execute it so that the installation will conform and adjust itself to the building structure, its equipment and its usage. The work shall be symmetrical, plumb, uniform, properly aligned, and firmly secured in place.

C. Install equipment in accordance with the manufacturer's instructions and recommendations unless otherwise noted or specified.

3.02 TESTS

A. General:
1. Demonstrate that all components of the work of this Division have been provided and that they operate in accordance with the Contract Documents.
2. Provide instruments and personnel for tests and demonstrations. Submit signed test results.

B. Specific: Refer to the other sections of this Division for test requirements.

3.03 DELIVERY, HANDLING, STORAGE OF MATERIALS AND PROTECTION OF WORK

A. Protect materials against dirt, water, chemical and mechanical damage both while in storage and during construction.

B. Cover materials in such a manner that no finished surfaces will be damaged, marred or splattered with plaster or paint. and all moving parts will be kept clean and dry.

C. Replace or refinish any damaged materials including fronts of control panels, ductwork fittings, and shop fabricated ductwork.

D. Keep cabinets and other openings closed to prevent entry of foreign matter.

3.04 CLEANUP AND HOUSEKEEPING

A. Cleaning shall be done as the work proceeds. Periodically remove waste and debris to keep the site as clean as is practical.

B. Leave exposed parts of the mechanical work in a neat, clean and usable condition, with painted surfaces unblemished and plated metal surfaces polished.

3.05 PROJECT CONDITIONS

A. Site Examinations and Conditions:
1. Regard information relative to existing conditions, services and structure as approximate only. Verify dimensions and locations, and be knowledgeable of all working conditions before submitting Bid. Verify pressure, location, size, and elevation of existing services (to

which points of connection are to be made or crossed) as soon as possible and prior to commencement of any new work.

2. Make minor deviations necessary to conform with actual locations and conditions. Submission of Bid presumes proper examination of Site, locations, dimensions and conditions, and no additional cost will be honored for lack of such examinations.

B. Existing Services: Examine the Contract Drawings and visit the project site to ascertain the extent of the existing services. Where existing equipment/services serving existing structures and/or existing structures to be demolished are to remain in service, reroute, relocate, or extend such existing equipment and/or services to accommodate this project without additional cost.

C. Interruption of Existing Services: Where it is necessary to reroute existing services or utilities, or to make connections of new work to existing services or utilities, give timely written notice of such intent to the Owner and secure written approval before proceeding. Make all such interruptions at such time as permitted by the Owner. Anticipate such interruptions to be made outside of normal working hours or normal working days; therefore, no additional cost will be permitted for such work. Except in a case of emergency involving life, limb or health, do not operate any existing equipment (including valves). Where such operations are necessary, they shall be performed by the Owner's personnel.

D. Access and Placement of Work:

1. Check and coordinate for clearance, accessibility and placement of equipment either by going through openings provided or by placing equipment during construction. Ordering of equipment to be shipped, disassembled, or disassembly of equipment at Project Site and re-assembly of equipment to accomplish this requirement shall be executed without additional cost. Where provided openings are inadequate to accommodate equipment, provide new openings and restoration of same, all at no additional cost. Obtain written approval for new openings before proceeding.
2. Verify location of all plumbing fixtures and equipment within finished spaces with the Architectural Drawings. In the event that Mechanical Drawings do not indicate exact locations, or are in conflict with the Architectural Drawings, obtain information regarding proper locations. Installation of work without proper instruction under such circumstances will result in relocation of work, when directed, without additional cost.

E. Verification and Coordination: Drawings indicating suggested distribution routes are diagrammatic only, and all scaled and figured dimensions are approximate and are indicated for estimating purposes only. The Drawings do not indicate necessary offsets and like items. Do not construe Contract Drawings as fabrication drawings. Prior to fabrication and installation of work, verify all dimensions, sizes and distribution routes with actual conditions, and prepare submittal and fabrication drawings. Coordinate to avoid possible conflicts and resolve same where such exist. Install work to conform to structure, avoid obstruction, preserve headroom, and keep openings and passageway clear. Changes necessary, resulting from such verification and coordination, shall not be a cause for additional cost.

3.06 WARRANTY

A. Guarantee, in writing, all work against fault of any product or workmanship for a period of not less than one year after formal acceptance by the Owner; except, where longer periods are specified in the Specifications, such longer periods shall govern. However, when any component fails at any time during this period, the warranty period for such component and all other components that are inactive because of said failure shall be suspended. The warranty period for such component shall resume to run for the remaining portion of the warranty period when failed component is completely repaired and in operation; however, in no case shall the resumed portion of the warranty period be less than 3 months in duration.

B. Neither payments for work, nor total or partial occupancy of work by the Owner, within or prior to the warranty period specified, shall be construed as acceptance of faulty work or shall condone any negligence of omission of Contractor in doing the work.

3.07 SAFETY REQUIREMENTS

A. Enclose and guard belts, pulleys, chains, gears, couplings, projecting setscrews, keys and

other rotating parts in accordance with the OSHA 1910.219. Insulate, guard, and cover any high-temperature equipment and piping so located as to endanger personnel or creature a fire hazard.

3.08 MANUFACTURER'S RECOMMENDATIONS

A. Where installation procedures or any part thereof are required to be in accordance with the recommendations of the manufacturer of the material or equipment being installed, furnish printed copies of these recommendations to the installing Contractor and Architect prior to installation. Do not proceed with the installation of the item until the recommendations are received. Failure to furnish these recommendations can be cause for rejection of the material.

END OF SECTION

SECTION 23 0500
BASIC MECHANICAL MATERIALS AND METHODS

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

A. The contract documents shall apply in their entirety to the work specified herein.

B. Submittals: Submit shop drawings and manufacturer's data on each item marked [S] in accordance with the Division 01 section on submittals and Section 23 00 00, Basic Mechanical Requirements.

C. Maintenance and Operation Manuals: Provide manufacturer's maintenance and operation manuals on each item marked [M/O] in accordance with the Division 01 section on maintenance and operation manuals and Section 23 00 00, Basic Mechanical Requirements.

PART 2 PRODUCTS

2.01 ELECTRICAL MOTORS [S] [M/O]

A. Provide all motors indicated on drawings necessary for equipment under the Mechanical Work. See electrical drawings for voltage and phase of electrical services.

B. Unless otherwise specified, all motors 1/2 HP or larger: heavy duty, ball bearing, squirrel cage induction type in drip proof or splash proof enclosure, 1.15 service factor, and shall be suitable for the voltage system specified or indicated. Motor speed shall not exceed 1750 rpm unless otherwise indicated or specified. Motors exposed outdoors: either epoxy encapsulated winding or TEFC enclosure.

C. Each motor shall have sufficient starting torque to start the apparatus driven.

D. Provide all motors with junction boxes or terminals boxes and provide adjustable slide rails for all motors with belt drives. All motors shall have a nameplate voltage rating of the specified operating voltage.

E. Provide overload protection on single phase motors.

F. Motors rated 1 HP and larger shall have shaft, bearings, etc. capable of operating with multiple grooved sheaves and two or more belts.

G. Provide with nameplates permanently attached to exterior housing with manufacturer's name and all electrical characteristics specified thereon.

H. Brake horsepower shall not exceed 90% of rated motor horsepower.

I. Motors shall be Lincoln, Westinghouse, General Electric, or approved equivalent.

2.02 MOTOR STARTERS [S] [M/O]

A. See Electrical Drawings for voltage and phase of electrical services.

B. Starters for motors will be provided under Division 26. Provide to Division 26 the data necessary for motor starter heater sizing for all motors.

C. Enclosure: NEMA 1 (unless location of starters dictates otherwise) of sufficient size to contain all accessories specified.

2.03 BELT DRIVES [S] [M/O]

A. V Type. Drives requiring not more than 2 belts: variable pitch type; size for mid-point of operating range. Drives requiring 3 or more belts: nonadjustable constant speed type. Provide belts in matched sets.

B. All belt drives shall have a minimum rating of 1.5 times the motor nameplate horsepower rating.

2.04 BELT AND DRIVE GUARDS [S]

A. Provide all rotating equipment drives and couplings with suitable guards.

B. Drive guards shall be as standard by the equipment manufacturer.

C. Belt guards shall be as standard by the equipment manufacturer.

2.05 DIELECTRIC UNIONS [S]

A. Dielectric unions or flanged unions: constructed so that two pipes being connected are completely insulated (including bolt sleeves and washers) from each other with no metal-to-metal contact; EPCO or approved equivalent.

B. Unions shall have a water-impervious insulation barrier capable of limiting galvanic current to 1 percent of the short-circuit current in a corresponding bimetallic joint and, when dry, shall also be able to withstand a 600-volt breakdown test.

2.06 PRESSURE AND TEMPERATURE TEST PLUGS [S]

A. Brass body and gasketed cap, 1/4-inch mpt fitting to receive either a temperature or pressure probe 1/8-inch O.D. with neoprene (max. 200 degrees F) at 500 psi or nordel (max. 275 degrees F) at 500 psi valve core; "Pete's Plug" or approved equivalent.

2.07 ACCESS DOORS [S]

A. Flush-mounted sheet metal access doors with lock and concealed hinge; stainless steel door; Milcore, or approved equivalent.
   1. Access doors through fire-rated separations shall have like fire rating.

2.08 EQUIPMENT IDENTIFICATION [S]

A. General: Identify all equipment using brass discs or laminated plastics. Install as specified below in readily visible locations not interfering with insulation or equipment operation.
   1. Brass Discs: Provide minimum 0.040-inch in thickness and 2-inches in diameter or square. Top line of each tag shall have 1/4-inch high black filled letters to indicate designation of service. Bottom line shall have 7/16-inch high black filled numbers to indicate equipment or valve number.
   2. Laminated Plastic: Provide white on black with engraved black letters. The equipment identifying name and number lettering size shall be a minimum of 1/4-inch in height, nameplate data 3/16-inch in height and the manufacturer's name and location 1/8-inch in height. Provide laminated plastic tags either 2-1/2-inches by 3-1/2-inches or 3-1/2-inches by 5-inches, as required.

2.09 PRIMERS AND PAINTS [S]

A. All equipment furnished under Division 23, unless otherwise noted, shall be furnished with a factory applied prime coat.

B. Where field priming or touch-up priming is required, primer shall be as follows for ferrous metal surfaces:
   1. Metal Surfaces, Not Galvanized: Latex, corrosion resistant primer suitable for metal surfaces or Epoxy-polyamide, green primer paint, formula 150, type I (QPL).
   2. Metal Surfaces, Galvanized: Galvanized repair compound with high zinc dust content; ZRC Cold Galvanizing Compound, or approved equivalent (no known equivalent).

C. Finish painting of Mechanical equipment furnished under Division 23: See Section 09 90 00 - Paints and Coatings.
   1. Non-metallic surfaces: Latex (Acrylic Emulsion, Exterior Wood and Masonry) Paint.

D. All exterior exposed ductwork shall be provided with salt air corrosion protective coating.

2.10 SEALANTS [S]

A. Non-fireproof Penetrations: Silicone rubber sealant; DowCorning 785/4, or approved equivalent.

B. Fireproof Penetrations: Sealant shall comply with ASTM-E-814 (UL 1479 or UL 94); 3M Brand Fire Barrier Penetration Sealing System with CP-25 caulk, or approved equivalent.

2.11 SEALANTS, WATERSTOP

A. Cold applied, pre-formed, plasticized, waterstop sealing compound consisting of blends of refined hydrocarbon resins and plasticizing compounds; Synko-Flex Waterstop and Primer, or approved equivalent (no known equivalent).

PART 3 EXECUTION

3.01 GENERAL

A. Install products in accordance with product manufacturer's recommendations. After installation of systems and until formal acceptance of systems by the Owner, be responsible for operation and maintenance of systems.

3.02 FORMING, CUTTING, AND PATCHING

A. Provide Forming, recesses, chases, blocking and grounds necessary for Mechanical Work.

B. Provide Cutting (including core drilling and saw cutting), patching and repairing existing structures to accommodate the Mechanical Work. Such work shall include voids, holes, and the like resulting from removal of existing or addition of new Mechanical Work. Restoration shall match existing work.

C. Core drill all holes through existing concrete structures. Before drilling through any structural members, obtain written permissions form the Architect. Before coring, check all proposed hole locations with electronic device to assure clearance of obstruction (i.e., reinforcement bars, piping, conduits, etc.).

D. Saw cut all existing concrete and masonry openings and slabs.

3.03 ELECTRICAL WORK

A. Coordinate with Division 26. See Division 26 Contract Documents for voltage and phase of electrical services.

B. All power wiring and conduits for same serving motors, and where indicated on Division 26 Contract Drawings, to mechanical control panels, separate or equipment mounted, shall be provided under Division 26.

C. The following shall be provided under Division 23:
   1. Pre-wired mechanical control panels.
   2. All automatic or temperature control and interlock wiring, regardless of voltage, and conduits for same necessary for proper operation of equipment under Division 23. This includes interlock wiring between motor starter coils, interlocking relays, contactors, mechanical equipment control panels, temperature control devices, and temperature control panels.
   3. Power wiring and conduits for same not indicated on the Division 26 Contract Drawings to mechanical control panels (separate or equipment mounted).

D. Install all wiring under Division 23 in rigid conduit or electrical metallic tubing indoors and in rigid conduit outdoors. All such wiring shall be concealed.

3.04 BELT DRIVES

A. Select drives for proper speed required for conditions indicated. Conditions indicated are estimated conditions and may vary under actual operating conditions. To adjust speed for actual operating conditions, change drive as often as necessary, at no additional cost.

3.05 DIELECTRIC UNIONS

A. Install dielectric unions in acceptable locations and provide devices for all piping and equipment connections where ferrous and copper metal is joined.

B. Where piping is buried, provide additional protection in the following manner. Thoroughly clean device and piping surfaces 5-feet upstream and downstream of connection point. Prime piping surface to be covered. Wrap connection point and piping with double wrapping of identified pressure-sensitive tape.

3.06 FLASHING

A. Flash and counter flash with metal to make waterproof all penetrations through roofs or exterior walls. Roof flashing shall have a minimum 8-inch skirt. The metal flashing and counterflashing shall be the same material as the equipment to which they are attached. Factory-fabricated flashing may be used for piping. Prior to any interior finish work, test the integrity of all flashing

with water hose.

3.07 WELDING

A. All welding shall comply with provisions of applicable ASME Boiler and Pressure Vessel Code, ANSI Code for Pressure Piping, or other statutes or ordinances having jurisdiction. All welders shall be certified for all welding positions under the qualification tests prescribed by the National Certified Welding Bureau; National Association of Plumbing, Heating, Cooling Contractors; or by other reputable testing laboratories, using procedures covered in the ASME Boiler Construction Code, Section IX, Qualification standards for Welding and Brazing Procedures, Welders, Brazers and Welding and Brazing Operators; and shall hold a current certification of his qualifications obtained within 12 months prior to date of contract. Prior to welding operation, submit for review evidence of such certification.

B. Welded joints, fabrication, assembly and erection shall conform to the requirements of ANSI B 31.1 “POWER PIPING” of the American National Standard Code for Pressure Piping. Perform all welding by the metal arc process, either manual, semi-automatic, or automatic.

3.08 EQUIPMENT INSTALLATION

A. Install equipment where shown, as indicated, and in accordance with the manufacturer's recommendations for the specific service.

B. Provide anchor bolts, setting Drawings and templates for setting equipment.

C. Assure correct alignment of equipment after setting.

D. Where grouting is necessary, use non-shrink type.

E. Before bolting any equipment coat threads with an anti-seize and lubricating compound. Do not use powder driven anchors unless written permission has been obtained from the Architect.

F. Provide all exposed moving or rotating parts of machines with guards in compliance with OSHA requirements. Install all guards in removable sections, if necessary, and with studs and wing nuts for removal of same in maintenance. Make provision for RPM readings on guards covering end of shafts; enclose fan belts at both sides of belts.

3.09 MAINTENANCE AND ACCESS TO EQUIPMENT

A. Where valves, dampers, control devices, coils, or other like devices (i.e, plumbing P-trap, water hammer arresters, gauges, thermometers) requiring maintenance, checking or readings are inaccessibly concealed in walls or ceilings, and where indicated, provide square or rectangular access doors. Where space permits, doors for ceiling installation shall not be less than 18-inches by 18-inches. Prior to installation, verify all access locations.

B. Where there are lubrications within equipment, extend such to exterior of equipment.

3.10 REVIEW OF WORK

A. Do not allow or cause any mechanical work to be covered, concealed or enclosed until such work has been tested and reviewed. Should such work be covered, concealed or enclosed before being tested and reviewed, such shall be uncovered and thereafter restored at no additional cost.

3.11 EQUIPMENT IDENTIFICATION

A. Manufacturer's Nameplates: Provide all equipment with manufacturer's nameplates secured to the respective equipment and indicating, but not being limited to, the manufacturer's name, model, size, serial number, capacity and electrical characteristics. Clean, polish and protect all such nameplates with a coat of clear protective finish.

B. Equipment Tags: Identify all equipment (such as machinery, motor starters, control panels, pushbuttons and other like devices) exposed to view with identification tags. Secure tags to equipment surface. Where size or surface curvature does not permit such, secure with No. 16 brass jack chain.

C. Valve Tags:
   1. Identify each valve with a tag with distinguishing number. Secure tags to valves with No.

16 brass jack chain.

2. Provide valve chart and schedule in aluminum frame with clear heavy plastic shield, and mount same at location directed. Indicate on the Record Drawings the location of valves with numbers corresponding to the valve schedule. Valve chart and schedule shall include, but not be limited to, tag number, location, usage/function, valve manufacturer's name and valve model number. Numbers for new valves shall continue from existing valve numbering system.

D. Piping Identification:
   1. Identify each pipe, whether concealed or exposed, as to the content and character of material it carries (piping buried excepted).
   2. Location of Markers: Not to exceed 20-feet on straight run of pipe (including risers and drops) and so located as to be conspicuously visible from any reasonable vantage point; adjacent each valve; adjacent each tee; at each side of penetration of the structure or enclosure; at each obstruction.

3.12 PRIMING, PAINTING, AND COATING

A. Properly clean surfaces to be touched up of rust, dirt, scale, wax and other deleterious materials. Prime surfaces. Touch up with like material all damaged galvanized or factory-primed metal surfaces. Do not prime over manufacturer’s nameplates on equipment.

B. Coat all bare steel parts of piping accessories below grade with coats of coal-tar based bituminous mastic.

C. Except for factory priming, factory finish painting and otherwise specified under this Article, all field priming (except touch up) and finish painting shall be under other Divisions.

D. Paint flat black interior surfaces of all concealed unlined galvanized sheet metal ductwork behind air outlets and inlets.

E. All exposed insulation surfaces in finished areas shall be ready for finish painting; glue size if necessary.

3.13 CLEANING AND DE-GREASING OF PIPING

A. General:
   1. Clean all piping systems to remove all dirt, grease, scale, foreign substances, etc., as specified in each separate section of the Specifications.
   2. Prior to commencing work, submit for approval a complete procedure for cleaning and flushing for each separate piping system. Include flushing source, system inlet flushing pressure and size of inlet and outlet flushing connections with their locations for each system. Install flushing connections at all low points of each piping system to ensure complete flushing of the system.
   3. Use air and/or gas blown through the lines of gas and air systems, unless specified otherwise, to prove the piping clean. All other piping systems shall be thoroughly flushed out with water unless specified otherwise.

3.14 TESTS AND ADJUSTMENTS

A. At the completion of the Work, completely adjust all valves and equipment for their proper use and rating.

END OF SECTION

SECTION 23 0529

HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Fastener systems.
   2. Equipment supports.

1.02 PERFORMANCE REQUIREMENTS

A. Structural Performance: Hangers and supports for HVAC piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
   1. Design supports for multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.
   2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
   3. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

1.03 SUBMITTALS

A. Product Data: For each type of product indicated.

B. 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:
   1. Trapeze pipe hangers.
   2. Equipment supports.

C. Welding certificates.

1.04 QUALITY ASSURANCE

A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 PRODUCTS

2.1 METAL FRAMING SYSTEMS

A. MFMA Manufacturer Metal Framing Systems:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      a. Allied Tube & Conduit.
      b. Cooper B-Line, Inc.
      c. Flex-Strut Inc.
      d. GS Metals Corp.
      e. Thomas & Betts Corporation.
      f. Unistrut Corporation; Tyco International, Ltd.
      g. Wesanco, Inc.
   2. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes.
   3. Standard: MFMA-4.
   4. Channels: Continuous slotted steel channel with inturned lips.
   5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.

6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

B. Non-MFMA Manufacturer Metal Framing Systems:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      a. Anvil International; a subsidiary of Mueller Water Products Inc.
      b. Empire Industries, Inc.
      c. ERICO International Corporation.
      d. Haydon Corporation; H-Strut Division.
      e. NIBCO INC.
      f. PHD Manufacturing, Inc.
      g. PHS Industries, Inc.
   2. Description: Shop- or field-fabricated pipe-support assembly made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
   3. Standard: Comply with MFMA-4.
   4. Channels: Continuous slotted steel channel with inturned lips.
   5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
   6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

2.02 FASTENER SYSTEMS

A. 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.

B. Mechanical-Expansion Anchors: Insert-wedge-type, stainless- 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.

2.03 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.04 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
   1. Properties: Nonstaining, noncorrosive, and nongaseous.
   2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

PART 3 EXECUTION

3.01 HANGER AND SUPPORT INSTALLATION

A. Fastener System Installation:
   1. 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.
   2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

B. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

C. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

D. 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.

E. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, 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.

F. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

3.02 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make bearing surface smooth.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.03 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. 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:
   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. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.04 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches (40 mm).

C. 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.
   1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils (0.05 mm).

D. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 painting Sections.

E. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.05 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use carbon-steel pipe hangers and supports and metal trapeze pipe hangers] and attachments for general service applications.

F. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION

SECTION 23 0548

VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SUMMARY

A. This Section includes the following:
   1. Restraining braces and cables.

1.02 TECHNICAL REQUIREMENTS

A. Structural steel bases shall be cleaned of welding slag and painted with a coat of red primer-finish.

B. All mounts shall be selected to perform their function without undue stress or overloading. All isolators that are to be used with structural steel bases, as shown or specified shall be equipped with height saving brackets. When applicable these isolators shall have a method for leveling and the spring isolators shall sit in a neoprene cup of have two layers of ribbed neoprene pad with a steel separation plate bonded to the underside of the base.

C. When neoprene connectors are not used, the first three support locations from isolated equipment require resilient hangers or mounts with deflections equal to the equipment isolation system. All other piping requires resilient hangers and mounts with 0.35-inch minimum static deflections or as scheduled.

D. All equipment shall be restrained from displacements exceeding 1/4-inch due to thrust forces. Thrust restraint assemblies shall consist of a spring element in series with a neoprene cup and shall be factory preset to allow for a maximum of 1/4-inch movement at start and stop. The assembly shall be furnished with angle brackets for attachment to both the equipment and ductwork or the equipment and the structure. Brackets shall be attached at the centerline of thrust, symmetrically on both sides of the unit.

E. Typical applicable codes and standards
   1. Seismic design shall be in accordance with 2016 California Building Code, Chapter 16A.
   2. Attachments of floor – or roof – mounted equipment weighing less than 400 lbs need not be designed to resist seismic loads. Attachments for vibration – isolated and suspended equipment weighing less than 20 lbs. needs not be designed to resist seismic loads. However, attachment of such equipment is still required.
   3. Seismic sway bracing of suspended piping and ductwork shall be installed in accordance with the 2011 Mason Industries Seismic Restraint Guidelines for Suspended Systems.

1.03 SUBMITTALS

A. Product Data: For each product indicated.

B. Welding certificates.

C. Qualification Data: For professional engineer.

D. Field quality-control test reports.

1.04 QUALITY ASSURANCE

A. Comply with seismic-restraint requirements in the CBC unless requirements in this Section are more stringent.

B. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

C. 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 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.

PART 2 PRODUCTS

2.01 SEISMIC-RESTRAINT DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. California Dynamics Corporation.
   2. Cooper B-Line, Inc., a division of Cooper Industries.
   3. Kinetics Noise Control.
   4. Mason Industries.
   5. TOLCO Incorporated; a brand of NIBCO INC.

B. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an agency acceptable to authorities having jurisdiction.
   1. 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.

C. 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.

D. Restraint Cables: ASTM A 603 galvanized-steel 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.

E. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod.

F. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

G. 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.

PART 3 EXECUTION

3.01 APPLICATIONS

A. 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.

B. 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.

3.02 VIBRATION-CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

A. Comply with requirements in Division 07 Section "Roof Accessories" for installation of roof curbs, equipment supports, and roof penetrations.

B. Equipment Restraints:
   1. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch (3.2 mm).
   2. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.

C. Install cables so they do not bend across edges of adjacent equipment or building structure.

D. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.

E. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

F. 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.

G. Drilled-in Anchors:
   1. 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.
   2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
   3. 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.
   4. Set anchors to manufacturer's recommended torque, using a torque wrench.
   5. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.03 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:
   1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
   2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
   3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
   4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
   5. Test to 90 percent of rated proof load of device.
   6. Measure isolator restraint clearance.
   7. Measure isolator deflection.
   8. If a device fails test, modify all installations of same type and retest until satisfactory results are achieved.

C. Remove and replace malfunctioning units and retest as specified above.

D. Prepare test and inspection reports.

3.04 ADJUSTING

A. Adjust isolators after piping system is at operating weight.

B. 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.

C. Adjust active height of spring isolators.

D. Adjust restraints to permit free movement of equipment within normal mode of operation.

END OF SECTION

SECTION 23 0553
IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Equipment labels.
   2. Duct labels.

1.02 SUBMITTAL

A. Product Data: For each type of product indicated.

PART 2 PRODUCTS

2.01 EQUIPMENT LABELS

A. Plastic Labels for Equipment:
   1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch (3.2mm) thick, and having predrilled holes for attachment hardware.
   2. Letter Color: White.
   3. Background Color: Black.
   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-quarters the size of principal lettering.
   7. Fasteners: Stainless-steel rivets.
   8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. 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.

C. 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.

2.02 DUCT LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch (3.2 mm) thick, and having predrilled holes for attachment hardware.

B. Letter Color: White.

C. Background Color: Black.

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.

H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

I. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings, duct size, and an arrow indicating flow direction.
   1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions or as separate unit on each duct label to indicate flow direction.
   2. Lettering Size: At least 1-1/2 inches (38 mm) high.

2.03 STENCILS

A. Lettering Size: Minimum letter height of 1-1/4 inches (32 mm) for viewing distances up to 15 feet (4-1/2 m) and proportionately larger lettering for greater viewing distances.

B. Stencil Material: Fiberboard or metal.

C. Stencil Paint: Exterior, gloss, alkyd enamel. Paint may be in pressurized spray-can form.

D. Identification Paint: Exterior alkyd enamel. Paint may be in pressurized spray-can form.

PART 3 EXECUTION

3.01 PREPARATION

A. 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.

3.02 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.03 DUCT LABEL INSTALLATION

A. Install self-adhesive duct labels with permanent adhesive on air ducts in the following color codes:
   1. Blue: For supply ducts.

