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**SPECIFICATION SPECIAL PROVISIONS FOR THE "GREENBOOK"
STANDARD SPECIFICATIONS FOR PUBLIC WORKS CONSTRUCTION**

**PART 2
CONSTRUCTION MATERIALS**

SECTION 200 - ROCK MATERIALS

200-1 ROCK PRODUCTS.

Add the following subsection:

200-1.7 Rock Mulch. Rock mulch shall match the existing "red" color rock at the adjacent preschool.

200-1.7.1 Filter Fabric. Filter fabric shall be a nonwoven geotextile composed of polypropylene fibers, which are formed into a stable network such that the fiber retains their relative position. Mirafi 140N or approved equal.

**PART 3
CONSTRUCTION METHODS**

**SECTION 301 – SUBGRADE PREPARATION, TREATED MATERIALS, AND PLACEMENT OF
BASE MATERIALS**

Add the following subsections:

301-7 ROCK MULCH.

301-7.1 Installation. Rock mulch shall be installed to a minimum of 3" depth and carefully set in a tight and interlocking configuration to form a stable layer of rock. Rock mulch shall be placed in a manner which produces a reasonably well-graded mass of stone with minimal voids.

301-7.2 Payment. Payment for furnishing and installing the Rock Mulch shall be made at the unit price per TON and shall include full compensation for furnishing all labor, materials, filter fabric, tools, equipment, and incidentals and for doing all the work and no additional compensation will be allowed.

**PART 8
LANDSCAPING AND IRRIGATION**

SECTION 800 - MATERIALS

800-1 LANDSCAPE MATERIALS.

800-1.1 Topsoil.

800-1.1.1 General.

[Delete the second sentence and replace with the following:]

Topsoil shall be Class "C" in accordance with the requirements of Section 800-1.1.4 Class "C" topsoil. If imported topsoil is needed, Class "A" topsoil, in accordance with the requirements of Section 800-1.1.2 Class "A" topsoil shall be used.

Soil to be used as a planting medium shall be fertile, well drained, of uniform quality, and free of stones over 1" diameter, sticks, oils, chemicals, plaster, concrete, or other deleterious materials.

800-1.2 Soil Fertilizing and Conditioning Materials.

800-1.2.3 Commercial Fertilizer.

[Replace the first sentence with the following:]

Pre-plant commercial fertilizer shall be granular 12-12-12 (n-p-k). Post plant fertilizer shall be 14-7-3. Planting tablets shall be compressed, slow-release fertilizer tablets (20-10-5) in 21-gram sizes.

800-1.2.4 Organic Soil Amendment.

[Replace the first sentence with the following:]

Type 1 organic soil amendment shall be used if specified in the Soils Report. The Contractor shall supply the County Project Manager with a sample of the proposed amendment accompanied by a laboratory analysis from a State certified Agronomic Soil Testing Laboratory, which states that the amendment complies with the specifications in Table 800-1.2.4 for approval by the County Project Manager prior to installation.

800-1.2.5 Mulch.

[Replace the first sentence with the following:]

Mulch shall be as specified in section 200-1.7.

[Add the following subsection:]

800-1.2.6 Herbicides and Pesticides.

1. All chemicals used for weed control shall be registered by the State of California Department of Food and Agriculture and the Environmental Protection Agency with registration identification on the label. Label shall be at the job site at all times.
2. All chemicals shall be applied in accordance with registered label instruction and manufacturer's recommendations.

800-1.4 Plants.

800-1.4.1 General.

[Delete the first paragraph and replace with the following:]

Plants shall be inspected for approval by the County Project Manager upon delivery to the site. The Contractor may submit photographs of the plant specimens to be used for review by the County Project Manager and project Landscape Architect prior to delivery to the work site. The photograph review cannot be used to approve plant material and only serves as an indicator of available materials.

The Contractor shall notify the County Project Manager a minimum of 48 hours prior to plant material delivery to schedule the inspection. Any construction delays caused by the Contractor failing to give the 48-hour notice shall be at the Contractor's sole expense.