B. Locate labels near points where ducts enter into concealed spaces and at maximum intervals of 50 feet (15 m) in each space where ducts are exposed or concealed by removable ceiling system.

C. Stenciled duct label option: Stenciled labels showing service and flow direction may be provided instead of plastic-laminated duct labels, at installer’s option.

END OF SECTION

SECTION 23 0593
TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Balancing Air Systems:
      a. Constant-volume air systems.

1.02 DEFINITIONS

A. AABC: Associated Air Balance Council.

B. NEBB: National Environmental Balancing Bureau.

C. TAB: Testing, adjusting, and balancing.

D. TAB Specialist: An entity engaged to perform TAB Work.

1.03 SUBMITTALS

A. Strategies and Procedures Plan: Within 30 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.

B. Certified TAB reports.

C. Sample report forms.

D. Instrument Calibration Reports, including:
   1. Instrument type and make.
   2. Serial number
   3. Application
   4. Dates of use
   5. Dates of calibration

1.04 QUALITY ASSURANCE

A. TAB Contractor Qualifications: Engage a TAB entity certified by AABC or NEBB.
   1. TAB Field Supervisor: Employee of the TAB contractor and certified by AABC or NEBB.
   2. TAB Technician: Employee of the TAB contractor and who is certified AABC or NEBB as a TAB technician.

B. Certify TAB field data reports and perform the following:
   1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
   2. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.

C. TAB Report Forms: Use standard TAB contractor's forms.

D. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation."

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.

B. Examine systems for installed balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are accessible.

C. Examine the approved submittals for HVAC systems and equipment.

D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.

E. Examine equipment performance data including fan curves.
   1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
   2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.

F. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.

G. Examine test reports specified in individual system and equipment Sections.

H. Examine HVAC equipment and filters and verify that bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.

I. Examine control dampers and verify that they are accessible and their controls are connected and functioning.

J. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

K. Examine operating safety interlocks and controls on HVAC equipment.

L. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.02 PREPARATION

A. Prepare a TAB plan that includes strategies and step-by-step procedures.

B. Complete system-readiness checks and prepare reports. Verify the following:
   1. Permanent electrical-power wiring is complete.
   2. Automatic temperature-control systems are operational.
   3. Equipment and duct access doors are securely closed.
   4. Balance, smoke, and fire dampers are open.
   5. Isolating and balancing valves are open and control valves are operational.
   6. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
   7. Windows and doors can be closed so indicated conditions for system operations can be met.

3.03 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Total System Balance" or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and in this Section.
   1. Comply with requirements in ASHRAE 62.1-2004, Section 7.2.2, "Air Balancing."

B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.
   1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
   2. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Division 23 Section.

C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.

D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.04 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.

B. Prepare schematic diagrams of systems' "as-built" duct layouts.

C. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.

D. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.

E. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

F. Verify that motor starters are equipped with properly sized thermal protection.

G. Check dampers for proper position to achieve desired airflow path.

H. Check for airflow blockages.

I. Check condensate drains for proper connections and functioning.

J. Check for proper sealing of air-handling-unit components.

K. Verify that air duct system is sealed as specified in Division 23 Section "Metal Ducts."

3.05 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
   1. Measure total airflow.
      a. Where sufficient space in ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow.
   2. Measure fan static pressures as follows to determine actual static pressure:
      a. Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.
      b. Measure static pressure directly at the fan outlet or through the flexible connection.
      c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from the flexible connection, and downstream from duct restrictions.
      d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.
   3. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.
      a. Report the cleanliness status of filters and the time static pressures are measured.
   4. Measure static pressures entering and leaving other devices, such as sound traps, heat-recovery equipment, and air washers, under final balanced conditions.
   5. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
   6. Obtain approval from Commissioning Authority for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in Division 23 Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
   7. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.

B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.

1. Measure airflow of submain and branch ducts.
    a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.
2. Measure static pressure at a point downstream from the balancing damper, and adjust volume dampers until the proper static pressure is achieved.
3. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.

C. Measure air outlets and inlets without making adjustments.
1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.

D. Adjust air outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using branch volume dampers rather than extractors and the dampers at air terminals.
1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.06 PROCEDURES FOR MOTORS

A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:
1. Manufacturer's name, model number, and serial number.
2. Motor horsepower rating.
3. Motor rpm.
4. Efficiency rating.
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter thermal-protection-element rating.

3.07 PROCEDURES FOR HEAT-TRANSFER COILS

A. Measure, adjust, and record the following data for each refrigerant coil:
1. Dry-bulb temperature of entering and leaving air.
2. Wet-bulb temperature of entering and leaving air.
3. Airflow.
4. Air pressure drop.
5. Refrigerant suction pressure and temperature.

3.08 TOLERANCES

A. Set HVAC system's air flow rates and water flow rates within the following tolerances:
1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent.
2. Air Outlets and Inlets: Plus or minus 10 percent.

3.09 REPORTING

A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.

B. Status Reports: Prepare weekly progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.10 FINAL REPORT

A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
   1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
   2. Include a list of instruments used for procedures, along with proof of calibration.

B. Final Report Contents: In addition to certified field-report data, include the following:
   1. Fan curves.
   2. Manufacturers' test data.
   3. Field test reports prepared by system and equipment installers.
   4. Other information relative to equipment performance; do not include Shop Drawings and product data.

C. General Report Data: In addition to form titles and entries, include the following data:
   1. Title page.
   2. Name and address of the TAB contractor.
   3. Project name.
   4. Project location.
   5. Architect's name and address.
   6. Engineer's name and address.
   7. Contractor's name and address.
   8. Report date.
   9. Signature of TAB supervisor who certifies the report.
   10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
   11. Summary of contents including the following:
      a. Indicated versus final performance.
      b. Notable characteristics of systems.
      c. Description of system operation sequence if it varies from the Contract Documents.
   12. Nomenclature sheets for each item of equipment.
   13. Data for terminal units, including manufacturer's name, type, size, and fittings.
   14. Notes to explain why certain final data in the body of reports vary from indicated values.
   15. Test conditions for fans performance forms including the following:
      a. Settings for outdoor-, return-, and exhaust-air dampers.
      b. Conditions of filters.
      c. Cooling coil, wet- and dry-bulb conditions.
      d. Fan drive settings including settings and percentage of maximum pitch diameter.
      e. Other system operating conditions that affect performance.

D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:
   1. Quantities of outdoor, supply, return, and exhaust airflows.
   2. Duct, outlet, and inlet sizes.
   3. Balancing stations.
   4. Position of balancing devices.

E. Air-Handling-Unit Test Reports: For air-handling units with coils, include the following:
   1. Unit Data:
      a. Unit identification.
      b. Location.
      c. Make and type.
      d. Model number and unit size.
      e. Manufacturer's serial number.
      f. Unit arrangement and class.
      g. Discharge arrangement.

h. Sheave make, size in inches (mm), and bore.
i. Center-to-center dimensions of sheave, and amount of adjustments in inches (mm).
j. Number, make, and size of belts.
k. Number, type, and size of filters.

2. Motor Data:
   a. Motor make, and frame type and size.
   b. Horsepower and rpm.
   c. Volts, phase, and hertz.
   d. Full-load amperage and service factor.
   e. Sheave make, size in inches (mm), and bore.
   f. Center-to-center dimensions of sheave, and amount of adjustments in inches (mm).
3. Test Data (Indicated and Actual Values):
   a. Total air flow rate in cfm (L/s).
   b. Total system static pressure in inches wg (Pa).
   c. Fan rpm.
   d. Discharge static pressure in inches wg (Pa).
   e. Filter static-pressure differential in inches wg (Pa).
   f. Cooling-coil static-pressure differential in inches wg (Pa).
   g. Outdoor airflow in cfm (L/s).
   h. Return airflow in cfm (L/s).
   i. Outdoor-air damper position.
   j. Return-air damper position.

F. Apparatus-Coil Test Reports:

4. Coil Data:
   a. System identification.
   b. Location.
   c. Coil type.
   d. Number of rows.
   e. Fin spacing in fins per inch (mm) o.c.
   f. Make and model number.
   g. Face area in sq. ft. (sq. m).
   h. Tube size in NPS (DN).
   i. Tube and fin materials.
   j. Circuiting arrangement.
5. Test Data (Indicated and Actual Values):
   a. Air flow rate in cfm (L/s).
   b. Average face velocity in fpm (m/s).
   c. Air pressure drop in inches wg (Pa).
   d. Outdoor-air, wet- and dry-bulb temperatures in deg F (deg C).
   e. Return-air, wet- and dry-bulb temperatures in deg F (deg C).
   f. Entering-air, wet- and dry-bulb temperatures in deg F (deg C).
   g. Leaving-air, wet- and dry-bulb temperatures in deg F (deg C).
   h. Refrigerant expansion valve and refrigerant types.
   i. Refrigerant suction pressure in psig (kPa).
   j. Refrigerant suction temperature in deg F (deg C).

G. Fan Test Reports: For supply, return, and exhaust fans, include the following:
1. Fan Data:
   a. System identification.
   b. Location.
   c. Make and type.
   d. Model number and size.
   e. Manufacturer's serial number.
   f. Arrangement and class.

g. Sheave make, size in inches (mm), and bore.
h. Center-to-center dimensions of sheave, and amount of adjustments in inches (mm).

2. Motor Data:
a. Motor make, and frame type and size.
b. Horsepower and rpm.
c. Volts, phase, and hertz.
d. Full-load amperage and service factor.
e. Sheave make, size in inches (mm), and bore.
f. Center-to-center dimensions of sheave, and amount of adjustments in inches (mm).
g. Number, make, and size of belts.

3. Test Data (Indicated and Actual Values):
a. Total airflow rate in cfm (L/s).
b. Total system static pressure in inches wg (Pa).
c. Fan rpm.
d. Discharge static pressure in inches wg (Pa).
e. Suction static pressure in inches wg (Pa).

H. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:

1. Report Data:
a. System and air-handling-unit number.
b. Location and zone.
c. Traverse air temperature in deg F (deg C).
d. Duct static pressure in inches wg (Pa).
e. Duct size in inches (mm).
f. Duct area in sq. ft. (sq. m).
g. Indicated air flow rate in cfm (L/s).
h. Indicated velocity in fpm (m/s).
i. Actual air flow rate in cfm (L/s).
j. Actual average velocity in fpm (m/s).
k. Barometric pressure in psig (Pa).

I. Instrument Calibration Reports:

1. Report Data:
a. Instrument type and make.
b. Serial number.
c. Application.
d. Dates of use.
e. Dates of calibration.

3.11 INSPECTIONS

A. Initial Inspection:

1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the final report.
2. Check the following for each system:
a. Measure airflow of at least 10percent of air outlets.
b. Measure water flow of at least 5 percent of terminals.
c. Measure room temperature at each thermostat/temperature sensor. Compare the reading to the set point.
d. Verify that balancing devices are marked with final balance position.
e. Note deviations from the Contract Documents in the final report.

B. Final Inspection:

1. After initial inspection is complete and documentation by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by Architect.
2. The TAB contractor's test and balance engineer shall conduct the inspection in the presence of Architect.
3. Architect shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.
4. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
5. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.

C. TAB Work will be considered defective if it does not pass final inspections. If TAB Work fails, proceed as follows:
1. Recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.
2. If the second final inspection also fails, Owner may contract the services of another TAB contractor to complete TAB Work according to the Contract Documents and deduct the cost of the services from the original TAB contractor's final payment.

D. Prepare test and inspection reports.

3.12 ADDITIONAL TESTS

A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

END OF SECTION

SECTION 23 0713
DUCT INSULATION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section includes insulating the following duct services:
   1. Indoor, concealed supply and outdoor air.
   2. Indoor, concealed return located in unconditioned space.

1.03 SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied if any).

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
   1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
   2. Detail insulation application at elbows, fittings, dampers, specialties and flanges for each type of insulation.
   3. Detail application of field-applied jackets.
   4. Detail application at linkages of control devices.

C. Qualification Data: For qualified Installer.

D. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

E. Field quality-control reports.

1.04 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing 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 agency.
   1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
   2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.06 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Division 23 Section "Metal Ducts."

B. Coordinate clearance requirements with duct Installer for duct insulation application. Before preparing ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

C. Coordinate installation and testing of heat tracing.

1.07 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 PRODUCTS

2.01 INSULATION MATERIALS

A. Comply with requirements in "Duct Insulation Schedule, General," "Indoor Duct and Plenum Insulation Schedule," and "Aboveground, Outdoor Duct and Plenum Insulation Schedule" articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. 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.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type II for sheet materials.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Armacell LLC; AP Armaflex.
      b. K-Flex USA; Insul-Sheet, K-Flex Gray Duct Liner, and K-FLEX LS.
      c. Degussa; Solcoustic.

G. 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 III with factory-applied FSK jacket.Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. CertainTeed Corp.; SoftTouch Duct Wrap.
      b. Johns Manville; Microlite.
      c. Knauf Insulation; Friendly Feel Duct Wrap.

2.02 ADHESIVES

A. 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.

B. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Aeroflex USA, Inc.; Aeroseal.
      b. Armacell LLC; Armaflex 520 Adhesive.
      c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-75.
      d. K-Flex USA; R-373 Contact Adhesive.

C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.
      b. Eagle Bridges - Marathon Industries; 225.
      c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.
      d. Mon-Eco Industries, Inc.; 22-25.

D. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.
      b. Eagle Bridges - Marathon Industries; 225.
      c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-50.
      d. Mon-Eco Industries, Inc.; 22-25.

2.03 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
   1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below ambient services.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-80/30-90.
      b. Vimasco Corporation; 749.
   2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm (0.009 metric perm) at 43-mil (1.09-mm) dry film thickness.
   3. Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).
   4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
   5. Color: White.

C. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below ambient services.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-30.
      b. Eagle Bridges - Marathon Industries; 501.
      c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-35.
      d. Mon-Eco Industries, Inc.; 55-10.
   2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm (0.03 metric perm) at 35-mil (0.9-mm) dry film thickness.
   3. Service Temperature Range: 0 to 180 deg F (Minus 18 to plus 82 deg C).
   4. Solids Content: ASTM D 1644, 44 percent by volume and 62 percent by weight.
   5. Color: White.

D. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below ambient services.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Encacel.
      b. Eagle Bridges - Marathon Industries; 570.
      c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 60-95/60-96.
   2. Water-Vapor Permenance: ASTM F 1249, 0.05 perm (0.0033 metric perm) at 30-mil (0.8-mm) dry film thickness.
   3. Service Temperature Range: Minus 50 to plus 220 deg F (Minus 46 to plus 104 deg C).
   4. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
   5. Color: White.

2.04 SEALANTS

A. FSK and Metal Jacket Flashing Sealants:
   1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
b. Eagle Bridges - Marathon Industries; 405.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 95-44.
d. Mon-Eco Industries, Inc.; 44-05.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
5. Color: Aluminum.

B. ASJ Flashing Sealants, and Vinyl and PVC Jacket Flashing Sealants:
1. Products: Subject to compliance with requirements, provide one of the following:
a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
5. Color: White.

2.05 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.06 FIELD-APPLIED FABRIC-REINFORCING MESH

A. Woven Glass-Fiber Fabric: Approximately 6 oz./sq. yd. (203 g/sq. m) with a thread count of 5 strands by 5 strands/sq. in. (2 strands by 2 strands/sq. mm) for covering ducts.
1. Products: Subject to compliance with requirements, provide one of the following:
a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Chil-Glas No. 5.

B. Woven Polyester Fabric: Approximately 1 oz./sq. yd. (34 g/sq. m) with a thread count of 10 strands by 10 strands/sq. in. (4 strands by 4 strands/sq. mm), in a Leno weave, for ducts.
1. Products: Subject to compliance with requirements, provide one of the following:
a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Mast-A-Fab.
b. Vimasco Corporation; Elastafab 894.

2.07 FIELD-APPLIED CLOTHS

A. 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).
1. Products: Subject to compliance with requirements, provide one of the following:
a. Alpha Associates, Inc.; Alpha-Maritex 84215 and 84217/9485RW, Luben 59.

2.08 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.

2.09 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
1. Products: Subject to compliance with requirements, provide one of the following:
a. ABI, Ideal Tape Division; 428 AWF ASJ.

b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
c. Compac Corporation; 104 and 105.
d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
2. Width: 3 inches (75 mm).
3. Thickness: 11.5 mils (0.29 mm).
4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
1. Products: Subject to compliance with requirements, provide one of the following:
a. ABI, Ideal Tape Division; 491 AWF FSK.
b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
c. Compac Corporation; 110 and 111.
d. Venture Tape; 1525 CW NT, 1528 CW, and 1528 CW/SQ.
2. Width: 3 inches (75 mm).
3. Thickness: 6.5 mils (0.16 mm).
4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

C. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
1. Products: Subject to compliance with requirements, provide products by one of the following:
a. ABI, Ideal Tape Division; 488 AWF.
b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
c. Compac Corporation; 120.
d. Venture Tape; 3520 CW.
2. Width: 2 inches (50 mm).
3. Thickness: 3.7 mils (0.093 mm).
4. Adhesion: 100 ounces force/inch (1.1 N/mm) in width.
5. Elongation: 5 percent.
6. Tensile Strength: 34 lbf/inch (6.2 N/mm) in width.

2.10 SECUREMENTS

A. Bands:
1. Products: Subject to compliance with requirements, provide one of the following:
a. ITW Insulation Systems; Gerrard Strapping and Seals.
b. RPR Products, Inc.; Insul-Mate Strapping, Seals, and Springs.
2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304; 0.015 inch (0.38 mm) thick, 1/2 inch (13 mm) wide with wing seal.
3. 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) wide with wing seal.
4. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

B. Insulation Pins and Hangers:
1. Products: Subject to compliance with requirements, provide one of the following:
2. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated.
a. AGM Industries, Inc.; CWP-1.
b. GEMCO; CD.

c. Midwest Fasteners, Inc.; CD.

3. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch- (3.5-mm-) diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch (38-mm) galvanized carbon-steel washer.
4. 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:
   a. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch (0.76 mm) thick by 2 inches (50 mm) square.
   b. Spindle: Copper- or zinc-coated, low-carbon steel, fully annealed, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated.
   c. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
5. 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:
   a. Baseplate: Perforated, nylon sheet, 0.030 inch (0.76 mm) thick by 1-1/2 inches (38 mm) in diameter.
   b. 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).
   c. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
6. 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:
   a. Baseplate: Galvanized carbon-steel sheet, 0.030 inch (0.76 mm) thick by 2 inches (50 mm) square.
   b. Spindle: Copper- or zinc-coated, low-carbon steel, fully annealed, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated.
   c. Adhesive-backed base with a peel-off protective cover.
7. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick, galvanized-steel 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.
   a. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
8. 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.

C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- (19-mm-) wide, stainless steel or Monel.

D. Wire: 0.080-inch (2.0-mm) nickel-copper alloy.
   1. Manufacturers: Subject to compliance with requirements, provide the following:
      a. C & F Wire.

2.11 CORNER ANGLES

A. 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.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
   1. Verify that systems to be insulated have been tested and are free of defects.
   2. Verify that surfaces to be insulated are clean and dry.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.03 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.

B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct system as specified in insulation system schedules.

C. 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.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Keep insulation materials dry during application and finishing.

G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

H. Install insulation with least number of joints practical.

I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
   1. Install insulation continuously through hangers and around anchor attachments.
   2. 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.
   3. 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.

J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

K. Install insulation with factory-applied jackets as follows:
   1. Draw jacket tight and smooth.
   2. 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.
   3. Overlap jacket longitudinal seams at least 1-1/2 inches (38 mm). Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches (50 mm) o.c.
      a. For below ambient services, apply vapor-barrier mastic over staples.
   4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
   5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.

L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

N. 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.

3.04 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
   1. Seal penetrations with flashing sealant.
   2. 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.
   3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches (50 mm) below top of roof flashing.
   4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

C. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches (50 mm).
   1. Comply with requirements in Division 07 Section "Penetration Firestopping" for firestopping and fire-resistive joint sealers.

3.05 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. 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.

3.06 INSTALLATION OF MINERAL-FIBER INSULATION

A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
   1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
   2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
   3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
      a. On duct sides with dimensions 18 inches (450 mm) and smaller, place pins along longitudinal centerline of duct. Space 3 inches (75 mm) maximum from insulation end joints, and 16 inches (400 mm) o.c.
      b. On duct sides with dimensions larger than 18 inches (450 mm), place pins 16 inches (400 mm) o.c. each way, and 3 inches (75 mm) maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
      c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
      d. Do not overcompress insulation during installation.
      e. Impale insulation over pins and attach speed washers.
      f. 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.
   4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with

insulation by removing 2 inches (50 mm) from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch (13-mm) outward-clinching staples, 1 inch (25 mm) o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.

b. Install vapor stops for ductwork and plenums operating below 50 deg F (10 deg C) at 18-foot (5.5-m) intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches (75 mm).

5. Overlap unfaced blankets a minimum of 2 inches (50 mm) on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches (450 mm) o.c.

6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.

7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- (150-mm-) wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches (150 mm) o.c.

3.07 FINISHES

A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 09 painting Sections.

1. 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.

a. Finish Coat Material: Interior, flat, latex-emulsion size.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless-steel jackets.

3.08 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Inspect ductwork, randomly selected by Architect, 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 duct system defined in the "Duct Insulation Schedule, General" Article.

C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.09 DUCT INSULATION SCHEDULE, GENERAL

A. Plenums and Ducts Requiring Insulation:

1. Indoor, concealed supply and outdoor air.
2. Indoor, concealed return located in unconditioned space.

B. Items Not Insulated:

1. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
2. Factory-insulated flexible ducts.
3. Factory-insulated plenums and casings.
4. Flexible connectors.

5. Vibration-control devices.
6. Factory-insulated access panels and doors.

3.10 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. All supply and return and outside air duct insulation shall be mineral fiber blanket or board, 0.75 lb/cu. ft nominal density of thickness to achieve R-8.0.

B. All exhaust ducts serving Type 1 hoods shall be insulated with two layers of 1-1/2 inch thick fire rated duct wrap.

3.11 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

END OF SECTION

SECTION 23 1123
FACILITY NATURAL-GAS PIPING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:
   1. Pipes, tubes, and fittings.
   2. Piping specialties.
   3. Piping and tubing joining materials.
   4. Valves.
   5. Pressure regulators.

1.03 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

1.04 PERFORMANCE REQUIREMENTS

A. Minimum Operating-Pressure Ratings:
   1. Piping and Valves: 100 psig (690 kPa) minimum unless otherwise indicated.
   2. Service Regulators: 65 psig (450 kPa) minimum unless otherwise indicated.

B. Natural-Gas System Pressure within Buildings: Two pressure ranges. Primary pressure is more than 0.5 psig (3.45 kPa) but not more than 2 psig (13.8 kPa), and is reduced to secondary pressure of 0.5 psig (3.45 kPa) or less..

C. Delegated Design: Design restraints and anchors for natural-gas piping and equipment, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

1.05 SUBMITTALS

A. Product Data: For each type of the following:
   1. Piping specialties.
   2. Corrugated, stainless-steel tubing with associated components.
   3. Valves. Include pressure rating, capacity, settings, and electrical connection data of selected models.
   4. Pressure regulators. Indicate pressure ratings and capacities.
   5. Dielectric fittings.

B. Shop Drawings: For facility natural-gas piping layout. Include plans, piping layout and elevations, sections, and details for fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, expansion joints and loops, and attachments of the same to building structure. Detail location of anchors, alignment guides, and expansion joints and loops.
   1. Shop Drawing Scale: 1/4 inch per foot (1:50).
   2. Retain service meter assembly option in subparagraph below if Contractor installs service meter.
   3. Detail mounting, supports, and valve arrangements for pressure regulator assembly.

C. Delegated-Design Submittal: For natural-gas piping and equipment indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
   1. Detail fabrication and assembly of seismic restraints.
   2. Design Calculations: Calculate requirements for selecting seismic restraints.

D. Coordination Drawings: Plans and details, drawn to scale, on which natural-gas piping is shown and coordinated with other installations, using input from installers of the items involved.

E. Site Survey: Plans, drawn to scale, on which natural-gas piping is shown and coordinated with other services and utilities.

F. Qualification Data: For qualified professional engineer.

G. Welding certificates.

H. Field quality-control reports.

I. Operation and Maintenance Data: For motorized gas valves and pressure regulators to include in emergency, operation, and maintenance manuals.

1.06 QUALITY ASSURANCE

A. Steel Support Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

C. 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.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Handling Flammable Liquids: Remove and dispose of liquids from existing natural-gas piping according to requirements of authorities having jurisdiction.

B. 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.

C. Store and handle pipes and tubes having factory-applied protective coatings to avoid damaging coating, and protect from direct sunlight.

D. Protect stored PE pipes and valves from direct sunlight.

1.08 PROJECT CONDITIONS

A. Perform site survey, research public utility records, and verify existing utility locations. Contact utility-locating service for area where Project is located.

B. Interruption of Existing Natural-Gas Service: Do not interrupt natural-gas service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide purging and startup of natural-gas supply according to requirements indicated:
   1. Notify the Owner no fewer than two days in advance of proposed interruption of natural-gas service.
   2. Do not proceed with interruption of natural-gas service without Owner’s written permission.

1.09 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

B. Coordinate requirements for access panels and doors for valves installed concealed behind finished surfaces. Comply with requirements in Division 08 Section "Access Doors and Frames."

PART 2 PRODUCTS

2.01 PIPES, TUBES, AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.
   1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
   2. Wrought-Steel Welding Fittings: ASTM A 234/A 234M for butt welding and socket welding.
   3. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.
   4. Forged-Steel Flanges and Flanged Fittings: ASME B16.5, minimum Class 150, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
      a. Material Group: 1.1.
      b. End Connections: Threaded or butt welding to match pipe.
      c. Lapped Face: Not permitted underground.
      d. Gasket Materials: ASME B16.20, metallic, flat, asbestos free, aluminum o-rings, and spiral-wound metal gaskets.
      e. Bolts and Nuts: ASME B18.2.1, carbon steel aboveground and stainless steel underground.
   5. Protective Coating for Underground Piping: Factory-applied, three-layer coating of epoxy, adhesive, and PE.
      a. Joint Cover Kits: Epoxy paint, adhesive, and heat-shrink PE sleeves.
   6. Mechanical Couplings:
      a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
         1) Dresser Piping Specialties; Division of Dresser, Inc.
         2) Smith-Blair, Inc.
      b. Steel flanges and tube with epoxy finish.
      c. Buna-nitrile seals.
      d. Steel bolts, washers, and nuts.
      e. Coupling shall be capable of joining PE pipe to PE pipe, steel pipe to PE pipe, or steel pipe to steel pipe.
      f. Steel body couplings installed underground on plastic pipe shall be factory equipped with anode.

B. PE Pipe: ASTM D 2513, SDR 11.
   1. PE Fittings: ASTM D 2683, socket-fusion type or ASTM D 3261, butt-fusion type with dimensions matching PE pipe.
   2. PE Transition Fittings: Factory-fabricated fittings with PE pipe complying with ASTM D 2513, SDR 11; and steel pipe complying with ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.
   3. Anodeless Service-Line Risers: Factory fabricated and leak tested.
      a. Underground Portion: PE pipe complying with ASTM D 2513, SDR 11 inlet.
      b. Casing: Steel pipe complying with ASTM A 53/A 53M, Schedule 40, black steel, Type E or S, Grade B, with corrosion-protective coating covering. Vent casing aboveground.
      c. Aboveground Portion: PE transition fitting.
      d. Outlet shall be threaded or flanged or suitable for welded connection.
      e. Tracer wire connection.
      f. Ultraviolet shield.
      g. Stake supports with factory finish to match steel pipe casing or carrier pipe.
   4. Transition Service-Line Risers: Factory fabricated and leak tested.
      a. Underground Portion: PE pipe complying with ASTM D 2513, SDR 11 inlet connected to steel pipe complying with ASTM A 53/A 53M, Schedule 40, Type E or S, Grade B, with corrosion-protective coating for aboveground outlet.
      b. Outlet shall be threaded or flanged or suitable for welded connection.

c. Bridging sleeve over mechanical coupling.
d. Factory-connected anode.
e. Tracer wire connection.
f. Ultraviolet shield.
g. Stake supports with factory finish to match steel pipe casing or carrier pipe.

5. Plastic Mechanical Couplings, NPS 1-1/2 (DN 40) and Smaller: Capable of joining PE pipe to PE pipe.
   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      1) Lyall, R. W. & Company, Inc.
      2) Mueller Co.; Gas Products Div.
      3) Perfection Corporation; a subsidiary of American Meter Company.
   b. PE body with molded-in, stainless-steel support ring.
   c. Buna-nitrile seals.
   d. Acetal collets.
   e. Electro-zinc-plated steel stiffener.
6. Plastic Mechanical Couplings, NPS 2 (DN 50) and Larger: Capable of joining PE pipe to PE pipe, steel pipe to PE pipe, or steel pipe to steel pipe.
   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      1) Lyall, R. W. & Company, Inc.
      2) Mueller Co.; Gas Products Div.
      3) Perfection Corporation; a subsidiary of American Meter Company.
   b. Fiber-reinforced plastic body.
   c. PE body tube.
   d. Buna-nitrile seals.
   e. Acetal collets.
   f. Stainless-steel bolts, nuts, and washers.
7. Steel Mechanical Couplings: Capable of joining plain-end PE pipe to PE pipe, steel pipe to PE pipe, or steel pipe to steel pipe.
   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      1) Dresser Piping Specialties; Division of Dresser, Inc.
      2) Smith-Blair, Inc.
   b. Steel flanges and tube with epoxy finish.
   c. Buna-nitrile seals.
   d. Steel bolts, washers, and nuts.
   e. Factory-installed anode for steel-body couplings installed underground.

2.02 PIPING SPECIALTIES

A. Appliance Flexible Connectors:
   1. Indoor, Fixed-Appliance Flexible Connectors: Comply with ANSI Z21.24.
   2. Indoor, Movable-Appliance Flexible Connectors: Comply with ANSI Z21.69.
   3. Outdoor, Appliance Flexible Connectors: Comply with ANSI Z21.75.
   4. Corrugated stainless-steel tubing with polymer coating.
   5. Operating-Pressure Rating: 0.5 psig (3.45 kPa).
   6. End Fittings: Zinc-coated steel.
   7. Threaded Ends: Comply with ASME B1.20.1.
   8. Maximum Length: 72 inches (1830 mm).

B. Quick-Disconnect Devices: Comply with ANSI Z21.41.
   1. Copper-alloy convenience outlet and matching plug connector.
   2. Nitrile seals.
   3. Hand operated with automatic shutoff when disconnected.
   4. For indoor or outdoor applications.

5. Adjustable, retractable restraining cable.

C. Y-Pattern Strainers:
1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 (DN 50) and smaller; flanged ends for NPS 2-1/2 (DN 65) and larger.
3. Strainer Screen: 60-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
4. CWP Rating: 125 psig (862 kPa).

D. Basket Strainers:
1. Body: ASTM A 126, Class B, high-tensile cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 (DN 50) and smaller; flanged ends for NPS 2-1/2 (DN 65) and larger.
3. Strainer Screen: 60-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
4. CWP Rating: 125 psig (862 kPa).

E. T-Pattern Strainers:
1. Body: Ductile or malleable iron with removable access coupling and end cap for strainer maintenance.
2. End Connections: Grooved ends.
3. Strainer Screen: 60-mesh startup strainer, and perforated stainless-steel basket with 57 percent free area.
4. CWP Rating: 750 psig (5170 kPa).

F. Weatherproof Vent Cap: Cast- or malleable-iron increaser fitting with corrosion-resistant wire screen, with free area at least equal to cross-sectional area of connecting pipe and threaded-end connection.

2.03 JOINING MATERIALS

A. Joint Compound and Tape: Suitable for natural gas.

B. 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.

C. Brazing Filler Metals: Alloy with melting point greater than 1000 deg F (540 deg C) complying with AWS A5.8/A5.8M. Brazing alloys containing more than 0.05 percent phosphorus are prohibited.

2.04 MANUAL GAS SHUTOFF VALVES

A. See "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles for where each valve type is applied in various services.

B. General Requirements for Metallic Valves, NPS 2 (DN 50) and Smaller: Comply with ASME B16.33.
1. CWP Rating: 125 psig (862 kPa).
2. Threaded Ends: Comply with ASME B1.20.1.
3. Dryseal Threads on Flare Ends: Comply with ASME B1.20.3.
4. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
5. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction for valves 1 inch (25 mm) and smaller.
6. Service Mark: Valves 1-1/4 inches (32 mm) to NPS 2 (DN 50) shall have initials "WOG" permanently marked on valve body.

C. General Requirements for Metallic Valves, NPS 2-1/2 (DN 65) and Larger: Comply with ASME B16.38.
1. CWP Rating: 125 psig (862 kPa).
2. Flanged Ends: Comply with ASME B16.5 for steel flanges.

3. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
4. Service Mark: Initials "WOG" shall be permanently marked on valve body.

D. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim: MSS SP-110.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. BrassCraft Manufacturing Company; a Masco company.
   b. Conbraco Industries, Inc.; Apollo Div.
   c. Lyall, R. W. & Company, Inc.
   d. McDonald, A. Y. Mfg. Co.
   e. Perfection Corporation; a subsidiary of American Meter Company.
2. Body: Bronze, complying with ASTM B 584.
3. Ball: Chrome-plated bronze.
4. Stem: Bronze; blowout proof.
5. Seats: Reinforced TFE; blowout proof.
6. Packing: Threaded-body packnut design with adjustable-stem packing.
7. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
8. CWP Rating: 600 psig (4140 kPa).
9. Listing: Valves NPS 1 (DN 25) and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

E. Bronze Plug Valves: MSS SP-78.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Lee Brass Company.
   b. McDonald, A. Y. Mfg. Co.
2. Body: Bronze, complying with ASTM B 584.
3. Plug: Bronze.
4. Ends: Threaded, socket, or flanged as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
5. Operator: Square head or lug type with tamperproof feature where indicated.
6. Pressure Class: 125 psig (862 kPa).
7. Listing: Valves NPS 1 (DN 25) and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
8. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

F. Cast-Iron, Nonlubricated Plug Valves: MSS SP-78.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. McDonald, A. Y. Mfg. Co.
   b. Mueller Co.; Gas Products Div.
   c. Xomox Corporation; a Crane company.
2. Body: Cast iron, complying with ASTM A 126, Class B.
3. Plug: Bronze or nickel-plated cast iron.
4. Seat: Coated with thermoplastic.
5. Stem Seal: Compatible with natural gas.
6. Ends: Threaded or flanged as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
7. Operator: Square head or lug type with tamperproof feature where indicated.
8. Pressure Class: 125 psig (862 kPa).
9. Listing: Valves NPS 1 (DN 25) and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

G. Cast-Iron, Lubricated Plug Valves: MSS SP-78.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Flowserve.
      b. Homestead Valve; a division of Olson Technologies, Inc.
      c. McDonald, A. Y. Mfg. Co.
      d. Milliken Valve Company.
      e. Mueller Co.; Gas Products Div.
      f. R&M Energy Systems, A Unit of Robbins & Myers, Inc.
   2. Body: Cast iron, complying with ASTM A 126, Class B.
   3. Plug: Bronze or nickel-plated cast iron.
   4. Seat: Coated with thermoplastic.
   5. Stem Seal: Compatible with natural gas.
   6. Ends: Threaded or flanged as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
   7. Operator: Square head or lug type with tamperproof feature where indicated.
   8. Pressure Class: 125 psig (862 kPa).
   9. Listing: Valves NPS 1 (DN 25) and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
   10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

H. PE Ball Valves: Comply with ASME B16.40.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Kerotest Manufacturing Corp.
      b. Lyall, R. W. & Company, Inc.
      c. Perfection Corporation; a subsidiary of American Meter Company.
   2. Body: PE.
   3. Ball: PE.
   4. Stem: Acetal.
   5. Seats and Seals: Nitrile.
   6. Ends: Plain or fusible to match piping.
   7. CWP Rating: 80 psig (552 kPa).
   8. Operating Temperature: Minus 20 to plus 140 deg F (Minus 29 to plus 60 deg C).
   9. Operator: Nut or flat head for key operation.
   10. Include plastic valve extension.
   11. Include tamperproof locking feature for valves where indicated on Drawings.

I. Valve Boxes:
   1. Cast-iron, two-section box.
   2. Top section with cover with "GAS" lettering.
   3. Bottom section with base to fit over valve and barrel a minimum of 5 inches (125 mm) in diameter.
   4. Adjustable cast-iron extensions of length required for depth of bury.
   5. Include tee-handle, steel operating wrench with socket end fitting valve nut or flat head, and with stem of length required to operate valve.

2.05 PRESSURE REGULATORS

A. General Requirements:
   1. Single stage and suitable for natural gas.
   2. Steel jacket and corrosion-resistant components.
   3. Elevation compensator.
   4. End Connections: Threaded for regulators NPS 2 (DN 50) and smaller; flanged for regulators NPS 2-1/2 (DN 65) and larger.

B. Line Pressure Regulators: Comply with ANSI Z21.80.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Maxitrol Company.
   b. American Meter Company.
   c. Eclipse Combustion, Inc.
   d. Fisher Control Valves and Regulators; Division of Emerson Process Management.
   e. Invensys.
   f. Actaris
   g. Richards Industries; Jordan Valve Div.
2. Body and Diaphragm Case: Cast iron or die-cast aluminum.
3. Springs: Zinc-plated steel; interchangeable.
4. Diaphragm Plate: Zinc-plated steel.
5. Seat Disc: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the valve port.
6. Orifice: Aluminum; interchangeable.
7. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
8. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to the regulator.
9. Pressure regulator shall maintain discharge pressure setting downstream, and not exceed 150 percent of design discharge pressure at shutoff.
10. Overpressure Protection Device: Factory mounted on pressure regulator.
11. Atmospheric Vent: Factory- or field-installed, stainless-steel screen in opening if not connected to vent piping.
12. Maximum Inlet Pressure: 5 psig (34.5 kPa).

2.06 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Capitol Manufacturing Company.
      b. Central Plastics Company.
      c. Hart Industries International, Inc.
      d. Jomar International Ltd.
      e. Matco-Norca, Inc.
      f. McDonald, A. Y. Mfg. Co.
      g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
      h. Wilkins; a Zurn company.
   2. Description:
      a. Standard: ASSE 1079.
      b. Pressure Rating: 125 psig (860 kPa) minimum at 180 deg F (82 deg C).
      c. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Flanges:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Capitol Manufacturing Company.
      b. Central Plastics Company.
      c. Matco-Norca, Inc.
      d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
      e. Wilkins; a Zurn company.
   2. Description:
      a. Standard: ASSE 1079.
      b. Factory-fabricated, bolted, companion-flange assembly.

c. Pressure Rating: 125 psig (860 kPa) minimum at 180 deg F (82 deg C).
d. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Insulating Kits:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Advance Products & Systems, Inc.
b. Calpico, Inc.
c. Central Plastics Company.
d. Pipeline Seal and Insulator, Inc.
2. 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.

2.07 LABELING AND IDENTIFYING

A. Detectable Warning Tape: Acid- and alkali-resistant, PE film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches (150 mm) wide and 4 mils (0.1 mm) thick, continuously inscribed with a description of utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches (750 mm) deep; colored yellow.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine roughing-in for natural-gas piping system to verify actual locations of piping connections before equipment installation.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Close equipment shutoff valves before turning off natural gas to premises or piping section.

B. Inspect natural-gas piping according to NFPA 54 National Fuel Gas Code to determine that natural-gas utilization devices are turned off in piping section affected.

C. Comply with NFPA 54 National Fuel Gas Code requirements for prevention of accidental ignition.

3.03 OUTDOOR PIPING INSTALLATION

A. Comply with NFPA 54 National Fuel Gas Code for installation and purging of natural-gas piping.

B. Install underground, natural-gas piping buried at least 36 inches (900 mm) below finished grade. Comply with requirements by local gas company having jurisdiction.
1. If natural-gas piping is installed less than 36 inches (900 mm) below finished grade, install it in containment conduit.

C. Install underground, PE, natural-gas piping according to ASTM D 2774.

D. Steel Piping with Protective Coating:
1. Apply joint cover kits to pipe after joining to cover, seal, and protect joints.
2. Repair damage to PE coating on pipe as recommended in writing by protective coating manufacturer.
3. Replace pipe having damaged PE coating with new pipe.

E. Install fittings for changes in direction and branch connections.

F. Install pressure gage downstream from each service regulator.

3.04 INDOOR PIPING INSTALLATION

A. Comply with NFPA 54 National Fuel Gas Code for installation and purging of natural-gas piping.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. 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.

C. Arrange for pipe spaces, chases, slots, sleeves, and openings in building structure during progress of construction, to allow for mechanical installations.

D. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

E. 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.

F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

G. Locate valves for easy access.

H. Install natural-gas piping at uniform grade of 2 percent down toward drip and sediment traps.

I. Install piping free of sags and bends.

J. Install fittings for changes in direction and branch connections.

K. Verify final equipment locations for roughing-in.

L. Comply with requirements in Sections specifying gas-fired appliances and equipment for roughing-in requirements.

M. Drips and Sediment Traps: Install drips at points where condensate may collect, including service-meter outlets. Locate where accessible to permit cleaning and emptying. Do not install where condensate is subject to freezing.
   1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use nipple a minimum length of 3 pipe diameters, but not less than 3 inches (75 mm) long and same size as connected pipe. Install with space below bottom of drip to remove plug or cap.

N. Extend relief vent connections for service regulators, line regulators, and overpressure protection devices to outdoors and terminate with weatherproof vent cap.

O. Conceal pipe installations in walls, pipe spaces, utility spaces, above ceilings, below grade or floors, and in floor channels unless indicated to be exposed to view.

P. Concealed Location Installations: Except as specified below, install concealed natural-gas piping and piping installed under the building in containment conduit constructed of steel pipe with welded joints as described in Part 2. Install a vent pipe from containment conduit to outdoors and terminate with weatherproof vent cap.
   1. Above Accessible Ceilings: Natural-gas piping, fittings, valves, and regulators may be installed in accessible spaces without containment conduit.
   2. In Floors: Install natural-gas piping with welded or brazed joints and protective coating in cast-in-place concrete floors. Cover piping to be cast in concrete slabs with minimum of 1-1/2 inches (38 mm) of concrete. Piping may not be in physical contact with other metallic structures such as reinforcing rods or electrically neutral conductors. Do not embed piping in concrete slabs containing quick-set additives or cinder aggregate.
   3. In Floor Channels: Install natural-gas piping in floor channels. Channels must have cover and be open to space above cover for ventilation.
   4. In Walls or Partitions: Protect tubing installed inside partitions or hollow walls from physical damage using steel striker barriers at rigid supports.
      a. Exception: Tubing passing through partitions or walls does not require striker barriers.

5. Prohibited Locations:
    a. Do not install natural-gas piping in or through circulating air ducts, clothes or trash chutes, chimneys or gas vents (flues), ventilating ducts, or dumbwaiter or elevator shafts.
    b. Do not install natural-gas piping in solid walls or partitions.

Q. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.

R. Connect branch piping from top or side of horizontal piping.

S. Install unions in pipes NPS 2 (DN 50) and smaller, adjacent to each valve, at final connection to each piece of equipment. Unions are not required at flanged connections.

T. Do not use natural-gas piping as grounding electrode.

U. Install strainer on inlet of each line-pressure regulator and automatic or electrically operated valve.

V. Install pressure gage downstream from each line regulator.

W. Install sleeves for piping penetrations of walls, ceilings, and floors. Retain first paragraph below for piping that penetrates an exterior concrete wall or concrete slab.

X. Install sleeve seals for piping penetrations of concrete walls and slabs. Install escutcheons for piping penetrations of walls, ceilings, and floors.

3.05 VALVE INSTALLATION

A. Install manual gas shutoff valve for each gas appliance ahead of corrugated stainless-steel tubing, aluminum, or copper connector.

B. Install underground valves with valve boxes.

C. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.

D. Install earthquake valves aboveground outside buildings according to listing.

E. Install anode for metallic valves in underground PE piping.

3.06 PIPING JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Threaded Joints:
    1. Thread pipe with tapered pipe threads complying with ASME B1.20.1.
    2. Cut threads full and clean using sharp dies.
    3. Ream threaded pipe ends to remove burrs and restore full inside diameter of pipe.
    4. Apply appropriate tape or thread compound to external pipe threads unless dryseal threading is specified.
    5. 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.

D. Welded Joints:
    1. Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators.
    2. Bevel plain ends of steel pipe.
    3. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter.

F. Flanged Joints: Install gasket material, size, type, and thickness appropriate for natural-gas service. Install gasket concentrically positioned.

G. Flared Joints: Cut tubing with roll cutting tool. Flare tube end with tool to result in flare dimensions complying with SAE J513. Tighten finger tight, then use wrench. Do not overtighten.

H. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
   1. Plain-End Pipe and Fittings: Use butt fusion.
   2. Plain-End Pipe and Socket Fittings: Use socket fusion.

3.07 HANGER AND SUPPORT INSTALLATION

A. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."

B. Comply with requirements for pipe hangers and supports specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."

C. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:
   1. NPS 1 (DN 25) and Smaller: Maximum span, 96 inches (2438 mm); minimum rod size, 3/8 inch (10 mm).
   2. NPS 1-1/4 (DN 32): Maximum span, 108 inches (2743 mm); minimum rod size, 3/8 inch (10 mm).
   3. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): Maximum span, 108 inches (2743 mm); minimum rod size, 3/8 inch (10 mm).
   4. NPS 2-1/2 to NPS 3-1/2 (DN 65 to DN 90): Maximum span, 10 feet (3 m); minimum rod size, 1/2 inch (13 mm).

3.08 CONNECTIONS

A. Connect to utility's gas main according to utility's procedures and requirements.

B. Install natural-gas piping electrically continuous, and bonded to gas appliance equipment grounding conductor of the circuit powering the appliance according to NFPA 70.

C. Install piping adjacent to appliances to allow service and maintenance of appliances.

D. Connect piping to appliances using manual gas shutoff valves and unions. Install valve within 72 inches (1800 mm) of each gas-fired appliance and equipment. Install union between valve and appliances or equipment.

E. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance.

3.09 LABELING AND IDENTIFYING

A. Comply with requirements in Division 23 Section "Identification for HVAC Piping and Equipment" for piping and valve identification.

B. Install detectable warning tape directly above gas piping, 12 inches (300 mm) below finished grade, except 6 inches (150 mm) below subgrade under pavements and slabs.

3.10 PAINTING

A. Comply with requirements in Division 09 painting Sections for painting interior and exterior natural-gas piping.

B. Paint exposed, exterior metal piping, valves, service regulators, service meters and meter bars, earthquake valves, and piping specialties, except components, with factory-applied paint or protective coating.
   1. Alkyd System: MPI EXT 5.1D.
      a. Prime Coat: Alkyd anticorrosive metal primer.
      b. Intermediate Coat: Exterior alkyd enamel matching topcoat.
      c. Topcoat: Exterior alkyd enamel (flat).
      d. Color: Yellow.

C. Paint exposed, interior metal piping, valves, service regulators, service meters and meter bars, earthquake valves, and piping specialties, except components, with factory-applied paint or protective coating.
   1. Latex Over Alkyd Primer System: MPI INT 5.1Q.
      a. Prime Coat: Alkyd anticorrosive metal primer.
      b. Intermediate Coat: Interior latex matching topcoat.
      c. Topcoat: Interior latex (flat).
      d. Color: Yellow.
   2. Alkyd System: MPI INT 5.1E.
      a. Prime Coat: Alkyd anticorrosive metal primer.
      b. Intermediate Coat: Interior alkyd matching topcoat.
      c. Topcoat: Interior alkyd (flat).
      d. Color: Yellow.

D. Damage and Touchup: Repair marred and damaged factory-applied finishes with materials and by procedures to match original factory finish.

3.11 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:
   1. Test, inspect, and purge natural gas according to NFPA 54 National Fuel Gas Code and authorities having jurisdiction.

C. Natural-gas piping will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.12 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain earthquake valves.

3.13 OUTDOOR PIPING SCHEDULE

A. Underground natural-gas piping shall be the following:
   1. PE pipe and fittings joined by heat fusion, or mechanical couplings; service-line risers with tracer wire terminated in an accessible location.

B. Aboveground natural-gas piping shall be one of the following:
   1. Steel pipe with malleable-iron fittings and threaded joints, painted.
   2. Steel pipe with wrought-steel fittings and welded joints, painted.

C. Branch Piping in Cast-in-Place Concrete to Single Appliance: Annealed-temper copper tube with wrought-copper fittings and brazed joints. Install piping embedded in concrete with no joints in concrete.

D. Containment Conduit: Steel pipe with wrought-steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping.

3.14 INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES LESS THAN 0.5 PSIG (3.45 kPa)

A. Aboveground, branch piping NPS 1 (DN 25) 1 ½" and smaller shall be the following:
   1. Steel pipe with malleable-iron fittings and threaded joints.

B. Aboveground, distribution piping shall be the following:
   1. Steel pipe with malleable-iron fittings and threaded joints.

C. Underground, below building, piping shall be one of the following:
   1. Steel pipe with malleable-iron fittings and threaded joints.
   2. Steel pipe with wrought-steel fittings and welded joints.

D. Containment Conduit: Steel pipe with wrought-steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping.

E. Containment Conduit Vent Piping: Steel pipe with malleable-iron fittings and threaded or wrought-steel fittings with welded joints. Coat underground pipe and fittings with protective coating for steel piping.

3.15 ABOVEGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE

A. Valves for pipe sizes NPS 2 (DN 50) and smaller at service meter shall be one of the following:
   1. Two-piece, full-port, bronze ball valves with bronze trim.
   2. Bronze plug valve.

B. Valves for pipe sizes NPS 2-1/2 (DN 65) and larger at service meter shall be one of the following:
   1. Two-piece, full-port, bronze ball valves with bronze trim.
   2. Bronze plug valve.
   3. Cast-iron, nonlubricated plug valve.

C. Distribution piping valves for pipe sizes NPS 2 (DN 50) and smaller shall be one of the following:
   1. Two-piece, full-port, bronze ball valves with bronze trim.
   2. Bronze plug valve.

D. Distribution piping valves for pipe sizes NPS 2-1/2 (DN 65) and larger shall be one of the following:
   1. Two-piece, full-port, bronze ball valves with bronze trim.
   2. Bronze plug valve.
   3. Cast-iron, nonlubricated plug valve.

E. Valves in branch piping for single appliance shall be one of the following:
   1. Two-piece, full-port, bronze ball valves with bronze trim.
   2. Bronze plug valve.

END OF SECTION

SECTION 23 3113
METAL DUCTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:
   1. Single-wall rectangular ducts and fittings.
   2. Single-wall round and flat-oval ducts and fittings.
   3. Sheet metal materials.
   4. Duct liner.
   5. Sealants and gaskets.
   6. Hangers and supports.
   7. Seismic-restraint devices.

B. Related Sections:
   1. Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
   2. Division 23 Section "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.03 PERFORMANCE REQUIREMENTS

A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.

B. Structural Performance: Duct hangers and supports and seismic restraints shall withstand the effects of gravity and seismic loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems."

C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

1.04 SUBMITTALS

A. Product Data: For each type of the following products:
   1. Adhesives.
   2. Sealants and gaskets.
   3. Seismic-restraint devices.

B. Shop Drawings:
   1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
   2. Factory- and shop-fabricated ducts and fittings.
   3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
   4. Elevation of top of ducts.
   5. Dimensions of main duct runs from building grid lines.
   6. Fittings.
   7. Reinforcement and spacing.
   8. Seam and joint construction.
   9. Penetrations through fire-rated and other partitions.
   10. Equipment installation based on equipment being used on Project.
   11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.

12. Hangers and supports, including methods for duct and building attachment, seismic restraints, and vibration isolation.

C. Delegated-Design Submittal:
   1. Sheet metal thicknesses.
   2. Joint and seam construction and sealing.
   3. Reinforcement details and spacing.
   4. Materials, fabrication, assembly, and spacing of hangers and supports.
   5. Design Calculations: Calculations, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation for selecting hangers and supports and seismic restraints.

D. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
   1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
   2. Suspended ceiling components.
   3. Structural members to which duct will be attached.
   4. Size and location of initial access modules for acoustical tile.
   5. Penetrations of smoke barriers and fire-rated construction.
   6. Items penetrating finished ceiling including the following:
      a. Lighting fixtures.
      b. Air outlets and inlets.
      c. Speakers.
      d. Sprinklers.
      e. Access panels.
      f. Perimeter moldings.

E. Welding certificates.

F. Field quality-control reports.

1.05 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

B. Welding Qualifications: Qualify procedures and personnel according to the following:
   1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
   2. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up."

D. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

PART 2 PRODUCTS

2.01 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.02 SINGLE-WALL ROUND DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Lindab Inc.
      b. McGill AirFlow LLC.
      c. SEMCO Incorporated.
      d. Sheet Metal Connectors, Inc.
      e. Spiral Manufacturing Co., Inc.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
   1. Transverse Joints in Ducts Larger Than 60 Inches (1524 mm) in Diameter: Flanged.

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
   1. Fabricate round ducts larger than 90 inches (2286 mm) in diameter with butt-welded longitudinal seams.
   2. Fabricate flat-oval ducts larger than 72 inches (1830 mm) in width (major dimension) with butt-welded longitudinal seams.

D. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.03 SHEET METAL MATERIALS

A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
   1. Galvanized Coating Designation: G90 (Z275).
   2. Finishes for Surfaces Exposed to View: Mill phosphatized.

C. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.

D. Tie Rods: Galvanized steel, 1/4-inch (6-mm) minimum diameter for lengths 36 inches (900 mm) or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches (900 mm).

2.04 DUCT LINER

A. Flexible Elastomeric Duct Liner: Preformed, cellular, closed-cell, sheet materials complying with ASTM C 534, Type II, Grade 1; and with NFPA 90A or NFPA 90B.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Aeroflex USA, Inc.
      b. Armacell LLC.
      c. Rubatex International, LLC.
   2. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
   3. Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.
      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).
      b. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. Insulation Pins and Washers:
   1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch- (3.5-mm-) diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch (38-mm) galvanized carbon-steel washer.
   2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick galvanized steel; with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.

C. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 7-11, "Flexible Duct Liner Installation."
   1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.
   2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
   3. Butt transverse joints without gaps, and coat joint with adhesive.
   4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
   5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.
   6. Apply adhesive coating on longitudinal seams in ducts with air velocity of 2500 fpm (12.7 m/s).
   7. Secure liner with mechanical fasteners 4 inches (100 mm) from corners and at intervals not exceeding 12 inches (300 mm) transversely; at 3 inches (75 mm) from transverse joints and at intervals not exceeding 18 inches (450 mm) longitudinally.
   8. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:
      a. Fan discharges.
      b. Intervals of lined duct preceding unlined duct.
      c. Upstream edges of transverse joints in ducts where air velocities are higher than 2500 fpm (12.7 m/s) or where indicated.

9. Secure insulation between perforated sheet metal inner duct of same thickness as specified for outer shell. Use mechanical fasteners that maintain inner duct at uniform distance from outer shell without compressing insulation.
    a. Sheet Metal Inner Duct Perforations: 3/32-inch (2.4-mm) diameter, with an overall open area of 23 percent.
10. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

2.05 SEALANT AND GASKETS

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.

B. Two-Part Tape Sealing System:
1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
2. Tape Width: 4 inches (102 mm).
3. Sealant: Modified styrene acrylic.
4. Water resistant.
5. Mold and mildew resistant.
6. Maximum Static-Pressure Class: 10-inch wg (2500 Pa), positive and negative.
7. Service: Indoor and outdoor.
8. Service Temperature: Minus 40 to plus 200 deg F (Minus 40 to plus 93 deg C).
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
10. For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
11. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Water-Based Joint and Seam Sealant:
1. Application Method: Brush on.
2. Solids Content: Minimum 65 percent.
3. Shore A Hardness: Minimum 20.
4. Water resistant.
5. Mold and mildew resistant.
6. VOC: Maximum 75 g/L (less water).
7. Maximum Static-Pressure Class: 10-inch wg (2500 Pa), positive and negative.
8. Service: Indoor or outdoor.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

D. Solvent-Based Joint and Seam Sealant:
1. Application Method: Brush on.
2. Base: Synthetic rubber resin.
3. Solvent: Toluene and heptane.
4. Solids Content: Minimum 60 percent.
5. Shore A Hardness: Minimum 60.
6. Water resistant.
7. Mold and mildew resistant.
8. VOC: Maximum 395 g/L.
9. Maximum Static-Pressure Class: 10-inch wg (2500 Pa), positive or negative.
10. Service: Indoor or outdoor.

11. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

E. Flanged Joint Sealant: Comply with ASTM C 920.
1. General: Single-component, acid-curing, silicone, elastomeric.
2. Type: S.
3. Grade: NS.
4. Class: 25.
5. Use: O.

F. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

G. Round Duct Joint O-Ring Seals:
1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg (0.14 L/s per sq. m at 250 Pa) and shall be rated for 10-inch wg (2500-Pa) static-pressure class, positive or negative.
2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.06 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.

B. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1 (Table 5-1M), "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."

C. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.

D. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

E. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

F. Trapeze and Riser Supports:
1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.

2.07 SEISMIC-RESTRAINT DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Cooper B-Line, Inc.; a division of Cooper Industries.
2. Ductmate Industries, Inc.
3. Hilti Corp.
4. Mason Industries.
5. TOLCO; a brand of NIBCO INC.
6. Unistrut Corporation; Tyco International, Ltd.

B. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an agency acceptable to authorities having jurisdiction.
1. 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.

C. Channel Support System: Shop- or field-fabricated support assembly made of slotted steel channels rated in tension, compression, and torsion forces and with accessories for attachment to braced component at one end and to building structure at the other end. Include matching components and corrosion-resistant coating.

D. Restraint Cables: ASTM A 603, galvanized-steel cables with end connections made of cadmium-plated steel assemblies with brackets, swivel, and bolts designed for restraining cable service; and with an automatic-locking and clamping device or double-cable clips.

E. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod.

F. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

PART 3 EXECUTION

3.01 DUCT INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.

B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.

C. Install round ducts in maximum practical lengths.

D. Install ducts with fewest possible joints.

E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

H. Install ducts with a clearance of 1 inch (25 mm), plus allowance for insulation thickness.

I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.

J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches (38 mm).

K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Division 23 Section "Air Duct Accessories" for fire and smoke dampers.

L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines." During construction, provide temporary closures of metal or taped polyethylene on open ductwork.

3.02 DUCT SEALING

A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

B. Seal ducts to the following seal classes according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":
   1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
   2. Supply-Air Ducts: Seal Class A.
   3. Return-Air Ducts: Seal Class B.
   4. Exhaust Ducts: Seal Class B.

3.03 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
   1. Where practical, install concrete inserts before placing concrete.
   2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
   3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches (100 mm) thick.
   4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches (100 mm) thick.
   5. Do not use powder-actuated concrete fasteners for seismic restraints.

C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1 (Table 5-1M), "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches (610 mm) of each elbow and within 48 inches (1200 mm) of each branch intersection.

D. Hangers Exposed to View: Threaded rod and angle or channel supports.

E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet (5 m).

F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.04 SEISMIC-RESTRAINT-DEVICE INSTALLATION

A. Install ducts with hangers and braces designed to support the duct and to restrain against seismic forces required by applicable building codes. Comply with SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems."
   1. Space lateral supports a maximum of 40 feet (12 m) o.c., and longitudinal supports a maximum of 80 feet (24 m) o.c.
   2. Brace a change of direction longer than 12 feet (3.7 m).

B. Select seismic-restraint devices with capacities adequate to carry present and future static and seismic loads.

C. Install cables so they do not bend across edges of adjacent equipment or building structure.

D. Install cable restraints on ducts that are suspended with vibration isolators.

E. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction.

F. Attachment to Structure: If specific attachment is not indicated, anchor bracing and restraints to structure, to flanges of beams, to upper truss chords of bar joists, or to concrete members.

G. Drilling for and Setting Anchors:
   1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcement or embedded items during drilling. Notify the Architect if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
   2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
   3. 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.
   4. Set anchors to manufacturer's recommended torque, using a torque wrench.
   5. Install zinc-coated steel anchors for interior applications and stainless-steel anchors for applications exposed to weather.

3.05 CONNECTIONS

A. Make connections to equipment with flexible connectors complying with Division 23 Section "Air Duct Accessories."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.06 PAINTING

A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Division 09 painting Sections.

3.07 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Duct System Cleanliness Tests:
   1. Visually inspect duct system to ensure that no visible contaminants are present.
   2. Test sections of metal duct system, chosen randomly by Owner, for cleanliness according to "Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."
      a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.

C. Duct system will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.10 START UP

A. Air Balance: Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."

3.11 DUCT SCHEDULE

A. Supply Ducts:
   1. Ducts Connected to Packaged Air Conditioning Units:
      a. Pressure Class: Positive 1-inch wg (250 Pa).
      b. Minimum SMACNA Seal Class: A

B. Return Ducts:
   1. Ducts Connected to Packaged Air Conditioning Units:
      a. Pressure Class: Positive or negative 1-inch wg (250 Pa).
      b. Minimum SMACNA Seal Class: B.

C. Exhaust Ducts:
   1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:
      a. Pressure Class: Negative 1-inch wg (250 Pa).
      b. Minimum SMACNA Seal Class: B if negative pressure, and A if positive pressure.

D. Elbow Configuration:
   1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
      a. Velocity 1000 fpm (5 m/s) or Lower:
         1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
         2) Mitered Type RE 4 with vanes.
      b. Velocity 1000 to 1500 fpm (5 to 7.6 m/s):
         1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
         2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.
         3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
      c. Velocity 1500 fpm (7.6 m/s) or Higher:
         1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.

2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

2. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
   a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
   b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
   c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
3. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbows."
   a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
      1) Velocity 1000 fpm (5 m/s) or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
      2) Velocity 1000 to 1500 fpm (5 to 7.6 m/s): 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
      3) Velocity 1500 fpm (7.6 m/s) or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
      4) Radius-to Diameter Ratio: 1.5.
   b. Round Elbows, 12 Inches (305 mm) and Smaller in Diameter: Stamped or pleated.
   c. Round Elbows, 14 Inches (356 mm) and Larger in Diameter: Standing seam.

E. Branch Configuration:
1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."
   a. Rectangular Main to Rectangular Branch: 45-degree entry.
   b. Rectangular Main to Round Branch: Spin in.
2. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.
   a. Velocity 1000 fpm (5 m/s) or Lower: 90-degree tap.
   b. Velocity 1000 to 1500 fpm (5 to 7.6 m/s): Conical tap.
   c. Velocity 1500 fpm (7.6 m/s) or Higher: 45-degree lateral.

END OF SECTION

SECTION 23 3300
AIR DUCT ACCESSORIES

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Backdraft and pressure relief dampers.
   2. Manual volume dampers.
   3. Flange connectors.
   4. Turning vanes.
   5. Duct-mounted access doors.
   6. Flexible connectors.
   7. Duct accessory hardware.

1.02 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.
   1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:
      a. Special fittings.
      b. Manual volume damper installations.
      c. Wiring Diagrams: For power, signal, and control wiring.

C. Operation and maintenance data.

1.03 QUALITY ASSURANCE

A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

B. Comply with AMCA 500-D testing for damper rating.

PART 2 PRODUCTS

2.01 MATERIALS

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
   1. Galvanized Coating Designation: G90 (Z275).
   2. Exposed-Surface Finish: Mill phosphatized.

C. Extruded Aluminum: Comply with ASTM B 221 (ASTM B 221M), Alloy 6063, Temper T6.

D. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

E. Tie Rods: Galvanized steel, 1/4-inch (6-mm) minimum diameter for lengths 36 inches (900 mm) or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches (900 mm).

2.02 BACKDRAFT AND PRESSURE RELIEF DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Duro Dyne Inc.
   2. Greenheck Fan Corporation.
   3. Nailor Industries Inc.
   4. Pottorff; a division of PCI Industries, Inc.

5. Ruskin Company.

B. Description: Gravity balanced.

C. Maximum Air Velocity: 3000 fpm (15 m/s).

D. Maximum System Pressure: 2-inch wg (0.5 kPa).

E. Frame: 0.052-inch- (1.3-mm-) thick, galvanized sheet steel, with welded corners and mounting flange.

F. Blades: Multiple single-piece blades, center-pivoted, maximum 6-inch (150-mm) width, 0.025-inch- (0.6-mm-) thick, roll-formed aluminum with sealed edges.

G. Blade Action: Parallel.

H. Blade Seals: Neoprene, mechanically locked.

I. Blade Axles:
   1. Material: Aluminum.
   2. Diameter: 0.20 inch (5 mm).

J. Tie Bars and Brackets: Aluminum.

K. Return Spring: Adjustable tension.

L. Bearings: Synthetic pivot bushings.

M. Accessories:
   1. Adjustment device to permit setting for varying differential static pressure.
   2. Counterweights and spring-assist kits for vertical airflow installations.
   3. Electric actuators.
   4. Chain pulls.
   5. Screen Mounting: Front mounted in sleeve.
      a. Sleeve Thickness: 20-gage (1.0-mm) minimum.
      b. Sleeve Length: 6 inches (152 mm) minimum.
   6. Screen Mounting: Rear mounted.
   7. Screen Material: Galvanized steel.
   8. Screen Type: Bird.
   9. 90-degree stops.

2.03 MANUAL VOLUME DAMPERS

A. Standard, Steel, Manual Volume Dampers:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Nailor Industries Inc.
      b. Pottorff; a division of PCI Industries, Inc.
      c. Ruskin Company.
   2. Standard leakage rating, with linkage outside airstream.
   3. Suitable for horizontal or vertical applications.
   4. Frames:
      a. Hat-shaped, galvanized-steel channels, 0.064-inch (1.62-mm) minimum thickness.
      b. Mitered and welded corners.
      c. Flanges for attaching to walls and flangeless frames for installing in ducts.
   5. Blades:
      a. Multiple or single blade.
      b. Parallel- or opposed-blade design.
      c. Stiffen damper blades for stability.
      d. Galvanized-steel, 0.064 inch (1.62 mm) thick.
   6. Blade Axles: Galvanized steel.
   7. Bearings:
      a. Oil-impregnated bronze.

b. Dampers in ducts with pressure classes of 3-inch wg (750 Pa) or less shall have axles full length of damper blades and bearings at both ends of operating shaft.

8. Tie Bars and Brackets: Galvanized steel.

2.04 FLANGE CONNECTORS

A. Manufacturers:
1. Ductmate Industries, Inc.
2. Nexus PDQ; Division of Shilco Holdings Inc.
3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Description: Add-on or roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.

C. Material: Galvanized steel.

D. Gage and Shape: Match connecting ductwork.

2.05 TURNING VANES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Ductmate Industries, Inc.
2. Duro Dyne Inc.
3. METALAIRE, Inc.

B. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.

C. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 4-3, "Vanes and Vane Runners," and 4-4, "Vane Support in Elbows."

D. Vane Construction: Double wall.

2.06 DUCT-MOUNTED ACCESS DOORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Ductmate Industries, Inc.
2. Greenheck Fan Corporation.
3. Nailor Industries Inc.
4. Pottorff; a division of PCI Industries, Inc.
5. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 7-2 (7-2M), "Duct Access Doors and Panels," and 7-3, "Access Doors - Round Duct."
1. Door:
a. Double wall, rectangular.
b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
c. Vision panel.
d. Hinges and Latches: 1-by-1-inch (25-by-25-mm) butt or piano hinge and cam latches.
e. Fabricate doors airtight and suitable for duct pressure class.
2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
3. Number of Hinges and Locks:
a. Access Doors Less Than 12 Inches (300 mm) Square: No hinges and two sash locks.
b. Access Doors up to 18 Inches (460 mm) Square: Two hinges and two sash locks.

c. Access Doors up to 24 by 48 Inches (600 by 1200 mm): Three hinges and two compression latches with outside and inside handles.
d. Access Doors Larger than 24 by 48 Inches (600 by 1200 mm): Four hinges and two compression latches with outside and inside handles.

2.07 DUCT ACCESS PANEL ASSEMBLIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Ductmate Industries, Inc.
2. Flame Gard, Inc.
3. 3M.

B. Labeled according to UL 1978 by an NRTL.

C. Panel and Frame: Minimum thickness 0.0528-inch (1.3-mm) carbon steel.

D. Fasteners: Carbon steel. Panel fasteners shall not penetrate duct wall.

E. Gasket: Comply with NFPA 96; grease-tight, high-temperature ceramic fiber, rated for minimum 2000 deg F (1093 deg C).

F. Minimum Pressure Rating: 10-inch wg (2500 Pa), positive or negative.

2.08 FLEXIBLE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Ductmate Industries, Inc.
2. Duro Dyne Inc.
3. Ventfabrics, Inc.
4. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Materials: Flame-retardant or noncombustible fabrics.

C. Coatings and Adhesives: Comply with UL 181, Class 1.

D. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches (89 mm) wide attached to 2 strips of 2-3/4-inch- (70-mm-) wide, 0.028-inch- (0.7-mm-) thick, galvanized sheet steel or 0.032-inch- (0.8-mm-) thick aluminum sheets. Provide metal compatible with connected ducts.

E. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.
1. Minimum Weight: 26 oz./sq. yd. (880 g/sq. m).
2. Tensile Strength: 480 lbf/inch (84 N/mm) in the warp and 360 lbf/inch (63 N/mm) in the filling.
3. Service Temperature: Minus 40 to plus 200 deg F (Minus 40 to plus 93 deg C).

F. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.
1. Minimum Weight: 24 oz./sq. yd. (810 g/sq. m).
2. Tensile Strength: 530 lbf/inch (93 N/mm) in the warp and 440 lbf/inch (77 N/mm) in the filling.
3. Service Temperature: Minus 50 to plus 250 deg F (Minus 45 to plus 121 deg C).

G. Thrust Limits: Combination coil spring and elastomeric insert with spring and insert in compression, and with a load stop. Include rod and angle-iron brackets for attaching to fan discharge and duct.
1. Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.
2. Outdoor Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.

5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
7. Coil Spring: Factory set and field adjustable for a maximum of 1/4-inch (6-mm) movement at start and stop.

2.09 DUCT ACCESSORY HARDWARE

A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.

B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.

B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.

C. Install backdraft dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.

D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.
   1. Install steel volume dampers in steel ducts.

E. Set dampers to fully open position before testing, adjusting, and balancing.

F. Install test holes at fan inlets and outlets and elsewhere as indicated.

G. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
   1. Upstream and downstream from duct filters.
   2. At outdoor-air intakes and mixed-air plenums.
   3. At drain pans and seals.
   4. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
   5. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors; and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
   6. At each change in direction and at maximum 50-foot (15-m) spacing.
   7. Control devices requiring inspection.
   8. Elsewhere as indicated.

H. Install access doors with swing against duct static pressure.

I. Access Door Sizes:
   1. One-Hand or Inspection Access: 8 by 5 inches (200 by 125 mm).
   2. Two-Hand Access: 12 by 6 inches (300 by 150 mm).
   3. Head and Hand Access: 18 by 10 inches (460 by 250 mm).
   4. Head and Shoulders Access: 21 by 14 inches (530 by 355 mm).
   5. Body Access: 25 by 14 inches (635 by 355 mm).
   6. Body plus Ladder Access: 25 by 17 inches (635 by 430 mm).

J. Label access doors according to Division 23 Section "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.

K. Install flexible connectors to connect ducts to equipment.

L. Connect diffusers to ducts directly or with maximum 60-inch (1500-mm) lengths of flexible duct clamped or strapped in place.

M. Connect flexible ducts to metal ducts with draw bands.

N. Install duct test holes where required for testing and balancing purposes.

O. Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch (6-mm) movement during start and stop of fans.

3.02 FIELD QUALITY CONTROL

A. Tests and Inspections:
   1. Operate dampers to verify full range of movement.
   2. Inspect locations of access doors and verify that purpose of access door can be performed.
   3. Operate fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
   4. Inspect turning vanes for proper and secure installation.
   5. Ensure duct silencers are installed with airflow arrows in direction of airflow.

END OF SECTION

SECTION 23 37 13
DIFFUSERS, REGISTERS, AND GRILLES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:
   1. Fixed face registers and grilles.

B. Related Sections:
   1. Division 23 Section "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.

1.03 SUBMITTALS

A. Product Data: For each type of product indicated, include the following:
   1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
   2. Diffuser, Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

B. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:
   1. Ceiling suspension assembly members.
   2. Method of attaching hangers to building structure.
   3. Size and location of initial access modules for acoustical tile.
   4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
   5. Duct access panels.

C. Source quality-control reports.

PART 2 - PRODUCTS

2.01 CEILING DIFFUSERS

A. Fixed Face Register ‘A’:
   1. Material: Steel.
   2. Finish: Baked enamel, white.
   3. Face Arrangement: 1/8 by 3/4 inch blades on 3/4 inch centers. Double deflection blades for supply.
   4. Frame: 1-1/4 inches (32 mm) wide.
   5. Mounting: Countersunk screw.
   6. Damper Type: Adjustable opposed blade, where indicated.

2.02 SOURCE QUALITY CONTROL

A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install diffusers, registers, and grilles level and plumb.

B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.

C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.03 ADJUSTING

A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION

SECTION 23 8119
SELF-CONTAINED AIR-CONDITIONERS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section includes packaged, air-cooled air-conditioning units with refrigerant compressors and controls intended for indoor installations.

1.03 SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
   1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   2. Wiring Diagrams: For power, signal, and control wiring.

C. Operation and Maintenance Data: For self-contained air conditioners to include in emergency, operation, and maintenance manuals.

D. Warranty: Sample of special warranty.

1.04 QUALITY ASSURANCE

A. 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.

B. ARI Compliance:
   1. Applicable requirements in ARI 210/240.
   2. Applicable requirements in ARI 340/360.
   3. Applicable requirements in ARI 390.

C. ASHRAE Compliance:
   1. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Standard for Refrigeration Systems."
   2. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2004, Section 4 - "Outdoor Air Quality," Section 5 - "Systems and Equipment," Section 6 - "Ventilation Rate Procedures," and Section 7 - "Construction and Startup."

D. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2004.

1.05 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork are specified in Division 03 Section "Cast-in-Place Concrete."

1.06 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of self-contained air conditioners that fail in materials or workmanship within specified warranty period.
   1. Warranty Period:
      a. For Compressor: Five year(s) from date of Substantial Completion.
      b. For Parts: One year(s) from date of Substantial Completion.
      c. For Labor: One year(s) from date of Substantial Completion.

1.07 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Filters: One set(s) of filters for each unit.
   2. Fan Belts: One set(s) of belts for each unit.
   3. Gaskets: One set(s) for each access door.
   4. Fuses: One set(s) for each air-handling unit.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Carrier Corporation.
   2. Trane Company.
   3. YORK International Corporation.

2.02 CASING

A. General Fabrication Requirements for Casings: Formed and reinforced double-wall insulated panels, fabricated to allow removal for access to internal parts and components, with joints between sections sealed. Suitable for roof curb mounting.

B. Exterior Casing Material: Galvanized steel with factory-painted finish, with pitched roof panels and knockouts with grommet seals for electrical and piping connections and lifting lugs.
   1. Exterior Casing Thickness: 18 gauge top cover, 20 gauge access panels and 16 gauge corner posts.

C. Casing Insulation and Adhesive: Comply with NFPA 90A or NFPA 90B.
   1. Materials: ASTM C 1071, Type I.
   2. Thickness: 1-1/2 inch (25 mm).
   3. Liner materials shall have air-stream surface coated with an erosion- and temperature-resistant coating or faced with a plain or coated fibrous mat or fabric.
   4. Liner Adhesive: Comply with ASTM C 916, Type I.

D. Condensate Drain Pans: Formed sections of stainless-steel sheet, a minimum of 2 inches (50 mm) deep, and complying with ASHRAE 62.1-2004.
   1. Double-Wall Construction: Fill space between walls with foam insulation and seal moisture tight.
   2. Drain Connections: Threaded nipple both sides of drain pan.
   3. Pan-Top Surface Coating: Corrosion-resistant compound.

E. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.

2.03 FANS

A. Belt-Driven Supply-Air Fans: Double width, forward curved, centrifugal; with permanently lubricated, single-speed motor installed on an adjustable fan base resiliently mounted in the casing. Aluminum or painted-steel wheels, and galvanized- or painted-steel fan scrolls.

B. Condenser-Coil Fan: Direct-driven propeller with corrosion resistant blades riveted to corrosion resistant steel supports, mounted on shaft of permanently lubricated motor.

C. Fan Motor: Comply with requirements in 23 05 00 Basic Mechanical Materials and Methods.

D. Outdoor-Air-Intake Accessories:

   1. Outside air hood.
   2. Manual volume damper.

2.04 COILS

A. Supply-Air Refrigerant Coil:

1. Aluminum-plate fin and seamless internally grooved copper tube in steel casing with equalizing-type vertical distributor.
2. Polymer strip shall prevent all copper coil from contacting steel coil frame or condensate pan.
3. Coil Split: Interlaced.

B. Outdoor-Air Refrigerant Coil:
1. Aluminum-plate fin and seamless internally grooved copper tube in steel casing with equalizing-type vertical distributor. Microchannel design with two pass arrangement.
2. Polymer strip shall prevent all copper coil from contacting steel coil frame or condensate pan.

2.05 REFRIGERANT CIRCUIT COMPONENTS

A. Number of Refrigerant Circuits: Two.

B. Compressor: Hermetic, scroll, mounted on vibration isolators; with internal overcurrent, short cycle and high-temperature protection, internal pressure relief.

C. Refrigeration Specialties:
1. Refrigerant: R-410A.
2. Expansion valve with replaceable thermostatic element.
3. Refrigerant filter/dryer.
4. Manual-reset high-pressure safety switch.
5. Automatic-reset low-pressure safety switch.
6. Minimum off-time relay.
7. Automatic-reset compressor motor thermal overload.
8. Brass service valves installed in compressor suction and liquid lines.

2.06 AIR FILTRATION

A. Minimum arrestance according to ASHRAE 52.1, and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.
1. Pleated: Minimum MERV 13.

2.07 ELECTRICAL POWER CONNECTION

A. Provide for single connection of power to unit with unit-mounted disconnect switch accessible from outside unit and control-circuit transformer with built-in overcurrent protection.

2.08 CONTROLS

A. Basic Unit Controls:
1. Control-voltage transformer.
2. Programmable Wall-mounted thermostat or sensor with the following features:
a. Heat-cool-off switch.
b. Fan on-auto switch.
c. Fan-speed switch.
d. Automatic changeover.
e. Adjustable deadband.
f. Exposed set point.
g. Exposed indication.
h. Degree F indication.
i. Unoccupied-period-override push button.
j. Data entry and access port to input temperature set points, occupied and unoccupied periods, and output room temperature, supply-air temperature, operating mode, and status.

B. Electronic Controller:
1. Controller shall have volatile-memory backup.
2. Safety Control Operation:

a. Smoke Detectors: Stop fan and close outdoor-air damper if smoke is detected. Provide additional contacts for alarm interface to fire alarm control panel.
b. Low-Discharge Temperature: Stop fan and close outdoor-air damper if supply air temperature is less than 40 deg F (4 deg C).
c. Defrost Control for Condenser Coil: Pressure differential switch to initiate defrost sequence.

3. Scheduled Operation: Occupied and unoccupied periods on seven-day clock with a minimum of four programmable periods per day.
4. Unoccupied Period:
   a. Heating Setback: 10 deg F (5.6 deg C).
   b. Cooling Setback: System off.
   c. Override Operation: Two hours.
5. Supply Fan Operation:
   a. Occupied Periods: Run fan continuously.
   b. Unoccupied Periods: Cycle fan to maintain setback temperature.
6. Refrigerant Circuit Operation:
   a. Occupied Periods: Cycle or stage compressors to match compressor output to cooling load to maintain room temperature. Cycle condenser fans to maintain maximum hot-gas pressure.

2.09 ACCESSORIES

A. Coil guards of painted, galvanized-steel wire.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of RTUs.

B. Examine roughing-in for RTUs to verify actual locations of piping and duct connections before equipment installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
   1. Construct concrete bases of dimensions indicated, but not less than 4 inches (100 mm) larger than supported equipment and minimum 6 inches (150 mm) above finished ground elevation.
   2. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   3. Install anchor bolts to elevations required for proper attachment to supported equipment.
   4. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
   5. Use 3000-psi (20.7-MPa), 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section "Cast-in-Place Concrete."

B. Install seismic restraints according to manufacturer's written instructions.

3.03 CONNECTIONS

A. Install condensate drain, minimum connection size, with trap and indirect connection to nearest roof drain or area drain.

B. Duct installation requirements are specified in other Division 23 Sections. Drawings indicate the general arrangement of ducts. The following are specific connection requirements:
   1. Connect supply ducts to RTUs with flexible duct connectors specified in Division 23 Section "Air Duct Accessories."

3.04 FIELD QUALITY CONTROL

A. 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.

B. Perform tests and inspections and prepare test reports.
   1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing. Report results in writing.

C. Tests and Inspections:
   1. After installing RTUs and after electrical circuitry has been energized, test units for compliance with requirements.
   2. Inspect for and remove shipping bolts, blocks, and tie-down straps.
   3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
   4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Remove and replace malfunctioning units and retest as specified above.

3.05 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

B. Complete installation and startup checks according to manufacturer's written instructions and do the following:
   1. Inspect for visible damage to unit casing.
   2. Inspect for visible damage to furnace combustion chamber.
   3. Inspect for visible damage to compressor, coils, and fans.
   4. Inspect internal insulation.
   5. Verify that labels are clearly visible.
   6. Verify that clearances have been provided for servicing.
   7. Verify that controls are connected and operable.
   8. Verify that filters are installed.
   9. Clean condenser coil and inspect for construction debris.
   10. Clean furnace flue and inspect for construction debris.
   11. Connect and purge gas line.
   12. Remove packing from vibration isolators.
   13. Verify lubrication on fan and motor bearings.
   14. Inspect fan-wheel rotation for movement in correct direction without vibration and binding.
   15. Adjust fan belts to proper alignment and tension.
   16. Start unit according to manufacturer's written instructions.
       a. Start refrigeration system.
       b. Do not operate below recommended low-ambient temperature.
       c. Complete startup sheets and attach copy with Contractor's startup report.
   17. Inspect and record performance of interlocks and protective devices; verify sequences.
   18. Operate unit for an initial period as recommended or required by manufacturer.
   19. Perform the following operations for both minimum and maximum firing. Adjust burner for peak efficiency.
       a. Measure gas pressure on manifold.
       b. Inspect operation of power vents.
       c. Measure combustion-air temperature at inlet to combustion chamber.
       d. Measure flue-gas temperature at furnace discharge.
       e. Perform flue-gas analysis. Measure and record flue-gas carbon dioxide and oxygen concentration.
       f. Measure supply-air temperature and volume when burner is at maximum firing rate and when burner is off. Calculate useful heat to supply air.

20. Calibrate thermostats.
21. Adjust and inspect high-temperature limits.
22. Start refrigeration system and measure and record the following when ambient is a minimum of 15 deg F (8 deg C) above return-air temperature:
    a. Coil leaving-air, dry- and wet-bulb temperatures.
    b. Coil entering-air, dry- and wet-bulb temperatures.
    c. Outdoor-air, dry-bulb temperature.
    d. Outdoor-air-coil, discharge-air, dry-bulb temperature.
23. Inspect controls for correct sequencing of heating, mixing dampers, refrigeration, and normal and emergency shutdown.
24. Measure and record the following minimum and maximum airflows. Plot fan volumes on fan curve.
    a. Supply-air volume.
    b. Outdoor-air intake volume.
25. Simulate maximum cooling demand and inspect the following:
    a. Compressor refrigerant suction and hot-gas pressures.
    b. Short circuiting of air through condenser coil or from condenser fans to outdoor-air intake.
26. Verify operation of remote panel including pilot-light operation and failure modes. Inspect the following:
    a. High-temperature limit on gas-fired heat exchanger.
    b. Low-temperature safety operation.
    c. Filter high-pressure differential alarm.
    d. Smoke and firestat alarms.
27. After startup and performance testing and prior to Substantial Completion, replace existing filters with new filters.

3.06 CLEANING AND ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to site during other-than-normal occupancy hours for this purpose.

B. After completing system installation and testing, adjusting, and balancing RTU and air-distribution systems, clean filter housings and install new filters.

3.07 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain RTUs. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION

SECTION 26 0126
ELECTRICAL ACCEPTANCE AND START- UP TESTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Acceptance and start-up testing requirements for electrical power distribution equipment and systems. Contractor shall retain and pay for the services of a recognized independent testing firm for the purpose of performing inspections and tests as herein specified.
   1. The testing firm shall provide all material, equipment, labor, and technical supervision to perform such tests and inspections.
   2. It is the purpose of these tests to assure that all tested electrical equipment is operational and within industry and manufacturers tolerances and is installed in accordance with design specifications.
   3. Tile tests and inspections shall determine suitability for start-up and energization.
   4. The following equipment shall be tested and calibrated:
      a. Protective relays, instruments, and metering systems.
      b. Grounding system and ground fault protection systems.
      c. Low voltage cables and feeders.

1.02 CODES, STANDARDS, AND REFERENCES

A. All inspections and tests shall be in accordance with the following codes and standards except as provided otherwise herein.
   1. National Electrical Manufacturers Association – NEMA
   2. American Society for Testing and Materials – ASTM
   3. Institute of Electrical and Electronic Engineers – IEEE
   4. InterNational Electrical Testing Association – NETA
      a. Acceptance Testing Specifications – ATS latest edition.
   5. American National Standards Institute – ANSI 02
      a. National Electrical Safety Code.
   6. State and Local Codes and Ordinances.
   7. Insulated Cable Engineers Association – ICEA
   8. Occupational Safety and Health Administration – OSHA
   9. Section 01400 Building System Commissioning Program.
   10. National Fire Protection Association – NFPA
      a. ANSI/NFPA 70: National Electrical
      b. ANSI/NFPA 78: Lightning Protection Code
      c. ANSI/NFPA 101: Life Safety Code

B. All inspections and tests shall utilize the following references.
   1. Project design specifications.
   2. Project design drawings.
   3. Manufacturers instruction manuals applicable to each particular apparatus.
   4. Project list of equipment to be inspected and tested.

1.03 QUALIFICATIONS OF TESTING FIRM

A. The testing firm shall be an independent testing organization which can function as an unbiased testing authority, professionally independent of the manufacturers, suppliers, and installers of equipment.

B. The testing firm shall be regularly engaged in the testing of electrical equipment devices, installations, and systems with at least five (5) years of documented experience.

C. The testing firm shall meet OSHA criteria for accreditation of testing laboratories, or be a full member company of the InterNational Electrical Testing Association (NETA) or qualified to be a member of NETA.

D. The lead on-site, technical person shall be currently certified by the InterNational Electrical Association (NETA) or National Institute for Certification in Engineering Technologies (NICET) in electrical power distribution system testing.

E. The testing firm shall utilize engineers and technicians who are regularly employed by the firm for testing services.

F. The testing firm shall submit proof of the above qualifications with bid documents when requested.

G. The terms used herewithin, such as test agency, test contractor, testing laboratory, or contractor Test Company, shall be construed to mean the testing firm.

1.04 SUBMITTAL

A. Provide submittal per Contract General Conditions, Division 1, and Section 26 05 10.

B. Qualification of testing firm.

C. Certified test reports.

D. Two copies of blank forms for checklists, test reports, and other related forms for Engineer's review and approval.

1.05 GENERAL REQUIREMENTS

A. Routine insulation-resistance, continuity, and rotation tests for all distribution and utilization equipment shall be performed, prior to and in addition to acceptance tests specified herein.

B. The testing firm shall notify the Engineer within 3 working days prior to commencement of any testing.

C. Any system, material, or workmanship which is found defective on the basis of Acceptance Tests shall be reported to the Engineer with corrective recommendations.

D. The testing firm shall maintain a written-record of all tests and, upon completion of project shall assemble and certify a final test report.

E. Test report.

1.06 SAFETY AND PRECAUTIONS

A. Safety practices shall include, but are not limited to the following requirements:
   1. Occupational Safety and Health Act.
   2. Accident Prevention Manual for Industrial Operations, National Safety Council.
   3. Applicable state and local safety operating procedures.
   4. Owners safety practices.
   5. National Fire Protection Association – NFPA 70A.
   6. American National Standards for Personnel Protection.

B. All tests shall be performed with apparatus de-energized. Exceptions must be thoroughly reviewed to identify safety hazards and devise adequate safeguards.

C. The testing firm shall have a designated safety representative on the project to supervise the testing operations with respect to safety.

D. Test Report:
   1. The test report shall include the following:
      a. Summary of project.
      b. Listing of equipment tested.
      c. Test results.
      d. Recommendations.
   2. Furnish copies of the complete report to the Engineer as directed in the contract documents.

1.07 INSPECTION AND TEST PROCEDURES

A. Contractor to provide the testing arm with a copy of related contract documents such as drawings, specifications, engineer reviewed submittals, coordination study report including all relay settings and other necessary information.

B. Contractor to supply a suitable source of power to each site per testing firm requirements.

C. Contractor shall notify the testing firm when equipment becomes available for acceptance tests. Work shall be coordinated to expedite project scheduling.

D. Testing firm to review and evaluate all received documents and notify Contractor and Engineer of any shortcoming documents and/or other requirements immediately.

E. Testing firm to provide and comply with the following:
   1. Acceptance test procedures for each individual equipment listed on Part 1 of this section for Engineer review and approval prior to any test and after thorough evaluation of the system. Testing shall conform to the international Electrical Testing Association (NETA) specifications and standards for electrical power distribution equipment and systems and manufacturer's instructions.
   2. Refer to each individual specification section for testing requirements and comply.
   3. Inspect installed equipment and report any discrepancy and deficiency with contract documents and governing codes prior to testing.

1.08 SYSTEM FUNCTION TEST

A. Perform system function test upon completion of equipment test as defined in this section. It is the purpose of system function tests to prove the proper interaction of all sensing, processing, and action devices.

B. Implementation.
   1. Develop test parameters for the purpose of evaluation performance of all integral components and their functioning as a complete unit within design requirements.
   2. Test all interlocking devices.
   3. Record the operation of alarms and indicating devices.

1.09 DEFICIENCIES

A. All deficiencies reported by testing firm to be corrected by Contractor and Acceptance Test to be re-done accordingly.

END OF SECTION

SECTION 26 0510
GENERAL ELECTRICAL REQUIREMENTS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections.

B. All Specification Sections under Division 26.

1.02 SUMMARY

A. This Section includes:
   1. Definitions.
   2. Excavation.
   3. Coordination of work.
   4. Cleaning, patching repairing and painting.
   5. Guarantees.
   6. Field test.

1.03 REFERENCES

A. American National Standards Institute, Inc. (ANSI) Publications:
   1. C2 - National Electrical Safety Code.

B. California Code of Regulations (CCR) Publications:
   1. Title 8, Industrial Relations.
   2. Title 19, State Fire Marshal Regulations.
   3. Title 24, Part 2, Energy Conservation Standards.
   4. Title 24, Part 3, CCR, California Electrical Code.
   5. Title 24, Part 9, CCR, California Fire Code.

C. National Electrical Manufacturers Association (NEMA) Publication: ICS6-93 Enclosures for Industrial Controls and Systems.

D. National Fire Protection Association (NFPA) Publications:
   1. 70B Recommended Practice for Electrical Equipment Maintenance.
   2. NFPA 101 Life Safety Code.

E. State of California Public Utilities Commission (Cal. P.U.C.) Publications:
   1. G.O. 95 Rules for Construction of Underground Electrical Supply and Communications Rules for Overhead Electric Line Construction.
   2. G.O. 128 Systems.

1.04 DEFINITIONS

A. The following definitions apply to terms used in these standards.
   1. The words "work" or "electrical work" include products, labor, equipment, tools, appliances, transportation, and all related items directly or indirectly required to complete the specified and indicated electrical installation.
   2. The world "concealed" shall meant that the installation will not be visible when all permanent or removable elements of the construction are in place. The word "exposed" shall mean that the installation is visible when all permanent or removable elements of the construction are in place.
   3. The word "code" shall mean any and all regulations and requirements of regulatory bodies, public and private, having jurisdiction over the work involved.
   4. The word "product" used in Division 26 means all material, equipment, machinery, and/or appliances directly or indirectly required to complete the specified and/or indicated electrical work.
   5. The words "standard product" shall mean a manufactured product, illustrated and/or described in catalogs or brochures, that is in general distribution prior to the date of issue

of construction documents. Products will generally be identified by means of a specific catalog number and manufacturer's name.

6. "Provide" means furnish, install, connect and test unless otherwise noted.
7. The words "conduit" and "duct" are used interchangeably and have the same meaning.
8. "UFER" Ground: See Section 26 0526, "Grounding and Bonding".

1.05 DRAWINGS AND SPECIFICATIONS

A. Electrical drawings are diagrammatic but shall be followed as closely as actual construction and work of the other sections shall permit. Size and location of equipment is drawn to scale wherever possible.

B. Drawings and specifications are for the assistance and guidance of the Contractor. Exact locations, distances, and levels will be governed by the building. The Contractor shall make use of data in all the contract documents and verify information at the building site.

C. In any case where there appears to be a conflict or ambiguity between that which is shown on the electrical drawings or in the electrical specifications and any other part of the Contract Documents, it shall be understood that the greater quantity or the better quality shall be used unless a written decision by the owner's representative has been obtained.

D. Drawings and specifications are intended to complement each other. Where a conflict or ambiguity exists between the requirements of the drawings and the specifications, request clarification. Do not proceed with work without direction.

E. The Architect shall interpret the drawings and the specifications. The interpretation by the Architect as to the true intent and meaning thereof and the quality, quantity, and sufficiency of the materials and workmanship furnished there under shall be accepted as final and conclusion.

F. In the case of conflicts or ambiguities not clarified prior to the bidding deadline, use the most costly alternative (better quality, greater quantity, and larger size) in preparing the bid. A clarification will be issued to the successful bidder as soon as feasible after the award and, if appropriate, a deductive change order will be issued. No additional cost shall be approved for failure to use the most costly alternative in the bid.

G. Where items are specified in the singular, this division shall provide the quantity as shown on drawings plus any spares or extras indicated on the drawings or in the specifications.

H. RECORD DRAWINGS

1. On one (1) set of contract drawings, kept at the site during construction, mark all work that is installed differently from that shown on plans, including revised circuitry, material or equipment. Sufficient dimensions shall be provided to locate all materials installed beneath and outside the building including, but not limited to, underground conduits, cabling, ground rods, and stubouts.
2. All changes or revisions to the contract drawings including, but not limited to, those indicated by amendment, change order, field order, written response to RFI/RFC or other contractual means shall be kept current as the work progresses and shall be incorporated onto the final record drawings.
3. Accurately locate and dimension all underground and embedded conduit runs on the record drawings.
4. The marked drawings shall be kept current as the work progresses and shall be available for inspection upon request. At the close of construction, prepare a set of accurate reproducible record drawings and turn them over to the Architect. The correct and completed record drawings are a prerequisite to final contract payment.
    a. As part of the reproducible record drawings, the Contractor shall produce full size reproducible drawings with the: Final panelboard schedules as modified during construction and final light fixture schedule as modified during construction.
    b. These drawings shall be on Architectural base sheets and numerically sequenced to follow the last "E" sheet.
5. As part of the reproducible record drawings, the Contractor shall produce full size

reproducible drawings for all signal systems which shall include exact "As-Built" device locations, "As-Built" interconnection drawings, and "As-Built" riser diagrams, and provide one set in the panel board, motor control center, or main distribution panel.

1.06 EXAMINATION OF SITE

A. Examination of the building site shall be made by the Contractor. The Contractor shall compare it with the drawings and specification and satisfy himself as to the conditions under which work is to be performed. The Contractor shall, at such time, ascertain and check the locations of existing structures or equipment which may affect his work.

1.07 EXCAVATION

A. Prior to starting excavation or trenching, the Contractor shall perform an underground Site Survey utilizing an electronic locator to verify the exact location of all existing underground utility piping, conduits and conductors. The Contractor shall submit for approval a site survey report to the Architect within five (5) working days after the survey is performed. The Site Survey Report shall show the horizontal location for existing utilities and identify any possible conflicts between the new work and existing utilities.

1.08 PERMITS, FEES AND INSPECTIONS

A. Permits, fees, and inspections shall be arranged for and paid by the Contractor.

B. The Contractor shall present to the Architect, properly signed certificates of the final inspection before work will be accepted.

1.09 ELECTRO-MECHANICAL REQUIREMENTS

A. The power wiring, safety switches, combination controllers (indicated on electrical plans), circuit breakers, and motor control equipment forming a part of motor-control centers or switchgear assemblies, and the electrical connection of the mechanical equipment to the electrical power source shall be included under Division 26.

B. The electrical components of mechanical equipment including, but not limited to, motors, motor-starters, control or pushbutton stations, float-pressure switches, solenoid valves, thermostats, junction boxes, and other devices functioning to control mechanical equipment shall be provided under Division 23. Interconnecting wiring for packaged equipment shall be provided as an integral part of the equipment.

C. Control Wiring: Installation of line and low voltage conduit, wiring and junction/outlet boxes not shown on the electrical drawings but required for controlling or monitoring mechanical equipment systems shall be furnished and installed under Division 23. Installation of these shall comply with the requirements of Division 26.

D. If substitution of controls or mechanical equipment other than that specified requires any changes in the electrical work from that shown on the plans or specified in Division 26, any additional cost of the equipment or electrical work shall be the responsibility of Division 23.

1.10 REQUIREMENTS OF REGULATORY AGENCIES

A. Perform work in accordance with all pertaining status, ordinances, laws, rules, codes, regulations, standards local codes and the lawful orders of all public authorities having jurisdiction, the same as if repeated in full herein without limitations.

1.11 SUBMITTALS

A. Submittal requirements for Division 26 shall be in accordance with Division 1 except as modified herein. All time requirements shall be based on the notice to proceed date of the General Contract. All materials and equipment furnished under Division 26 shall; be submitted to the Architect for approval. Such approval shall be in writing from the Architect including that which is exactly as specified. Any materials or equipment installed without written approval shall be subject to immediate removal. Approval of material or equipment shall in no way obviate compliance with the contract documents.

B. Submittals shall be packaged separately for each system or major piece of equipment and reviewed by the Contractor for verification of compliance with the contract documents prior to

submitting to the Architect. Separate, bound submittals shall be provided for each specification section to the Architect. All interface between specification sections shall be indicated in each submittal.

C. All materials and equipment shall be new and shall bear the inspection label of the Underwriters Laboratories (UL) where applicable. Materials and equipment shall be the latest standard product and shall be of the grade indicated by the trade names given.

D. The work shown on the contract drawings is engineered and designed to accommodate the equipment described hereinafter in these specifications.

E. Equipment submittal shall include manufacturer's name, model, type, number, finish, size and capacity of the equipment at the given conditions. This information shall be provided in bound submittals, each containing an index and all submittals. Provide seven (7) copies of each submittal. The title shall provide the project name, system identity, the specification number, and the Contractor's name and address. This submittal shall be in addition to the shop drawings hereinafter specified. Partial submittals of material submitted from time to time are not acceptable and may be returned without review.

F. Submittals shall be reviewed by the Architect for compliance with the contract documents. Submittals found to be incomplete or not in compliance with the contract documents shall be returned for re-submittal. The Architect shall review the original submittal and one (1) re-submittal per section (if required). The Contractor shall reimburse the Architect for all subsequent submittal review.

G. Shop drawings for service entrance equipment shall be submitted to and approved by the serving utility company metering shop prior to submittal to the Architect and Plan Department.

H. Equipment Layout Drawings: "Equipment Layout Drawings" shall be provided for each equipment room, yard or area containing equipment items furnished under Division 26. Layout drawings shall consist of a plan view of the room or area (to a ¼ inch =1 foot – 0 inch minimum scale) showing projected outlines of all equipment, complete with dotted lines indicating all required clearances, including all clearances needed for removal or service. Location of all conduit and pull boxes shall be indicated. Drawings shall indicate any and all conflicts with other trades.

I. All work, materials and equipment shall conform to the following standards:
   1. Basic Electrical Regulations, Title 24, State Building Standards, California Code of Regulations
   2. National Electrical Code
   3. Institute of Electrical and Electronic Engineers (IEEE)
   4. County and City Electrical Codes
   5. American National Standards Institute (ANSI)
   6. American Society for Testing and Materials Standard Tests (ASTM)
   7. Uniform Building Code (UBC)
   8. State Industrial Accident Commission (IAC)
   9. Insulated Power Cable Engineers Association (ICEA)
   10. National Electric Manufacturers Association (NEMA)
   11. National Fire Protection Association (NFPA)
   12. Occupational Safety and Health Act (OSHA)
   13. Underwriters' Laboratories, Inc. (UL)
   14. American Disabilities Act (ADA)
   15. National Electrical Contractors Association Standards for Construction (NECA)
   16. California State and Local Fire Marshal

J. Certified Test Reports: Certified Test Reports are reports of tests conducted on previously manufactured materials or equipment identical to that proposed for use. Before delivery of materials and equipment, submit certified copies of test reports specified in the individual sections.

K. Factory Tests: Factory Tests are tests which are required to be performed on the actual

materials or equipment proposed for use. Submit results of the tests in accordance with the requirements for laboratory test results of this contract.

L. Operation and Maintenance Manual: Furnish an operation and maintenance manual covering the stipulated electrical systems and equipment. Seven copies of the manual, bound in the hardback binders or approved equivalent, shall be provided to the Owner's Representative. Furnish one complete manual prior to the time that system or equipment tests are performed. Furnish the remaining manuals before the contract is completed. The manual shall be complete in all respects for all equipment, controls, accessories, and appurtenances stipulated. All wiring diagrams shall specifically cover the installed system indicating zones, spare zones and spare capacity, wiring, and components added to the system. Typical drawings will not be accepted.

M. Special Submissions:
   1. Test reports for the following:
      a. Ground fault devices.
      b. Megger Readings: Ground system, motors, feeders, switchboards, motor control centers and switchgear.
      c. Voltage Readings: Distribution, service, motors, and transformers.
      d Fire Alarm System.
      e. Power system testing by independent electrical testing laboratory.
   2. A system short circuit on the normal and emergency systems based on available fault symmetrical current as indicated on drawings at high voltage service and emergency generator, calculated by the per unit method or in accordance with the latest Institute Electrical and Electronics Engineers, Inc. (IEEE) recommendations. Reports shall be submitted in copies bound with a stiff cover and shall indicate calculated fault values and equipment ampere interrupting capacities (AIC) for each equipment including downstream panelboards, elevator controllers, dimmer banks, motor control centers, package equipment specified under Division 15, and individual feeder loads. AIC ratings shall be a minimum of 110% of calculated fault values. Reports shall include actual lengths and materials for each feeder per installing Contractor. It shall also include a tabular comparison of equipment withstand and AIC ratings, and calculated fault current at each equipment.

1.12 INCOMING SERVICE

A. Every effort has been made to determine as accurately as possible the requirements of the electrical and communication services. However, before submitting his bid, the Contractor shall verify the locations shown on the plans and shall include sufficient funds for materials and labor for extensions of lines to service locations which are acceptable to the Owner, etc. In addition, all costs levied by the Owner or any other work which is required for electrical, signal and telephone service to the project must be included, at no additional cost to the Owner.

B. Before any work is started on these facilities, verify all electrical, civil, architectural, and structural, dimensional and other requirements related to these facilities with the Owner, and examine the site, and its conditions and include for them in bid. No exception to this shall be permitted, and there shall be no cost to Owner should Contractor not take into account the existing site conditions.

C. Should any major changes to the work indicated be necessary to comply with the service requirements, notify the Architect at once and cease all work affected until approval for required modifications has been obtained from the Architect.

D. Within five days after award of Contract, notify Owner that the project is under construction and furnish them the dates on which the various services will be required. Coordinate with adequate notice, outages required for incoming services to the project.

1.13 SUBSTITUTIONS

A. Equipment submitted for substitution must fit the space conditions shown on the drawings, leaving adequate room for maintenance around all equipment. A minimum of 48 inches (or more if required by Code) must be maintained clear in front of all electrical panels, starters,

gutters or other electrical apparatus. Submit drawings showing the layout, size, and exact method of interconnection of conduit, wiring and controls, which shall conform to the manufacturer's recommendations and these specifications. The scale of these drawings shall be the scale of the contract drawings. The Contractor shall bear the excess costs, by any and all crafts, for fitting the equipment into the space and the system designated. Where additional labor or material is required to permit equipment submitted for substitution to function in an approved manner, this shall be furnished and installed by the Contractor without additional cost to the Owner.

B. No substitutions will be allowed for materials or equipment if three (3) or more manufacturers are indicated No substitutions will be allowed if not submitted within 30 days after notice to proceed.

C. An item submitted for substitution does not constitute an "equal" unless approval by the Architect has been given in writing.

D. Equipment submitted for substitution shall be approved in writing by the Architect and shall be accompanied by the following:
   1. A sample of each item submitted for substitution shall accompany the submittal if requested by the Architect.
   2. A unit price quotation shall be provided with each item intended for substitution. This quote shall include a unit price for the specified item and a unit price for the intended substitute item. The Contractor shall also provide a total (per item) of the differential payback to the Owner should the intended substitute item be approved as equivalent to that which is specified.
   3. The Contractor shall reimburse the Owner for the additional services required by the Architect to review and process substitutions.

E. Substitutions shall be approved in writing by the Architect. The determination of the Architect shall be final.

1.14 WARRANTY

A. Warranty requirements for Division 26 shall be in accordance with Division 1 except as modified herein.

B. All materials and equipment provided shall be warranted for a minimum period of one (1)-year from the official date of completion. In addition, provide two (2)-year extended warranty, for a total of three (3)-years, for the following items:
   1. Distribution Switchboards.
   2. Disconnect Switches.
   3. Panelboards.
   4. Circuit Breakers.

C. The Contractor shall provide all labor and materials required to correct problems which develop during the warranty period due to defective materials of faulty workmanship. The labor and materials to do this work shall be provided at no additional cost to the Owner.

D. Within one (1)-month prior to the expiration of the warranty period, the Contractor shall correct any and all defects covered by the warranty. This shall include tightening to original specifications of all bolted connections.

E. Warranty certificates shall be made out to Owner and shall be delivered to the Architect at the completion of the installation.

F. All equipment shall be guaranteed to be supported in such a way as to be free from objectionable vibration and noise.

G. Additional warranty requirement shall be as indicated in the following sections of Division 16.

1.15 OPERATION AND MAINTENANCE MANUALS

A. The Contractor shall furnish operation and maintenance manuals for each electrical system and for each piece of equipment. The complete manual, bound in hardback binders, or an approved equivalent, shall be provided to the Architect. Provide Seven (7) copies of each

manual. One (1) manual shall be furnished prior to the time that system or equipment tests are performed, and the remaining manuals shall be furnished one (1) week before the final job visit is made. The following identification shall be inscribed on the cover; the words "OPERATION AND MAINTENANCE MANUAL", the name and location of the building, the name of the Contractor, and the contract number.

B. The manual shall include the names, address, and the telephone numbers of each Subcontractor installing equipment and systems, and of the local representatives for each item of equipment and each system. The manual shall have a table of contents and be assembled to conform to the table of contents with tab sheets placed before instructions covering each subject. The instruction sheet shall be legible with large sheets of drawings folded in. The Manual shall include, but not limited to, the following:
   1. System layout showing components.
   2. Devices and controls.
   3. Wiring and control diagrams showing operation and control of each component.
   4. Sequence of operation describing start-up, operation, and shutdown.
   5. Functional description of the principal system components.
   6. Installation instructions.
   7. Maintenance and overhaul instructions.
   8. Lubrication schedule including type, grade, temperature, range, and frequency.
   9. Safety precautions, diagrams and illustrations.
   10. Test procedures.
   11. Performance data.
   12. Parts list.

C. The parts list for equipment shall indicate the sources of supply, recommended spare parts, and the service organization which is reasonably convenient to the building sit. The manual shall be complete in all respects for all equipment, controls, and accessories provided.

1.16 COORDINATION OF ALL WORK

A. Job Visits by the Architect:
   1. Periodic visits to the job by the Architect are for the express purpose of verifying compliance with the contract documents.
   2. Such visits shall not be construed as construction supervision. Neither shall such visits be construed as making the Architect responsible for providing a safe place for the performance of the work by the Contractor or the Contractor’s employees or the safety of the supplies of the Contractor or his Subcontractors.

B. Temporary Electrical Service:
   1. The Contractor shall provide labor and materials required for the installation and maintenance of temporary lighting and required power sources for the Contractor’s equipment inside the building or construction site and for pedestrian walkways during the period of construction.
   2. The building or construction site shall be sufficiently illuminated so that construction work can be safely performed. Special attention shall be given to adequately lighting stairs, ladders, pedestrian walkways, floor openings, etc. Walkway lights shall be controlled by a switch within the building or construction site.
   3. Power shall be on and all lighting shall be in operation before painting work commences.

C. Posted Operating Instructions:
   1. Operating instructions shall be provided by the Contractor at the conclusion of the project for each system and each principal piece of equipment for the use of operating and maintenance personnel. The operating instructions shall include wiring and control diagrams showing the entire system, including, but not limited to, equipment, devices, and control sequences. All operating instruction shall be approved by the Architect.
   2. Operating instructions shall be typewritten or engraved and shall be framed under glass or in approved laminated plastic and posted adjacent to each principal piece of equipment and shall include such instructions as start up, proper adjustment, operation, lubrication,

shutdown, safety-precautions, procedure in the event of equipment failure, and any other necessary items of instructions as recommended by the manufacturer of unit.

3. Operating instructions exposed to the weather shall be made of weather-resisting materials or shall be suitably enclosed to be weather protected. Operating instructions shall not face when exposed to sunlight and shall be secured to prevent easy removal or peeling.

1.17 TRAINING

A. User staff and maintenance personnel shall be thoroughly trained (minimum four (4)-hours) in the use of each system or major piece of equipment installed. This training shall be provided a part of the Contractors bid to supply the system or equipment. Additional training requirements, shall be as specified in the subsequent sections of Division 16.

1.18 DELIVERY AND STORAGE

A. Equipment and materials shall be properly stored, adequately protected, and carefully handled to prevent damage before and during installation. Equipment and materials shall be handled, stored, and protected in accordance with the manufacturer's recommendations and as approved by the Architect. Electrical conduit shall be stored to provide protection from the weather and accidental damage. Plastic conduit shall be stored on even supports and in locations not subject to direct sunrays or excessive heat. Cables shall be sealed, stored, and handled carefully to avoid damage to the outer covering or insulation and damage from moisture and weather. Damaged or defective items shall be replaced with new items a no cost to the Owner. The Architect shall determine if a damaged or defective item is to be replaced with a new item. The decisions by the Architect in these matters shall be final.

END OF SECTION

SECTION 26 0519
BUILDING WIRES AND CABLE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Wire and cable for 600 volts and less.

B. Wiring connectors and connections.

1.02 RELATED SECTIONS

A. Section 02315 - Excavation.

B. Section 02316 - Fill and Backfill: Bedding and backfilling.

C. Section 02317 - Trenching for Site Utilities: Excavating, bedding, and backfilling.

D. Section 26 05 53 – Identification for Electrical Systems.

1.03 REFERENCES

A. NECA 1 - Standard Practices for Good Workmanship in Electrical Contracting; National Electrical Contractors Association; 2010.

B. NETA STD ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems; International Electrical Testing Association; 2003.

C. NFPA 70 - National Electrical Code; National Fire Protection Association; 2014.

1.04 SUBMITTALS

A. See Section 01300 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide for each cable assembly type.

C. Test Reports: Indicate procedures and values obtained.

D. Design Data: Indicate voltage drop and ampacity calculations for aluminum conductors substituted for copper conductors.

E. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency.

F. Project Record Documents: Record actual locations of components and circuits.

1.05 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience and with service facilities within 100 miles (160 km) of Project.

C. Products: Furnish products listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

PART 2 PRODUCTS

2.01 WIRING REQUIREMENTS

A. Concealed Dry Interior Locations: Use only building wire in raceway.

B. Exposed Dry Interior Locations: Use only building wire in raceway.

C. Above Accessible Ceilings: Use only building wire in raceway.

D. Wet or Damp Interior Locations: Use only building wire in raceway.

E. Exterior Locations: Use only building wire in raceway, direct burial cable, or service-entrance cable.

F. Underground Installations: Use only building wire in raceway, direct burial cable, or service-entrance cable.

G. Use solid conductor for feeders and branch circuits 10 AWG and smaller.

H. Use stranded conductors for control circuits.

I. Use conductor not smaller than 12 AWG for power and lighting circuits.

J. Use conductor not smaller than 16 AWG for control circuits.

K. Use 10 AWG conductors for 20 ampere, 120 volt branch circuits longer than 75 feet (25 m).

L. Use 10 AWG conductors for 20 ampere, 277 volt branch circuits longer than 200 feet (60 m).

M. Conductor sizes are based on copper unless indicated as aluminum or "AL".

N. If aluminum conductor is substituted for copper conductor, size to match circuit requirements for conductor ampacity and voltage drop.

2.02 BUILDING WIRE

A. Description: Single conductor insulated wire.

B. Conductor: Copper.
   1. For Sizes Smaller Than 4 AWG: Copper.
   2. For Sizes 4 AWG and Larger: Copper or Aluminum.

C. Insulation Voltage Rating: 600 volts.

D. Insulation: NFPA 70, Type THHN/THWN or Type XHHW.
   1. For Feeders and Branch Circuits Smaller Than 4 AWG: Type THHN/THWN or XHHW.
   2. For Feeders and Branch Circuits Larger Than 4 AWG and larger: Type TW.

E. Insulation: Thermoplastic material rated 75 degrees C.

2.03 SERVICE ENTRANCE CABLE

A. Description: NFPA 70, Type USE.

B. Conductor: Copper.
   1. For Sizes Smaller Than 4 AWG: Copper.
   2. For Sizes 4 AWG and Larger: Copper.

C. Insulation Voltage Rating: 600 volts.

D. Insulation: Type XHHW.

2.04 WIRING CONNECTORS

A. Factory fabricated wiring connectors of size, ampacity rating, material, type, and class for application and service indicated. Furnish products listed and classified by testing firm acceptable to the authority having jurisdiction.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that interior of building has been protected from weather.

B. Verify that mechanical work likely to damage wire and cable has been completed.

C. Verify that raceway installation is complete and supported.

D. Verify that field measurements are as indicated.

3.02 PREPARATION

A. Completely and thoroughly swab raceway before installing wire.

3.03 INSTALLATION

A. Install wire and cable securely, in a neat and workmanlike manner, as specified in NECA

B. Route wire and cable as required to meet project conditions.
   1. Wire and cable routing indicated is approximate unless dimensioned.
   2. Where wire and cable destination are indicated and routing is not shown, determine exact routing and lengths required.
   3. Include wire and cable of lengths required to install connected devices within 10 ft (3000 mm) of location shown.

C. Use wiring methods indicated.

D. Pull all conductors into raceway at same time.

E. Use suitable wire pulling lubricant for building wire 4 AWG and larger.

F. Protect exposed cable from damage.

G. Support cables above accessible ceiling, using plastic cable ties to support cables from structure or ceiling suspension system. Do not rest cable on ceiling panels.

H. Use suitable cable fittings and connectors.

I. Neatly train and lace wiring inside boxes, equipment, and panelboards.

J. Clean conductor surfaces before installing lugs and connectors.

K. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.

L. Terminate aluminum conductors with tin-plated aluminum-bodied compression connectors only. Fill with anti- oxidant compound before installing conductor.

M. Use suitable reducing connectors or mechanical connector adaptors for connecting aluminum conductors to copper conductors.

N. Use split bolt connectors for copper conductor splices and taps, 6 AWG and larger. Tape uninsulated conductors and connector with electrical tape to 150 percent of insulation rating of conductor.

O. Use solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and smaller.

P. Use insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.

Q. Trench and backfill for direct burial cable installation as specified in Sections 02315 and 02316. Install warning tape along entire length of direct burial cable, within 4 inches (100 mm) of grade, as specified in Section 26 05 33.

R. Identify and color code wire and cable under provisions of Section 26 05 53. Identify each conductor with its circuit number or other designation indicated.

3.04 FIELD QUALITY CONTROL

A. Perform field inspection and testing in accordance with Section 01400.

B. Inspect and test in accordance with NETA STD ATS, except Section 4.

C. Perform inspections and tests listed in NETA STD ATS, Section 7.3.2.

END OF SECTION

SECTION 26 0526
GROUNDING AND BONDING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Grounding and bonding components.

B. Provide all components necessary to complete the grounding system(s) consisting of:
   1. Existing metal underground water pipe.
   2. Metal underground water pipe.
   3. Metal frame of the building.
   4. Steel water storage tank and supports.
   5. Concrete-encased electrode.
   6. Ground ring specified in Section 02590.
   7. Existing metal underground gas piping system.
   8. Metal underground gas piping system.
   9. Rod electrodes.
   10. Plate electrodes.

1.02 RELATED SECTIONS

A. Section 02590 - Site Grounding.

B. Section 03200 - Concrete Reinforcement.

C. Section 03300 - Cast-in-Place Concrete.

D. Section 13100 - Lightning Protection.

1.03 REFERENCES

A. NETA STD ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems; International Electrical Testing Association; 2003.

B. NFPA 70 - National Electrical Code; National Fire Protection Association; 2014.

1.04 PERFORMANCE REQUIREMENTS

A. Grounding System Resistance: 25 ohms.

1.05 SUBMITTALS

A. See Section 01300 - Administrative Requirements for submittals procedures.

B. Product Data: Provide for grounding electrodes and connections.

C. Test Reports: Indicate overall resistance to ground.

D. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency specified under Quality Assurance. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

E. Project Record Documents: Record actual locations of components and grounding electrodes.

F. Certificate of Compliance: Indicate approval of installation by authority having jurisdiction.

1.06 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

C. Products: Listed and classified by testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Cooper Power Systems: www.cooperpower.com.

B. Framatome Connectors International: www.fciconnect.com.

C. Lightning Master Corporation: www.lightningmaster.com.

2.02 ELECTRODES

A. Manufacturers:
   1. Cooper Power Systems: www.cooperpower.com.
   2. Framatome Connectors International: www.fciconnect.com.
   3. Lightning Master Corporation: www.lightningmaster.com.
   4. Substitutions: See Section 01600 - Product Requirements.

B. Rod Electrodes: Copper-clad steel.
   1. Diameter: 3/4 inch (19 mm).
   2. Length: 10 feet (3000 mm).

C. Foundation Electrodes: 3/0 AWG.

2.03 CONNECTORS AND ACCESSORIES

A. Mechanical Connectors: Bronze.

B. Exothermic Connections: Cadweld.

C. Wire: Stranded copper.

D. Grounding Electrode Conductor: Size to meet NFPA 70 requirements.

E. Grounding Well:
   1. Well Pipe: 8 inch (200 mm) by 24 inch (600 mm) long clay tile or concrete pipe with belled end.
   2. Well Cover: Cast iron with legend "GROUND" embossed on cover.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions prior to beginning work.

B. Verify that final backfill and compaction has been completed before driving rod electrodes.

3.02 INSTALLATION

A. Install ground electrodes at locations indicated. Install additional rod electrodes as required to achieve specified resistance to ground.

B. Provide grounding well pipe with cover at rod locations where indicated. Install well pipe top flush with finished grade.

C. Install 4 AWG bare copper wire in foundation footing.

D. Provide grounding electrode conductor and connect to reinforcing steel in foundation footing. Bond steel together.

E. Provide bonding to meet requirements described in Quality Assurance.

F. Bond together metal siding not attached to grounded structure; bond to ground.

G. Bond together reinforcing steel and metal accessories in pool and fountain structures.

H. Install ground grid under access floors. Construct grid of 2 AWG bare copper wire installed on 24 inch centers both ways. Bond each access floor pedestal to grid.

I. Bond together each metallic raceway, pipe, duct and other metal object entering space under access floors. Bond to underfloor ground grid. Use 2 AWG bare copper conductor.

J. Provide isolated grounding conductor for circuits supplying electronic cash registers, personal computers, and all other electronic equipment.

K. Provide grounding and bonding in patient care areas to meet requirements of NFPA 99 and NFPA 70.

L. Equipment Grounding Conductor: Provide separate, insulated conductor within each feeder and branch circuit raceway. Terminate each end on suitable lug, bus, or bushing.

M. Interface with site grounding system installed under Section 02590.

N. Interface with lightning protection system installed under Section 13100.

3.03 FIELD QUALITY CONTROL

A. Provide field inspection, testing, and adjusting in accordance with Section 01400.

B. Inspect and test in accordance with NETA STD ATS except Section 4.

C. Perform inspections and tests listed in NETA STD ATS, Section 7.13.

END OF SECTION

SECTION 26 0529
HANGERS AND SUPPORTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Conduit and equipment supports.

B. Anchors and fasteners.

1.02 REFERENCES

A. NECA 1 - Standard Practices for Good Workmanship in Electrical Contracting; National Electrical Contractors Association; 2010.

B. NFPA 70 - National Electrical Code; National Fire Protection Association; 2014.

1.03 SUBMITTALS

A. See Section 01300 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer’s catalog data for fastening systems.

C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.04 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Products: Listed and classified by testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Thomas & Betts Corporation: www.tnb.com.

B. Threaded Rod Company: www.threadedrod.com.

2.02 MATERIALS

A. Hangers, Supports, Anchors, and Fasteners - General: Corrosion-resistant materials of size and type adequate to carry the loads of equipment and conduit, including weight of wire in conduit.

B. Supports: Fabricated of structural steel or formed steel members; galvanized.

C. Anchors and Fasteners:
   1. Obtain permission from Architect before using powder-actuated anchors.
   2. Concrete Structural Elements: Use precast inserts.
   3. Steel Structural Elements: Use beam clamps or steel spring clips.
   4. Concrete Surfaces: Use self-drilling anchors or expansion anchors.
   5. Hollow Masonry, Plaster, and Gypsum Board Partitions: Use toggle bolts or hollow wall fasteners.
   6. Solid Masonry Walls: Use preset inserts.
   7. Sheet Metal: Use sheet metal screws.
   8. Wood Elements: Use wood screws.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install hangers and supports as required to adequately and securely support electrical system components, in a neat and workmanlike manner, as specified in NECA 1.
   1. Do not fasten supports to pipes, ducts, mechanical equipment, or conduit.
   2. Do not drill or cut structural members.
   3. Obtain permission from Architect before drilling or cutting structural members.

B. Rigidly weld support members or use hexagon-head bolts to present neat appearance with adequate strength and rigidity. Use spring lock washers under all nuts.

C. Install surface-mounted cabinets and panelboards with minimum of four anchors.

D. In wet and damp locations use steel channel supports to stand cabinets and panelboards 1 inch (25 mm) off wall.

E. Use sheet metal channel to bridge studs above and below cabinets and panelboards recessed in hollow partitions.

END OF SECTION

SECTION 26 0533
RACEWAYS, FITTINGS AND BOXES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Conduit, fittings and conduit bodies.

1.02 RELATED SECTIONS

A. Section 02582 - Underground Electrical Ducts and Manholes.

B. Section 07840 - Firestopping.

C. Section 26 05 26 - Grounding and Bonding.

D. Section 26 05 29 - Hangers and Supports for Electrical Systems.

E. Section 26 05 53 - Identification for Electrical Systems.

1.03 REFERENCES

A. ANSI C80.1 - American National Standard for Electrical Rigid Steel Conduit (ERSC); 2005.

B. ANSI C80.3 - American National Standard for Steel Electrical Metallic Tubing (EMT); 2005.

C. ANSI C80.5 - American National Standard for Electrical Rigid Aluminum Conduit (ERAC); 2005.

D. NECA 1 - Standard Practices for Good Workmanship in Electrical Contracting; National Electrical Contractors Association; 2010.

E. NECA 101 - Standard for Installing Steel Conduit (Rigid, IMC, EMT); National Electrical Contractors Association; 2006.

F. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; National Electrical Manufacturers Association; 2007.

G. NEMA RN 1 - Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit; National Electrical Manufacturers Association; 2005.

H. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Tubing and Conduit; National Electrical Manufacturers Association; 2013.

I. NEMA TC 3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing; National Electrical Manufacturers Association; 2013.

J. NFPA 70 - National Electrical Code; National Fire Protection Association; 2014.

1.04 SUBMITTALS

A. See Section 01300 - Administrative Requirements for submittals procedures.

B. Product Data: Provide for metallic conduit, flexible metal conduit, liquidtight flexible metal conduit, metallic tubing, nonmetallic conduit, flexible nonmetallic conduit, nonmetallic tubing, fittings, and conduit bodies.

C. Project Record Documents: Accurately record actual routing of conduits larger than 2 inches (51 mm).

1.05 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Products: Listed and classified by testing firm acceptable to authority having jurisdiction as suitable for purpose specified and shown.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Accept conduit on site. Inspect for damage.

B. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.

C. Protect PVC conduit from sunlight.

PART 2 PRODUCTS

2.01 CONDUIT REQUIREMENTS

A. Conduit Size: Comply with NFPA 70.
   1. Minimum Size: 1/2 inch (13 mm) unless otherwise specified.

B. Underground Installations:
   1. More than Five Feet (1.5 Meters) from Foundation Wall: Use thickwall non-metallic conduit.
   2. Within Five Feet (1.5 Meters) from Foundation Wall: Use thickwall nonmetallic conduit.
   3. In or Under Slab on Grade: Use rigid steel conduit, intermediate metal conduit, plastic coated conduit, thickwall non-metallic conduit, or thinwall non-metallic conduit.
   4. Minimum Size: 3/4 inch (19 mm).

C. Outdoor Locations Above Grade: Use intermediate metal conduit.

D. In Slab Above Grade:
   1. Use thickwall nonmetallic conduit.
   2. Maximum Size Conduit in Slab: 3/4 inch (19 mm); 1/2 inch (13 mm) for conduits crossing each other.

E. Wet and Damp Locations: Use thickwall nonmetallic conduit.

F. Dry Locations:
   1. Concealed: Use electrical metallic tubing.
   2. Exposed: Use intermediate metal conduit.

2.02 METAL CONDUIT

A. Manufacturers:
   1. Allied Tube & Conduit: www.alliedtube.com.
   2. Beck Manufacturing, Inc: www.beckmfg.com.
   3. Wheatland Tube Company: www.wheatland.com.
   4. Substitutions: See Product Requirements Spec section.

B. Rigid Steel Conduit: ANSI C80.1.

C. Rigid Aluminum Conduit: ANSI C80.5.

D. Intermediate Metal Conduit (IMC): Rigid steel.

E. Fittings and Conduit Bodies: NEMA FB 1; material to match conduit.

2.03 PVC COATED METAL CONDUIT

A. Manufacturers:
   1. Allied Tube & Conduit: www.alliedtube.com.
   2. Thomas & Betts Corporation: www.tnb.com.
   3. Robroy Industries: www.robroy.com.

B. Description: NEMA RN 1; rigid steel conduit with external PVC coating, 40 mil (0.1 mm) thick.

C. Fittings and Conduit Bodies: NEMA FB 1; steel fittings with external PVC coating to match conduit.

2.04 FLEXIBLE METAL CONDUIT

A. Manufacturers:
   1. AFC Cable Systems, Inc: www.afcweb.com.
   2. Electri-Flex Company: www.electriflex.com.
   3. International Metal Hose: www.metalhose.com.

B. Description: Interlocked steel construction.

C. Fittings: NEMA FB 1.

2.05 LIQUIDTIGHT FLEXIBLE METAL CONDUIT

A. Manufacturers:

1. AFC Cable Systems, Inc: www.afcweb.com.
2. Electri-Flex Company: www.electriflex.com.
3. International Metal Hose: www.metalhose.com.

B. Description: Interlocked steel construction with PVC jacket.

C. Fittings: NEMA FB 1.

2.06 ELECTRICAL METALLIC TUBING (EMT)

A. Manufacturers:
1. Allied Tube & Conduit: www.alliedtube.com.
2. Beck Manufacturing, Inc: www.beckmfg.com.
3. Wheatland Tube Company: www.wheatland.com.

B. Description: ANSI C80.3; galvanized tubing.

C. Fittings and Conduit Bodies: NEMA FB 1; steel or malleable iron compression type.

2.07 NONMETALLIC CONDUIT

A. Manufacturers:
1. AFC Cable Systems, Inc: www.afcweb.com.
2. Electri-Flex Company: www.electriflex.com.
3. International Metal Hose: www.metalhose.com.
4. Substitutions: See Product Requirements Spec section.

B. Description: NEMA TC 2; Schedule 40 PVC.

C. Fittings and Conduit Bodies: NEMA TC 3.

2.08 NONMETALLIC TUBING

A. Manufacturers:
1. Beck Manufacturing, Inc: www.beckmfg.com.
2. Cantex, Inc: www.cantexinc.com.
3. Lamson & Sessions (Carlon): www.carlon.com.
4. Substitutions See Product Requirements Spec section.

B. Description: NEMA TC 2.

C. Fittings and Conduit Bodies: NEMA TC 3.

2.09 BOXES, ENCLOSURES, AND CABINETS

A. Manufacturers:
1. Appleton Electric: www.appletonelec.com.
2. Arc-Co/Division of Arcade Technology: www.arc-co.com.
3. Unity Manufacturing: www.unitymfg.com.

2.10 OUTLET BOXES

A. Sheet Metal Outlet Boxes: NEMA OS 1, galvanized steel.
1. Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; include 1/2 inch (13 mm) male fixture studs where required.
2. Concrete Ceiling Boxes: Concrete type.

B. Nonmetallic Outlet Boxes: NEMA OS 2.

C. Cast Boxes: NEMA FB 1, Type FD, cast feralloy. Provide gasketed cover by box manufacturer. Provide threaded hubs.

D. Wall Plates for Finished Areas: As specified in Section 26 02726.

2.11 FLOOR BOXES

A. Floor Boxes: NEMA OS 1, fully adjustable, 1-1/2 inches (38 mm) deep.

B. Material: Cast metal.

C. Shape: Octagonal.

D. Service Fittings: As specified in Section 26 2726.

2.12 PULL AND JUNCTION BOXES

A. Sheet Metal Boxes: NEMA OS 1, galvanized steel.

B. Hinged Enclosures: As specified in Section 26 0533.

C. Surface Mounted Cast Metal Box: NEMA 250, Type 4; flat-flanged, surface mounted junction box:
   1. Material: Galvanized cast iron.
   2. Cover: Furnish with ground flange, neoprene gasket, and stainless steel cover screws.

D. In-Ground Cast Metal Box: NEMA 250, Type 6, outside or inside flanged, recessed cover box for flush mounting:
   1. Material: Galvanized cast iron or Cast aluminum.
   2. Cover: Smooth cover with neoprene gasket and stainless steel cover screws.
   3. Cover Legend: "ELECTRIC".

E. Fiberglass Handholes: Die molded glass fiber hand holes:
   1. Cable Entrance: Pre-cut 6 x 6 inch (150 x 150 mm) cable entrance at center bottom of each side.
   2. Cover: Glass fiber weatherproof cover with nonskid finish.

2.13 CABINETS AND ENCLOSURES

A. Manufacturers:
   1. Cooper B-Line: www.bline.com.
   2. Qube Corporation: www.qubeinc.com.
   3. Robroy Industries: www.robroy.com.

2.14 HINGED COVER ENCLOSURES

A. Construction: NEMA 250, Type 1 steel enclosure.

B. Covers: Continuous hinge, held closed by flush latch operable by key.

C. Provide interior plywood panel for mounting terminal blocks and electrical components; finish with white enamel.

D. Enclosure Finish: Manufacturer's standard enamel.

2.15 CABINETS

A. Boxes: Galvanized steel.

B. Backboard: Provide 3/4 inch (19 mm) thick plywood backboard for mounting terminal blocks. Paint matte white.

C. Fronts: Steel, flush or surface type with concealed trim clamps, door with concealed hinge, and flush lock keyed to match branch circuit panelboard.

D. Knockouts:

E. Provide metal barriers to form separate compartments wiring of different systems and voltages.

F. Provide accessory feet for free-standing equipment.

2.16 TERMINAL BLOCKS

A. Manufacturers:
   1. Allen-Bradley/Rockwell Automation: www.ab.com.
   2. Cooper Bussmann: www.bussmann.com.
   3. WECO Electrical Connectors Inc: www.weco.ca.

B. Terminal Blocks: NEMA ICS 4.

C. Power Terminals: Unit construction type with closed back and tubular pressure screw connectors, rated 600 volts.

D. Signal and Control Terminals: Modular construction type, suitable for channel mounting, with tubular pressure screw connectors, rated 300 volts.

E. Provide ground bus terminal block, with each connector bonded to enclosure.

2.17 ACCESSORIES

A. Plastic Raceway: Plastic channel with hinged or snap-on cover.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as shown on drawings.

B. Verify routing and termination locations of conduit prior to rough-in.

C. Conduit routing is shown on drawings in approximate locations unless dimensioned. Route as required to complete wiring system.

D. Verify locations of floor boxes and outlets in offices and work areas prior to rough-in.

3.02 INSTALLATION

A. Install conduit securely, in a neat and workmanlike manner, as specified in NECA 1.

B. Install steel conduit as specified in NECA 101.

C. Install nonmetallic conduit in accordance with manufacturer's instructions.

D. Arrange supports to prevent misalignment during wiring installation.

E. Support conduit using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers.

F. Group related conduits; support using conduit rack. Construct rack using steel channel; provide space on each for 25 percent additional conduits.

G. Fasten conduit supports to building structure and surfaces under provisions of Section 26 0529.

H. Do not support conduit with wire or perforated pipe straps. Remove wire used for temporary supports.

I. Do not attach conduit to ceiling support wires.

J. Arrange conduit to maintain headroom and present neat appearance.

K. Route exposed conduit parallel and perpendicular to walls.

L. Route conduit installed above accessible ceilings parallel and perpendicular to walls.

M. Route conduit in and under slab from point-to-point.

N. Do not cross conduits in slab.

O. Maintain adequate clearance between conduit and piping.

P. Maintain 12 inch (300 mm) clearance between conduit and surfaces with temperatures exceeding 104 degrees F (40 degrees C).

Q. Cut conduit square using saw or pipecutter; de-burr cut ends.

R. Bring conduit to shoulder of fittings; fasten securely.

S. Join nonmetallic conduit using cement as recommended by manufacturer. Wipe nonmetallic conduit dry and clean before joining. Apply full even coat of cement to entire area inserted in fitting. Allow joint to cure for 20 minutes, minimum.

T. Use conduit hubs or sealing locknuts to fasten conduit to sheet metal boxes in damp and wet locations, and to cast boxes.

U. Install no more than equivalent of three 90 degree bends between boxes. Use conduit bodies to make sharp changes in direction, as around beams. Use hydraulic one shot bender to fabricate or factory elbows for bends in metal conduit larger than 2 inch (50 mm) size.

V. Avoid moisture traps; provide junction box with drain fitting at low points in conduit system.

W. Provide suitable fittings to accommodate expansion and deflection where conduit crosses seismic, control, and expansion joints.

X. Provide suitable pull string in each empty conduit except sleeves and nipples.

Y. Use suitable caps to protect installed conduit against entrance of dirt and moisture.

Z. Ground and bond conduit under provisions of Section 26 0526.

AA. Identify conduit under provisions of Section 26 0553.

AB. Install boxes securely, in a neat and workmanlike manner, as specified in NECA 1.

AC. Install in locations as shown on Drawings, and as required for splices, taps, wire pulling, equipment connections, and as required by NFPA 70.

AD. Coordinate installation of outlet boxes for equipment connected under Section 26 0534.

AE. Set wall mounted boxes at elevations to accommodate mounting heights indicated.

AF. Electrical boxes are shown on Drawings in approximate locations unless dimensioned.
1. Adjust box locations up to 10 feet (3 m) if required to accommodate intended purpose.

AG. Orient boxes to accommodate wiring devices oriented as specified in Section 26 0534.

AH. Maintain headroom and present neat mechanical appearance.

AI. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.

AJ. Inaccessible Ceiling Areas: Install outlet and junction boxes no more than 6 inches (150 mm) from ceiling access panel or from removable recessed luminaire.

AK. Install boxes to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07840.

AL. Coordinate mounting heights and locations of outlets mounted above counters, benches, and backsplashes.

AM. Locate outlet boxes to allow luminaires positioned as shown on reflected ceiling plan.

AN. Align adjacent wall mounted outlet boxes for switches, thermostats, and similar devices.

AO. Use flush mounting outlet box in finished areas.

AP. Locate flush mounting box in masonry wall to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat opening.

AQ. Do not install flush mounting box back-to-back in walls; provide minimum 6 inches (150 mm) separation. Provide minimum 24 inches (600 mm) separation in acoustic rated walls.

AR. Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness.

AS. Use stamped steel bridges to fasten flush mounting outlet box between studs.

AT. Install flush mounting box without damaging wall insulation or reducing its effectiveness.

AU. Use adjustable steel channel fasteners for hung ceiling outlet box.

AV. Do not fasten boxes to ceiling support wires.

AW. Support boxes independently of conduit, except cast box that is connected to two rigid metal conduits both supported within 12 inches (305 mm) of box.

AX. Use gang box where more than one device is mounted together. Do not use sectional box.

AY. Use gang box with plaster ring for single device outlets.

AZ. Use cast outlet box in exterior locations exposed to the weather and wet locations.

BA. Use cast floor boxes for installations in slab on grade; formed steel boxes are acceptable for other installations.

BB. Set floor boxes level.

BC. Large Pull Boxes: Use hinged enclosure in interior dry locations, surface-mounted cast metal box in other locations.

BD. Clean electrical parts to remove conductive and harmful materials.

BE. Remove dirt and debris from enclosure.

BF. Clean finishes and touch up damage.

3.03 ADJUSTING

A. Adjust floor boxes flush with finish flooring material.

B. Adjust flush-mounting outlets to make front flush with finished wall material.

C. Install knockout closures in unused box openings.

3.04 CLEANING

A. Clean interior of boxes to remove dust, debris, and other material.

B. Clean exposed surfaces and restore finish.

C. Clean electrical parts to remove conductive and harmful materials.

D. Remove dirt and debris from enclosure.

E. Clean finishes and touch up damage.

END OF SECTION

SECTION 26 0534
OUTLET, PULL AND JUNCTION BOXES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Provisions of Section 26 05 10, "General Electrical Requirements".

1.02 REFERENCES

A. National Electrical Manufacturers Association.

B. American Society for Testing and Materials.

C. National Electrical Code
   1. Division 2 Section "Underground Ducts and Utility Structures" for exterior ductbanks, manholes, and underground utility construction.
   2. Division 7 Section "Through-Penetration Firestop Systems" for firestopping materials and installation at penetrations through walls, ceilings, and other fire-rated elements.
   3. Division 26 Section "General Electrical Requirements" for supports, anchors, and identification products.

1.03 SUMMARY

A. Outlet Boxes.

B. Pull Boxes.

C. Junction Boxes.

D. Floor Boxes.

1.04 WARRANTY:

A. Warranty shall comply with the provisions of Section 26 05 10, "General Electrical Requirements".

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. The size of each outlet or junction box shall be determined by the number and sizes of wires and conduits entering the box but shall be not less than 4-inch square and 2-1/8-inches deep unless otherwise indicated.

B. Outlet and junction boxes for interior use shall be galvanized or sherardized, one-piece pressed or welded steel, knockout type, except where other types of boxes are indicated or specified.

C. Outlet and junction boxes for exterior use shall be lug type "Bell" boxes "250L" through "254L", "Crouse-Hinds FS" type, as applicable or equal.

D. Outlet boxes shall be equipped with plaster rings, inserts and fixture studs as may be required. Knockout seals shall be provided where knockouts are not intact.

E. Plastic, fiber or composition boxes shall not be permitted.

F. Telecommunication Outlets: Voice and data wall outlet boxes shall be 4-11/16-inch square by 2-1/8-inch deep metal boxes, with plaster ring.

G. Outlet boxes for hazardous locations (Class I, Groups A, B, C, and D; and Class II, groups D, F and G) shall be in accordance with U.L. 886.

H. All exterior pull boxes, plates, fittings, etc., mounted below 10 feet – 0 inch in height shall be fitted with rustproof, tamperproof screws. Provide Owner with two (2) screw drivers (or wrenches) to fit special screws. Screws shall be Spanner, Key Slot, or Rosette.

I. Boxes in concrete shall be of the type to allow placing of conduit without displacing reinforcing bars and shall be type approved for concrete use. Boxes installed in poured concrete shall be packed with approved material to prevent concrete entering box. Do not use paper for such packing.

J. Floor boxes shall be Walker Box Resource RFB or equal, no known equal series with brass plates and brass carpet flanges for carpeted areas.

PART 3 EXECUTION

3.01 INSTALLATION

A. Outlet boxes shall be securely and independently fastened to the structure and in concealed work shall be supported flush with finished surface of walls or ceiling.

B. Bar hangers fitted with fixture studs shall be used to support and outlet boxes in stud partitions and in furred or plastered ceilings.

C. Fasteners shall be machine screws, nut and lock washers in metal, wood screws, in wood, or expansion shields or inserts in masonry or concrete. Wooden inserts will not be acceptable.

D. Label outside of box to identify panel and circuit numbers. Use indelible markers, non-erasing type, for boxes above ceilings or in concealed locations.

E. Fire alarm boxes shall be painted red.

END OF SECTION

SECTION 26 0553
ELECTRICAL IDENTIFICATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Nameplates and labels.

B. Wire and cable markers.

C. Conduit markers.

D. Field-painted identification of conduit.

1.02 RELATED SECTIONS

A. Section 09900 - Paints and Coatings.

1.03 REFERENCES

A. NFPA 70 - National Electrical Code; National Fire Protection Association; 2014.

1.04 SUBMITTALS

A. See Section 01300 - Administrative Requirements for submittals procedures.

B. Product Data: Provide catalog data for nameplates, labels, and markers.

C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency specified under Quality Assurance. Include instructions for storage, handling, protection, examination, preparation and installation of product.

1.05 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Products: Listed and classified by testing firm acceptable to authority having jurisdiction as suitable for purpose specified and shown.

1.06 EXTRA MATERIALS

A. See Section 01600 - Product Requirements for additional requirements.

PART 2 PRODUCTS

2.01 NAMEPLATES AND LABELS

A. Nameplates: Engraved three-layer laminated plastic, black letters on white background.

B. Locations:
   1. Each electrical distribution and control equipment enclosure.
   2. Communication cabinets.

C. Letter Size:
   1. Use 1/8 inch (3 mm) letters for identifying individual equipment and loads.
   2. Use 1/4 inch (6 mm) letters for identifying grouped equipment and loads.

D. Labels: Embossed adhesive tape, with 3/16 inch (5 mm) white letters on black background. Use only for identification of individual wall switches and receptacles, and control device stations.

2.02 WIRE MARKERS

A. Description: Cloth, tape, split sleeve, or tubing type wire markers.

B. Locations: Each conductor at panelboard gutters, pull boxes, outlet boxes, junction boxes, and at each load connection.

C. Legend:
   1. Power and Lighting Circuits: Branch circuit or feeder number indicated on drawings.
   2. Control Circuits: Control wire number indicated on schematic and interconnection

diagrams on drawings.

2.03 CONDUIT MARKERS

A. Location: Furnish markers for each conduit longer than 6 feet (2 m).

B. Spacing: 20 feet (6 m) on center.

C. Color:
   1. 480 Volt System: Orange.
   2. 208 Volt System: Black.
   3. Fire Alarm System: Red.
   4. Telephone System: Blue.

D. Legend:
   1. 480 Volt System: Orange.
   2. 208 Volt System: Black.
   3. Fire Alarm System: Red.
   4. Telephone System: Blue.

2.04 UNDERGROUND WARNING TAPE

A. Description: 4 inch (100 mm) wide plastic tape, detectable type colored yellow with suitable warning legend describing buried electrical lines.

PART 3 EXECUTION

3.01 PREPARATION

A. Degrease and clean surfaces to receive nameplates and labels.

3.02 INSTALLATION

A. Install nameplates and labels parallel to equipment lines.

B. Secure nameplates to equipment front using adhesive.

C. Secure nameplates to inside surface of door on panelboard that is recessed in finished locations.

D. Identify conduit using field painting under provisions of Division 1.
   1. Paint colored band on each conduit longer than 6 feet (2 m).
   2. Paint bands 20 feet (6 m) on center.
   3. Colors:
      a. 480 Volt System: Orange.
      b. 208 Volt System: Black.
      c. Fire Alarm System: Red.
      d. Telephone System: Blue.

E. Identify underground conduits using underground warning tape. Install one tape per trench at 3 inches (75 mm) below finished grade.

END OF SECTION

SECTION 26 0573
OVERCURRENT PROTECTIVE DEVICES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. The provisions of Section 26 05 10," General Electrical Requirements" and Section 26 27 26, "Wiring Devices".

1.02 REFERENCES

A. National Electrical Manufacturer Association FU 1.

B. National Electrical Code.

1.03 SUMMARY

A. Circuit breakers (each type and style).

B. Circuit breaker handle padlock assembly.

C. Fuses (each type and style).

D. Disconnect switches (each type and size).

E. Enclosures (each type and style).

1.04 WARRANTY

A. Warranty shall comply with the provisions of Section 26 05 10, "General Electrical Requirements".

PART 2 PRODUCTS

2.01 CIRCUIT BREAKERS

A. Circuit breakers for panelboards, distribution panelboards, distribution switchboards, and main service equipment shall be the manufactured product of the same manufacturer as the equipment in which the circuit breaker is installed.

B. Circuit breakers for panelboards and distribution panelboards shall be bolt-on type. Handle ties and dual, quad or tandem breakers are not acceptable. Mounting hardware, accessories, faceplates, enclosures, etc., shall be provided as required. Each and every circuit breaker shall be provided with a handle padlock attachment. This attachment shall allow the circuit breaker to be padlocked in either the "ON" or "OFF" position. Circuit breakers for distribution switchboards and main service equipment shall be as specified in Section 26 24 16, "Panelboards".

C. Circuit breakers shall be quick-break on manual and automatic operation, and the handle mechanism shall be trip-free to prevent holding contact closed against a short circuit or sustained overload. Contacts shall be of high pressure butt-type and shall be made of a silver alloy material. Arc chutes shall be provided. Automatic thermal and magnetic tripping devices shall be located in each pole for the breaker. The thermal device shall provide time delay tripping on overloads and the magnetic device shall provide instantaneous tripping on short circuits. Circuit breakers with frame sizes above 100 amperes shall have an instantaneous-magnetic trip adjustment of ten times the circuit breaker’s continuous amp rating (unless otherwise indicated). These adjustments shall be accessible from the front of the breaker.

D. Circuit breakers used for switching lighting loads directly shall be approved Type "SW".

E. Circuit breakers used to control motor loads directly shall be approved Type "HACR".

F. Short circuit interrupting capacity shall be as indicated on the plans and shall in no case be less than 10,000 amps symmetrical at 208/120 volt.

G. Circuit breakers provided for installation in existing switchboards or panelboards shall be of the same manufacturer as the existing switchboards or panelboards. The minimum A.I.C. shall not be less than that of the lowest rated device in the existing switchboard or panelboard.

2.02 FUSES:

A. Fuse identification labels, showing size and type installed, shall be placed inside the cover of each switch or fused circuit breaker.

B. All fuses shall be of one (1) manufacturer unless otherwise noted to ensure selective operation of protective devices.

C. Fuses shall be as manufactured by Bussmann, Gould-Shawmut, or Brush unless otherwise indicated.

D. Fuses shall be of the following type:
   1. Fuses 601 A through 6000 A serving all type of loads shall be U.L. Class L, type KRP-C.
   2. Fuses installed in safety switches at motor locations shall be 600 V, FRS or 250V, FRN.
   3. Fuses 1/10 A through 600 A shall be U.L. Class RK1; 600V, LPS-RK; 250V, LPN-RK, unless otherwise noted.

E. Spare fuses shall be provided in the amount of 20 percent of each size and type installed, but in no case shall be less than three (3) of each specified size and type supplied. These spares shall be neatly enclosed in a suitable cabinet or cabinets.

2.03 DISCONNECT SWITCHES:

A. The disconnect switches shall be heavy duty 240 volt type, externally operated, quick-made, quick-break knife switches, fused or non-fused as required. The number of poles and ampere rating shall be as shown on plans. Fused switches shall have Class "R" rejection features. All switches shall have a U.L. listed short circuit withstand rating. Switches in interior dry location shall be NEMA 1 enclosures. Switches in damp or exterior locations shall have NEMA 3R raintight enclosures. Switches shall be horsepower rated, unless otherwise specified.

B. If double lugging or oversized wires are required, provide a wireway or splice box.

C. Provide fuses as specified in this section. Fuses shall be installed so that the rating is clearly visible without removing fuse.

D. Provide a nameplate on each switch as specified in Section 26 05 53, "Electrical Identification". Nameplate shall indicate load served, source and circuit number.

E. Submit data on switches with drawings of the main switchboard, distribution switchboards or distribution panelboards, where switches are an assembled part.

PART 3 EXECUTION

3.01 INSTALLATION

A. Bolted connections shall be torque-tightened to manufacturer’s specifications.

B. Clipping of wires from standard cable to fit connector shall not be permitted. Appropriate connecting device shall be provided for multiple cable connections.

C. Install disconnect switches in locations shown on plans. Test switches a minimum of three (3) times to ensure correct operation.

3.02 TESTS:

A. Each and every circuit breaker shall be tested under load a minimum of three (3) times.

END OF SECTION

SECTION 26 2726
WIRING DEVICES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Wall switches.

B. Wall dimmers.

C. Receptacles.

D. Device plates and decorative box covers.

E. Floor box service fittings.

F. Access floor boxes.

1.02 RELATED SECTIONS

A. Section 26 05 33 – Raceway and Boxes for Electrical Systems.

1.03 REFERENCES

A. NECA 1 - Standard Practices for Good Workmanship in Electrical Contracting; National Electrical Contractors Association; 2010.

B. NEMA WD 1 - General Color Requirements for Wiring Devices; National Electrical Manufacturers Association; 2002 (R 2008).

C. NEMA WD 6 - Wiring Device -- Dimensional Requirements; National Electrical Manufacturers Association; 2002.

D. NFPA 70 - National Electrical Code; National Fire Protection Association; 2014.

1.04 SUBMITTALS

A. See Section 01300 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's catalog information showing dimensions, colors, and configurations.

C. Manufacturer's Installation Instructions.

1.05 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

C. Products: Provide products listed and classified by testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Cooper Wiring Devices: www.cooperwiringdevices.com.

B. GE Industrial: www.geindustrial.com.

C. Leviton Manufacturing, Inc: www.leviton.com.

2.02 WALL SWITCHES

A. Wall Switches: Heavy Duty, AC only general-use snap switch, complying with NEMA WD 6 and WD 1.
   1. Body and Handle: White plastic with toggle handle.
   2. Indicator Light: Light handle type switch.
   3. Locator Light: Lighted handle type switch; red color handle.
   4. Ratings:
      a. Voltage: 120 - 277 volts, AC.

b. Current: 20 amperes.

B. Switch Types: Single pole, double pole, 3-way, 4-way, pilot gang, and locator.

2.03 WALL DIMMERS

A. Wall Dimmers: Semiconductor dimmer for incandescent lamps, Type as indicated on drawings, complying with NEMA WD 6 and WD 1.
1. Body and Handle: White plastic with linear slide.
2. Voltage: 120 volts.
3. Power Rating: Match load shown on drawings; 600 watts minimum.

B. Accessory Wall Switches: Match dimmer appearance.

2.04 RECEPTACLES

A. Receptacles: Heavy duty, industrial type, complying with NEMA WD 6 and WD 1.
1. Device Body: White plastic – Normal power, Red plastic – Emergency power
2. Configuration: NEMA WD 6, type as specified and indicated.

B. Convenience Receptacles: Type 5 - 20.

C. Single Convenience Receptacles.

D. Duplex Convenience Receptacles.

E. GFCI Receptacles: Convenience receptacle with integral ground fault circuit interrupter to meet regulatory requirements.

2.05 WALL PLATES

A. Decorative Cover Plates: White, smooth plastic.

B. Jumbo Cover Plates: White, smooth plastic.

C. Weatherproof Cover Plates: Gasketed cast metal with hinged.

D. Covers for weatherproof receptacles shall be such that the weatherproof integrity of the receptacle is maintained while in use.

2.06 FLOOR MOUNTED SERVICE FITTINGS

A. Pedestal Convenience Receptacles:
1. Housing: Satin aluminum.
2. Device Plate: Stainless steel.
3. Configuration: One duplex.

B. Flush Cover Convenience Receptacles:
1. Material: Brass.
2. Configuration: Duplex flap opening.

C. Pedestal Communication Outlets:
1. Housing: Satin aluminum.
2. Device Plate: Stainless steel.

D. Flush Cover Communication Outlets:
1. Material: Brass.
2. Configuration: 2-1/8 inch (54 mm) x 1 inch (25 mm) combination threaded opening.

E. Pedestal Combination Fittings:
1. Housing: Satin aluminum.
2. Device Plate: Stainless steel.
3. Configuration: One duplex convenience receptacle with one bushed opening, 1 inch (25mm) inside diameter.

F. Flush Cover Combination Fittings:
1. Material: Brass.
2. Configuration: Duplex flap opening with 2-1/8 inch (54 mm) x 1 inch (25 mm) combination threaded opening.

G. Protective Ring: Brass finish.

H. Split Nozzles: Brass finish.

I. Carpet Rings: Brass.

2.07 ACCESS FLOOR BOXES

A. Manufacturers:
   1. Arc-Co./Division of Arcade Technology: www.arc-co.com.
   2. Unity Manufacturing: www.unitymfg.com.

B. Floor Boxes: As specified in Section 26 0534.

C. Access Floor Boxes: Sheet metal box suitable for mounting in access floor system.
   1. Size: 4 x 4.
   2. Cover: Impact resistant plastic with grey enamel finish.
   3. Convenience Receptacle: One with isolated ground.
   4. Communications Receptacle: modular jack.
   5. Data Receptacle: One.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that outlet boxes are installed at proper height.

B. Verify that wall openings are neatly cut and will be completely covered by wall plates.

C. Verify that floor boxes are adjusted properly.

D. Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

E. Verify that openings in access floor are in proper locations.

3.02 PREPARATION

A. Provide extension rings to bring outlet boxes flush with finished surface.

B. Clean debris from outlet boxes.

3.03 INSTALLATION

A. Install securely, in a neat and workmanlike manner, as specified in NECA 1.

B. Install devices plumb and level.

C. Install switches with OFF position down.

D. Install wall dimmers to achieve full rating specified and indicated after derating for ganging as instructed by manufacturer.

E. Do not share neutral conductor on load side of dimmers.

F. Install receptacles with grounding pole on top.

G. Connect wiring device grounding terminal to branch circuit equipment grounding conductor.

H. Install decorative plates on switch, receptacle, and blank outlets in finished areas.

I. Connect wiring devices by wrapping conductor around screw terminal.

J. Use jumbo size plates for outlets installed in masonry walls.

K. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface mounted outlets.

L. Install protective rings on active flush cover service fittings.

3.04 INTERFACE WITH OTHER PRODUCTS

A. Coordinate locations of outlet boxes provided under Section 26 0534 to obtain mounting heights specified and indicated on drawings.

B. Install wall switch 48 inches (1.2 m) above finished floor.

C. Install convenience receptacle 18 inches (450 mm) above finished floor.

D. Install convenience receptacle 6 inches (150 mm) above counter.

E. Install dimmer 48 inches (1.2 m) above finished floor.

F. Install telephone jack 18 inches (450 mm) above finished floor.

G. Install telephone jack for side-reach wall telephone to position top of telephone at 54 inches (1.4 m) above finished floor.

H. Install telephone jack for forward-reach wall telephone to position top of telephone at 48 inches (1.2 m) above finished floor.

I. Coordinate installation of access floor boxes with access floor system provided under Section 10270.

J. Coordinate the installation of wiring devices with underfloor duct service fittings provided under Section 26 0534.

3.05 FIELD QUALITY CONTROL

A. Perform field inspection and testing in accordance with Section 01400.

B. Inspect each wiring device for defects.

C. Operate each wall switch with circuit energized and verify proper operation.

D. Verify that each receptacle device is energized.

E. Test each receptacle device for proper polarity.

F. Test each GFCI receptacle device for proper operation.

G. Verify that each telephone jack is properly connected and circuit is operational.

3.06 ADJUSTING

A. Adjust devices and wall plates to be flush and level.

3.07 CLEANING

A. Clean exposed surfaces to remove splatters and restore finish.

END OF SECTION

SECTION 26 2813
FUSES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Fuses.

B. Spare fuse cabinet.

1.02 REFERENCES

A. NEMA FU 1 - Low Voltage Cartridge Fuses; National Electrical Manufacturers Association; 2012.

B. NFPA 70 - National Electrical Code; National Fire Protection Association; 2014.

1.03 SUBMITTALS

A. See Section 01300 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data sheets showing electrical characteristics, including time-current curves.

1.04 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience and with service facilities within 100 miles (160 km) of Project.

C. Products: Listed and classified by testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

1.05 MAINTENANCE MATERIALS

A. See Section 01600 - Product Requirements, for additional provisions.

B. Furnish two fuse pullers.

C. Furnish three of each size and type fuse installed.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Cooper Bussmann: www.bussmann.com.

B. Ferraz Shawmut, Inc: www.ferrazshawmut.com.

C. Littelfuse: www.littelfuse.com.

2.02 FUSES - GENERAL

A. Dimensions and Performance: NEMA FU 1, Class as specified or indicated.

B. Voltage: Rating suitable for circuit phase-to-phase voltage.

C. Main Service Switches Larger than 600 amperes: Class L (time delay).

D. Main Service Switches: Class RK1 (time delay).

E. Power Load Feeder Switches Larger than 600 amperes: Class L (time delay).

F. Power Load Feeder Switches: Class RK1 (time delay).

G. Motor Load Feeder Switches: Class RK1 (time delay).

H. Lighting Load Feeder Switches Larger than 600 amperes: Class L time delay.

I. Lighting Load Feeder Switches: Class RK1 (time delay).

J. Other Feeder Switches Larger than 600 amperes: L time delay; L fast-acting.

K. Other Feeder Switches: Class RK1 (time delay).

L. General Purpose Branch Circuits: Class RK1 (time delay).

M. Motor Branch Circuits: Class L time delay.

N. Lighting Branch Circuits: Class G.

2.03 SPARE FUSE CABINET

A. Description: Wall-mounted sheet metal cabinet with shelves, suitably sized to store spare fuses and fuse pullers specified.

B. Doors: Hinged, with hasp for padlock.

C. Finish: Prime finish for field painting.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install fuses with label oriented such that manufacturer, type, and size are easily read.

B. Install spare fuse cabinet where indicated.

END OF SECTION

SECTION 26 2816
ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Fusible switches.

B. Nonfusible switches.

1.02 RELATED SECTIONS

A. Section 26 28 13 - Fuses.

1.03 REFERENCES

A. NEMA FU 1 - Low Voltage Cartridge Fuses; National Electrical Manufacturers Association; 2012.

B. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum); National Electrical Manufacturers Association; 2013.

C. NETA STD ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems; International Electrical Testing Association; 2003.

D. NFPA 70 - National Electrical Code; National Fire Protection Association; 2014.

1.04 SUBMITTALS

A. See Section 01300 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide switch ratings and enclosure dimensions.

C. Project Record Documents: Record actual locations of enclosed switches.

1.05 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience and with service facilities within 100 miles (160 km) of Project.

C. Products: Listed and classified by testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Eaton Electrical/Cutler-Hammer: www.eatonelectrical.com.

B. GE Industrial: www.geindustrial.com.

C. Square D: www.squared.com.

D. Siemens: www.sea-siemens.com

2.02 COMPONENTS

A. Fusible Switch Assemblies: NEMA KS 1, Type HD enclosed load interrupter knife switch.
   1. Externally operable handle interlocked to prevent opening front cover with switch in ON position.
   2. Handle lockable in OFF position.
   3. Fuse clips: Designed to accommodate NEMA FU1, Class R fuses.

B. Nonfusible Switch Assemblies: NEMA KS 1, Type HD enclosed load interrupter knife switch.
   1. Externally operable handle interlocked to prevent opening front cover with switch in ON position.
   2. Handle lockable in OFF position.

C. Enclosures: NEMA KS 1.
   1. Interior Dry Locations: Type 1.

2. Exterior Locations: Type 3R.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install fuses in fusible disconnect switches.

C. Apply adhesive tag on inside door of each fused switch indicating NEMA fuse class and size installed.

3.02 FIELD QUALITY CONTROL

A. Perform field inspection, testing, and adjusting in accordance with Section 01400.

B. Inspect and test in accordance with NETA STD ATS, except Section 4.

C. Perform inspections and tests listed in NETA STD ATS, Section 7.5.

END OF SECTION

SECTION 31 1000
SITE CLEARING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Clearing and protection of vegetation.

B. Removal of existing debris.

1.02 RELATED REQUIREMENTS

A. Section 01 5713 - Temporary Erosion Control.

B. Section 01 7000 - Execution Requirements: Project conditions; protection of bench marks, survey control points, and existing construction to remain; reinstallation of removed products.

C. Section 31 2200 - Grading: Fill material for filling holes, pits, and excavations generated as a result of removal operations.

D. Section 31 2323 - Fill and Backfill: Filling holes, pits, and excavations generated as a result of removal operations.

PART 2 PRODUCTS[]

2.01 MATERIALS

A. Fill Material: As specified in Section 31 2200 - Grading

PART 3 EXECUTION

3.01 SITE CLEARING

A. Comply with other requirements specified in Section 01 7000.

B. Minimize production of dust due to clearing operations; do not use water if that will result in ice, flooding, sedimentation of public waterways or storm sewers, or other pollution.

3.02 VEGETATION

A. Do not remove or damage vegetation beyond the limits indicated on drawings.

B. Install substantial, highly visible fences at least 3 feet high to prevent inadvertent damage to vegetation to remain:
   1. At vegetation removal limits.

C. In areas where vegetation must be removed but no construction will occur other than pervious paving, remove vegetation with minimum disturbance of the subsoil.

D. Vegetation Removed: Do not burn, bury, landfill, or leave on site, except as indicated.
   1. Chip, grind, crush, or shred vegetation for mulching, composting, or other purposes; preference should be given to on-site uses.
   2. Trees: Sell if marketable; if not, treat as specified for other vegetation removed; remove stumps and roots to depth of 18 inches.
   3. Sod: Re-use on site if possible; otherwise sell if marketable, and if not, treat as specified for other vegetation removed.

E. Restoration: If vegetation outside removal limits or within specified protective fences is damaged or destroyed due to subsequent construction operations, replace at no cost to Owner.

3.03 DEBRIS

A. Remove debris, junk, and trash from site.

B. Leave site in clean condition, ready for subsequent work.

C. Clean up spillage and wind-blown debris from public and private lands.

END OF SECTION

SECTION 31 2200
GRADING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Removal of topsoil and subsoil.

B. Cutting, grading, filling and rough contouring the site.

C. Finish Grading.

1.02 RELATED REQUIREMENTS

A. Section 01 5713 - Temporary Erosion Control.

B. Section 01 4500 - Quality Control: Testing fill compaction.

C. Section 31 1000 - Site Clearing.

D. Section 31 2316 - Excavation.

E. Section 31 2323 - Fill and Backfill.

1.03 REFERENCE STANDARDS

A. ANSI/ASTM D1557 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10-lb Rammer and 18-inch Drop; '07.

B. CBC - 2007 California Building Code, based on 2006 International Building Code (IBC), with California Amendments.

1.04 SUBMITTALS

A. See Section 01 3000 - "Submittals", for submittal procedures.

B. Samples: Submit 10-lb sample of each type of fill to testing laboratory, in air-tight containers.

1.05 PROJECT RECORD DOCUMENTS

A. Accurately record actual locations of utilities remaining, by horizontal dimensions, elevations or inverts, and slope gradients.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. All grading shall be performed in accordance with the applicable provisions of the CBC.

2.02 MATERIALS

A. Topsoil: Excavated material, graded, free of roots, rocks larger than 1-inch, subsoil, debris and large weeds.

B. Subsoil: Excavated material, graded, free of lumps larger than 6-inches, rocks larger than 3-inches and debris.

C. Granular Fill: Type A.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify site conditions.

B. Verify that survey benchmark and intended elevations for the work are as indicated.

3.02 PREPARATION

A. Identify required lines, levels, contours and datum.

B. Identify known underground, above ground, and aerial utilities. Stake and flag locations.

C. Notify utility company to remove, rebuild and relocate utilities.

D. Protect above and below grade utilities which are to remain.

E. Protect bench marks, existing structures, sidewalks, paving and curbs from excavation equipment and vehicular traffic.

3.03 CLEARING AND GRUBBING

A. Debris from the demolition of the existing structures, grasses, weeds, brush, trees and other deleterious materials shall be removed from the proposed building, exterior hardscape and pavement areas and areas to receive structural fill before grading is performed. Any organic material and miscellaneous/demolition debris shall be legally disposed of off site. Any highly organic soils encountered shall be stripped and stockpiled for use on finished grades in landscape areas or exported from the site. Disking or mixing of organic material into the earth materials proposed to be used as structural fill shall not be permitted. Trees and their roots shall be completely removed, ensuring that 95 percent or more of the root systems are extracted.

B. Man-made objects encountered (i.e., septic tanks, leach lines, irrigation systems, underground utilities, old foundations, construction debris, etc.) shall be over-excavated, exported from the site, and legally disposed of off site. Cesspools or seepage pits, if encountered shall be abandoned and capped according to directions and supervision of San Bernardino County Department of Health, the State of California, and/or the appropriate governmental agency procedures which has jurisdiction over them before fill and/or pavement is placed over the area. If no procedures are required by the Health Department or if the following recommendations are more stringent, the cesspool or seepage pit shall be pumped free of any liquid and filled with a low strength sand/cement slurry to an elevation 5.0 feet below the final site grade in the area. The upper 5.0 feet of the cesspool or seepage pit shall be excavated and the area backfilled with a properly compacted fill material. The location of the cesspool or seepage pit shall be surveyed and plotted on the final "As Graded" plan prepared by the project Civil Engineer.

C. Wells, if encountered, shall be abandoned and capped according to directions and supervision of the San Bernardino County Department of Health, the State of California, and/or the appropriate governmental agency procedures which has jurisdiction over the well before fill and/or pavement is placed over the area.

3.04 TESTING AND INSPECTION

A. During grading, tests and observations shall be performed by the Geotechnical Engineer or this representative in order to verify that the grading is being performed in accordance with the project specifications. The minimum acceptable degree of compaction shall be 90 percent of the maximum dry density as obtained by the ASTM D1557 test method. Where testing indicates insufficient density, additional compaction effort shall be applied until retesting indicates satisfactory compaction.

B. Testing will be also conducted to verify that the soils will not subject concrete to sulfate attack and are not corrosive. Testing of any proposed import will be necessary prior to placement on the site. Testing of on-site soils may be done on either a selective or random basis as site conditions indicate.

C. If tests indicate work does not meet specified requirements, remove work, replace and retest at no cost to Owner.

END OF SECTION

SECTION 31 2316
EXCAVATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Excavating for footings, slabs-on-grade, and site structures.

B. Trenching for utilities outside the building to utility main connections.

1.02 RELATED REQUIREMENTS

A. Section 01 5713 - Temporary Erosion Control: Slope protection and erosion control.

B. Section 01 7000 - Execution Requirements: Project conditions; protection of bench marks, survey control points, and existing construction to remain; reinstallation of removed products; temporary bracing and shoring. General requirements for dewatering of excavations and water control.

C. Section 31 1000 - Site Clearing: Vegetation and existing debris removal.

D. Section 31 2200 - Grading: Soil removal from surface of site.

E. Section 31 2323 - Fill and Backfill: Fill materials, filling, and compacting.

PART 2 PRODUCTS

-- NOT APPLICABLE --

PART 3 EXECUTION

3.01 PREPARATION

A. Identify required lines, levels, contours, and datum locations.

B. Locate, identify, and protect utilities that remain and protect from damage.

C. Grade top perimeter of excavation to prevent surface water from draining into excavation. Provide temporary means and methods, as required, to maintain surface water diversion until no longer needed, or as directed by Architect.

3.02 EXCAVATING

A. Excavate to accommodate new structures and construction operations.

B. Slope banks of excavations deeper than 4 feet to angle of repose or less until shored.

C. Do not interfere with 45 degree bearing splay of foundations.

D. Cut utility trenches wide enough to allow inspection of installed utilities.

E. Hand trim excavations. Remove loose matter.

F. Remove excess excavated material from site.

3.03 FIELD QUALITY CONTROL

A. See Section 01 4500 - "Quality Control", for general requirements for field inspection and testing.

B. Provide for visual inspection of load-bearing excavated surfaces by Architect before placement of foundations.

3.04 PROTECTION

A. Divert surface flow from rains or water discharges from the excavation.

B. Prevent displacement of banks and keep loose soil from falling into excavation; maintain soil stability.

C. Protect open excavations from rainfall, runoff, freezing groundwater, or excessive drying so as to maintain foundation subgrade in satisfactory, undisturbed condition.

D. Protect bottom of excavations and soil adjacent to and beneath foundation from freezing.

E. Keep excavations free of standing water and completely free of water during concrete placement.

END OF SECTION

SECTION 31 2323
FILL AND BACKFILL

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Filling, backfilling, and compacting for site grading and footings, slabs-on-grade, and site structures.

B. Backfilling and compacting for utilities outside the building to utility main connections.

C. Filling holes, pits, and excavations generated as a result of removal (demolition) operations.

1.02 RELATED REQUIREMENTS

A. Section 01 5713 - Temporary Erosion Control: Slope protection and erosion control.

B. Section 31 2200 - Grading: Removal and handling of soil to be re-used.

C. Section 31 2316 - Excavation: Removal and handling of soil to be re-used.

D. Section 32 1313 - Portland Cement Concrete Paving: Leveling bed placement under paving.

1.03 REFERENCE STANDARDS

A. AASHTO T 180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54 kg (10-lb) Rammer and a 457 mm (18 in.) Drop; 2010.

B. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)); 2012.

C. ASTM D1556 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method; 2007.

D. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3 (2,700 kN m/m3)); 2012.

E. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method; 2008.

F. ASTM D2487 - Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System); 2011.

G. ASTM D2922 - Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth); 2005.

H. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth); 2005.

1.04 DEFINITIONS

A. Finish Grade Elevations: Indicated on drawings.

B. Subgrade Elevations: 4 inches below finish grade elevations indicated on drawings, unless otherwise indicated.

1.05 SUBMITTALS

A. See Section 01 3000 - "Submittals", for submittal procedures.

B. Materials Sources: Submit name of imported materials source.

C. Fill Composition Test Reports: Results of laboratory tests on proposed and actual materials used, including manufactured fill.

D. Compaction Density Test Reports.

1.06 DELIVERY, STORAGE, AND HANDLING

A. When necessary, store materials on site in advance of need.

B. When fill materials need to be stored on site, locate stockpiles where indicated.
   1. Separate differing materials with dividers or stockpile separately to prevent intermixing.
   2. Prevent contamination.

3. Protect stockpiles from erosion and deterioration of materials.

C. Verify that survey bench marks and intended elevations for the Work are as indicated.

PART 2 PRODUCTS

2.01 FILL MATERIALS

A. General Fill - Fill Type ____: Complying with State of _____ Highway Department standard.

B. General Fill: Subsoil excavated on-site.
1. Graded.
2. Free of lumps larger than 3 inches, rocks larger than 6 inches, and debris.
3. Conforming to ASTM D2487 Group Symbol CL, or as approved by the Soils Engineer.

C. Structural Fill - Fill Type ____: Complying with State of _____ Highway Department standard.

D. Structural Fill: Subsoil excavated on-site.
1. Graded.
2. Free of lumps larger than 3 inches, rocks larger than 2 inches, and debris.
3. Conforming to ASTM D2487 Group Symbol CL.

E. Concrete for Fill: Lean concrete, 1 or 2 sack slurry.

F. Granular Fill - Fill Type ____: Coarse aggregate, complying with State of _____ Highway Department standard.

G. Sand - Fill Type ____: Complying with State of _____ Highway Department standard.

2.02 ACCESSORIES

A. Geotextile Fabric: Non-biodegradable, woven, Structural Geogrid BX1200; manufactured by Tensar Earth Technologies, Inc., or approved equal by Architect; submittal required.

PART 3 EXECUTION

3.01 EXAMINATION

A. Identify required lines, levels, contours, and datum locations.

B. Verify underground tanks are anchored to their own foundations to avoid flotation after backfilling.

C. Verify areas to be filled are not compromised with surface or ground water.

3.02 PREPARATION

A. Scarify and proof roll subgrade surface to a depth of 6 inches to identify soft spots.

B. Cut out soft areas of subgrade not capable of compaction in place. Backfill with general fill.

C. Compact subgrade to density equal to or greater than requirements for subsequent fill material.

D. Until ready to fill, maintain excavations and prevent loose soil from falling into excavation.

3.03 FILLING

A. Fill to contours and elevations indicated using unfrozen materials.

B. Employ a placement method that does not disturb or damage other work.

C. Systematically fill to allow maximum time for natural settlement. Do not fill over porous, wet, frozen or spongy subgrade surfaces.

D. Maintain optimum moisture content of fill materials to attain required compaction density.

E. Granular Fill: Place and compact materials in equal continuous layers not exceeding 6 inches compacted depth.

F. Slope grade away from building minimum 2 inches in 10 feet, unless noted otherwise. Make gradual grade changes. Blend slope into level areas.

G. Correct areas that are over-excavated.

1. Other areas: Use general fill, flush to required elevation, compacted to minimum 95 percent of maximum dry density.

H. Compaction Density Unless Otherwise Specified or Indicated:
1. Under paving, slabs-on-grade, and similar construction: 95 percent of maximum dry density.

I. Reshape and re-compact fills subjected to vehicular traffic.

J. Maintain temporary means and methods, as required, to remove all water while fill is being placed as required, or until directed by the Architect. Remove and replace soils deemed unsuitable by classification and which are excessively moist due to lack of dewatering or surface water control.

3.04 FILL AT SPECIFIC LOCATIONS

3.05 FIELD QUALITY CONTROL

A. See Section 01 4500 - "Quality Control", for general requirements for field inspection and testing.

B. Perform compaction density testing on compacted fill in accordance with ASTM D1556, ASTM D2167, ASTM D2922, or ASTM D3017.

C. Evaluate results in relation to compaction curve determined by testing uncompacted material in accordance with ASTM D698 ("standard Proctor"), ASTM D1557 ("modified Proctor"), or AASHTO T 180.

D. If tests indicate work does not meet specified requirements, remove work, replace and retest.

3.06 CLEANING

A. See Section 01 7419 - Construction Waste Management and Disposal, for additional requirements.

B. Remove unused stockpiled materials, leave area in a clean and neat condition. Grade stockpile area to prevent standing surface water.

C. Leave borrow areas in a clean and neat condition. Grade to prevent standing surface water.

END OF SECTION

SECTION 32 1313
PORTLAND CEMENT CONCRETE PAVING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Concrete sidewalks, integral curbs, gutters, parking areas and roads.

B. Aggregate base course.

1.02 RELATED REQUIREMENTS

A. Section 01 3000 - Administrative Requirements: Submittal procedures, project meetings, progress schedules and documentation, reports, coordination.

B. Section 01 5713 - Temporary Erosion and Sedimentation Control.

C. Section 01 6000 - Product Requirements: Fundamental product requirements, substitutions and product options, delivery, storage, and handling.

D. Section 01 7000 - Execution Requirements: Examination, preparation, and general installation procedures; preinstallation meetings; cutting and patching; cleaning and protection; starting of systems; demonstration and instruction; closeout procedures except payment procedures; requirements for alterations work.

E. Section 02 4100 - Demolition: Selective demolition, site demolition, structure removal.

F. Section 31 2200 - Grading: Preparation of site for paving.

G. Section 31 2323 - Fill and Backfill: Compacted subbase for paving.

1.03 REFERENCE STANDARDS

A. ACI 301 - Specifications for Structural Concrete for Buildings; American Concrete Institute; '05.

B. ASTM A615/A615M - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement; '09.

C. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; '09.

D. ASTM C1116/C1116M - Standard Specification for Fiber-Reinforced Concrete; '09.

E. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types); '04 (2008).

F. ASTM D1752 - Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction; '04a (2008).

G. FS TT-S-227e - Polyurethane or Polysulfide Sealants; Federal Specifications.

H. FS TT-C-800 - Curing Compound, Concrete, for New and Existing Surfaces; Federal Specifications.

1.04 SUBMITTALS

A. See Section 01 3000 - "Submittals", for submittal procedures.

B. Product Data: Provide product data on joint sealant.

1.05 QUALITY ASSURANCE

A. Perform work in accordance with ACI 301.

B. Obtain cementitious materials from same source throughout.

PART 2 PRODUCTS

2.01 AGGREGATE BASE

A. Aggregate Base Course: Thickness and size of aggregate as indicated on the drawings.

2.02 FORM MATERIALS

A. Form Materials: Conform to ACI 301.

2.03 REINFORCING STEEL

A. Reinforcing Steel: ASTM A615, grade 60 billet steel deformed bars.
   1. #4 @ 24" oc, each way, as indicated on drawings.

2.04 CONCRETE MATERIALS

A. Cement: ASTM C150/C150M, Type II - Moderate Portland type.
   1. Acquire cement for entire project from same source.

B. Fine and Coarse Aggregates: ASTM C33/C33M.
   1. Acquire aggregates for entire project from same source.

C. Water: ASTM C1602/C1602M; clean, potable, and not detrimental to concrete.

D. Admixtures: Fly ash, calcium chloride or other admixtures are Not Allowed.

E. Structural Fiber Reinforcement: ASTM C1116/C1116M.
   1. Fiber Type: Alkali-resistant synthetic.
   2. Fiber Length: 1.5 inch, nominal.

2.05 ACCESSORIES

A. Curing Compound: FS TT-C-800, Type 1, 30 percent solids.

B. Fibrous Reinforcement (Required for all driveway areas): Collated, fibrillated, 100% virgin polypropylene fibers with lengths varying from 1-1/2 to 2-inches or nylon filamentized fibers of 3/4-inch length meeting requirements of ASTM D1116, Type III. Volume per cubic yard shall equal a minimum of 0.1% (1.5 lbs).

C. Joint Filler: ASTM D1751 type; 1/2-inch, "Homex 300" expansion joint filler.

D. Joint Sealant: Federal Specification TT-S-227e, 3/4-inch thick polyurethane joint sealant by Pacific Polymers, Inc.; "Elasto-Thane 227 High Shore".

E. All accessories listed above shall be used, as required.

2.06 CONCRETE MIX - BY PERFORMANCE CRITERIA

A. Mix and deliver concrete in accordance with ASTM C94, Alternative No. 2.

B. Select proportions for normal weight concrete in accordance with ACI 301, Method 2.

C. Provide concrete to the following criteria
   1. Compressive Strength: 4,000 psi @ 28 days.
   2. Slump: 3 to 4 inches.

D. Use accelerating admixtures in cold weather only when approved by Architect/Engineer. Use of admixtures will not relax cold weather placement requirements.

E. Use calcium chloride only when approved by Architect/Engineer.

F. Use set retarding admixtures during hot weather only when approved by Architect/Engineer..

2.07 SOURCE QUALITY CONTROL

A. Provide mix design under provisions of Section 01 4500 - "Quality Control".

B. Submit proposed mix design to appointed firm for review prior to commencement of work.

C. Test samples in accordance with ACI 301.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify base conditions

B. Verify compacted subgrade is acceptable and ready to support paving and imposed loads.

C. Verify gradients and elevations of base are correct.

3.02 PREPARATION

A. Moisten subgrade to minimize absorption of water from fresh concrete.

B. Notify Architect/Engineer minimum 24 hours prior to commencement of concreting operations.

3.03 FORMING

A. Place and secure forms to correct location, dimension, profile and gradient.

B. Assemble formwork to permit easy stripping and dismantling without damaging concrete.

C. Place expansion joint filler vertical in position, in straight lines. Secure to formwork during concrete placement.

3.04 JOINTS

A. Place expansion joints at 50-foot intervals (maximum), and control joints at 20-foot intervals (maximum), or as indicated. Align curb, gutter, paving and sidewalk joints.

B. Place joint filler between paving components and building or other appurtenances.

3.05 PLACING CONCRETE

A. Place concrete in accordance with ACI 301.

B. Ensure reinforcement, inserts, embedded parts, and formed joints are not disturbed during concrete placement.

C. Place concrete continuously over the full width of the panel and between predetermined construction joints. Do not break or interrupt successive pours such that cold joints occur.

D. Place concrete to pattern indicated. Saw cut contraction joints 3/16-inch wide at an optimum time after finishing. Cut 1/3 into depth of slab.

3.06 FINISHING

A. Paving: Light broom.

B. Sidewalk Paving: Light broom, radiused to 3/8-inch radius, and trowel joint edges.

C. Curbs and Gutters: Light broom.

D. Inclined Vehicular Ramps: Broomed perpendicular to slope.

E. Place curing compound on exposed concrete surfaces immediately after finishing. Apply in accordance with manufacturer's instructions.

F. Joint Sealant:

1. Surface Preparation: All joints must be absolutely clean. For concrete, sandblasting is required. All curing compounds, old caulks, waterproofing compounds, etc., must be removed. Polyethylene rod or polyurethane foam is recommended as a joint-filler and backup material. Fillers treated with bituminous products, grease or oil, should not be used. Where present, they must be removed or separated by vinyl tape or polyethylene film. All surfaces must be primed with ELASTO-THANE PRIMER.
2. Application: Apply by caulking gun, hand or pressure type, or pour from container. Bulk sealant can be applied by pumping equipment, trowel or putty knife. Press firmly into joint to assure good contact.

3.07 FIELD QUALITY CONTROL

A. Field Inspection and testing will be preformed under provisions of Section 01 4500 - "Quality Control".

B. Testing firm will take cylinders and perform slump tests in accordance with ACI 301.

3.08 PROTECTION

A. Immediately after placement, protect pavement from premature drying, excessive hot or cold temperatures, and mechanical injury.

END OF SECTION

SECTION 32 3119
ORNAMENTAL FENCES AND GATES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Ornamental gates, powder coat finish (2-part, prime powder and finish powder coat).

B. Gate framework, bars, and accessories.

C. Manual personnel gates and related hardware.

1.02 RELATED REQUIREMENTS

A. Section 02 4100 - Demolition: Selective demolition, site demolition, structure removal.

B. Section 05 5000 - Metal Fabrications.

C. Section 09 9000 - Painting and Coating.

D. Section 32 1313 - Portland Cement Concrete Paving.

1.03 REFERENCE STANDARDS

A. ADA - Americans with Disabilities Act; 1990.

B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; '08.

C. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; '07.

D. ASTM A513 - Standard Specification for Electric-Resistance-Welded Carbon and Alloy Steel Mechanical Tubing; '08a.

1.04 SUBMITTALS

A. See Section 01 3000 - "Submittals", for submittal procedures.

B. Product Data: Provide data on posts, bars, accessories, fittings and hardware.
   1. Provide manufacturer's printed data and cut sheets on motorized gate operators and appurtenant accessories.

C. Shop Drawings: Indicate fence layout, spacing of components, hardware anchorage, and schedule of components.
   1. Show dimensions, sizes, thicknesses, gauges, finishes, joining attachments and relationship to adjacent work.
   2. For standard manufactured items, submit work sheets showing illustrated cuts of items to be furnished, scale, details and dimensions.

1.05 QUALITY ASSURANCE

A. Designer Qualifications: Perform design under direct supervision of a Professional Engineer experienced in design of this type of work and licensed in the State in which the Project is located.

B. Perform welding by welders approved and certified in accordance with requirements of AWS.

PART 2 PRODUCTS

2.01 MATERIALS AND COMPONENTS

A. Materials and Components to meet the requirements of ASTM A513, A500 Grade B.

B. Solid steel bars, flat plates and shapes shall be manufactured from steel conforming to the requirements of ASTM A36.

C. Gate panels shall be as indicated on drawings.

D. Frames for gates shall be of sufficient size and thickness to provide adequate support without sag. Gate hardware shall be supplied by the manufacturer and shall be of sufficient size and capacity to support the gate specified.

E. Perforated Metal Panels: McNichols or approved equal.

1. Hole Size: 1/4".
2. Hole Centers: 3/16"
3. Hole Pattern: Staggered.
4. Gauge and Finish: 16 gauge, powder coated.

F. Kick Plate: As indicated on drawings; powder coated.

2.02 FABRICATION

A. Steel used in the manufacturing of metal siding, gates, and posts shall conform to the ASTM standards specified and shall be new prime material.

B. Panels, gates and flanged posts shall be of welded construction. No wire rods, screws or rivets shall be accepted to attach pickets to rails. Layout and welding shall be done by experienced craftsmen. Welds shall be made by the gas metal arc method and welds shall be neat, clean and of the sizes appropriate for conditions. All flush welds shall be ground smooth.

C. Ornamental Swinging Gate: 4"x4" 11ga posts, 2" x 2" 11ga frame, 3/4" x 3/4" pickets at 4" o.c., sand blasted, primered and powder coated black.

2.03 FINISH

A. Panels, angles and posts shall be Powder Coated.
1. Use a 2-part system with a prime powder coat and a finish powder coat. Tiger Drylac or approved equal.

B. Powder Coating:
1. Remove all drainage spikes and surface defects.
2. Keep surface clean. Do not transport uncovered loads.
a. Diesel fumes will contaminate surface.
3. If surface contamination has occurred or is suspected, clean surface with proprietary solvent/detergent designed for pre-cleaning prior to powdercoating.
4. Use iron phosphate pretreatment. Surface must be perfectly clean.
5. Pre-heat work prior to powder application.
6. Use "degassing" grade polyester powder only.
7. Check for correct curing by solvent testing. Adjust pre-heat and line speed to ensure full cure.

2.04 ACCESSORIES

A. Hardware for Single Swinging Gates: 180 degree hinges, 2 for gates up to 60 inches high, 3 for taller gates.

B. Personnel Gates shall automatically close with no more than 5 lbs force per ADA requirements.

PART 3 EXECUTION

3.01 PREPARATION

A. The Contractor shall verify any grade changes or surface irregularities.

B. Discrepancies between the approved Shop Drawings and field conditions must be approved by the Architect or Engineer prior to proceeding with the installation.

3.02 INSTALLATION

A. Gates shall be installed plumb and level and shall be the sizes and style indicated on the drawings. The Contractor shall install any gate stops that may be required. Any padlock provisions or strikes shall be field-attached to assure alignment. The Contractor shall lubricate the hinges and other gate hardware after installation.

B. All field welds and any abrasions to factory coatings shall be thoroughly cleaned, re-primed and touched up by the Contractor with paint manufactured by powder coating company. Color and finish to be same as provided on fences and gates.

3.03 CLEANING

A. The Contractor shall clean job site of excess materials.

3.04 HARDWARE

A. Provide exterior grade hardware as required to achieve the design intent. Exterior hardware to include, but not limitted to:
   1. Passage sets.
   2. Lock sets.
   3. Hinges.
   4. Cane bolts.
   5. Dead bolts.

B. All hardware shall be furnished as selected by owner, manufactured by Schlage (or equal), and warranted for one year.

END OF SECTION