All plants furnished by the Contractor shall be true to type or name as shown on the Plans and shall be tagged in accordance with the standard practice recommended by the Agricultural Code of the State of California.

All plants shall have been grown in nurseries that have been inspected by the governing authorities. Inspection of plant materials required by County, State, or Federal authorities shall be the responsibility of the Contractor, and it shall have secured permits or certificates prior to delivery of plants to site. Certificates of inspection shall be filed with the County Project Manager.

The Contractor shall obtain clearance from the County Agricultural Commissioner, as required by law, before planting plants delivered from outside the County in which they are to be planted. Evidence that such clearance has been obtained shall be filed with the County Project Manager.

Plants shall be subject to inspection and approval or rejection by the County Project Manager upon delivery to the site at any time before or during progress of the work. Inspections may include:

- a) Quantity, quality, size, and variety;
- b) Root condition;
- c) Latent defects and injuries resulting from handling, disease and insects; and installation.
- d) Uniformity of plant materials.
- e) Branching structure.

All plants that are rejected shall be immediately removed from the project site and replaced with new plants at the Contractor's expense.

800-2 IRRIGATION SYSTEM MATERIALS.

800-2.1 Pipe and Fittings.

800-2.1.1 General.

[Add the following before the first paragraph:]

Irrigation sleeve materials and fittings shall be in conformance with the details in the Plans

and as directed by the County Project Manager.

Materials and equipment installed or furnished shall be new. Any materials or equipment that do not meet the City standards shall be rejected and shall be removed from the site at no expense to the City.

Pipe (General)

1. Pressure supply line from the point of connection to the backflow prevention unit for domestic water systems, and to the strainer/pressure regulator assembly on reclaimed water systems shall be brass, copper or other materials approved by the County Project Manager.
2. All threaded pipe shall be threaded by the manufacturer of the pipe.

800-2.1.3 Plastic Pipe for Use with Solvent Weld or Threaded Fittings.

[Delete the second paragraph and add the following:]

Pipe shall be sized per the Plans. Schedule 40 pipe shall be used for all pipe and irrigation wire sleeves. Schedule 80 fittings shall be used.

The following paragraphs shall be added at the end of the subsection:

All PVC pipe must bear the following markings:

1. Manufacturer's name
2. Nominal pipe size
3. Schedule or class
4. Pressure rating in P.S.I.
5. NSF (National Sanitation Foundation) approval
6. Date of Extrusion
7. U.P.C. shield logo (IAPMO approval)

All fittings shall bear the manufacturer's name or trademark, material designation, size, applicable P.S.I. schedule and NSF seal of approval.

Solvent cement and primer for PVC solvent weld pipe and fittings shall be of type recommended by the manufacturer and shall follow installation methods prescribed by the pipe manufacturer.

800-2.2 Valves and Valve Boxes.

800-2.2.4 Remote Control Valves.

[Delete and add the following:]

Remote control valves shall be electrically operated and shall be the type indicated on the Plans.

800-2.2.7 Valve Boxes.

[Delete and add the following:]

Valve boxes in planting areas shall be made of durable, weather-resistant plastic material resistant to sunlight and chemical action of soils. For recycled or reclaimed water, lids shall be purple in color indicating that recycled water is being used. For domestic or potable water, lids shall be green in color. The valve box cover shall be secured with a hidden latch mechanism or bolts. The cover and box shall be capable of sustaining a load of 1,500 pounds. Valve box extensions shall be by the same manufacturer as the valve box.

Automatic control valves shall be 16"x11"x12" rectangular size. Gate/ball valve and quick coupler valve boxes shall be 10" circular size.

800-2.4 Sprinkler Equipment.

[Delete and replace with the following:]

All irrigation emitters shall be the model, size, and type indicated on the Plans.

800-3 ELECTRICAL MATERIALS.

800-3.2 Conduit and Conductors.

800-3.2.1 Conduit.

[Delete and replace with the following:]

Conduit and sweeps shall be schedule 40 PVC, gray in color, and specifically manufactured for use as electrical installation. The conduits shall be sized twice the diameter of the wire bundle to be carried within. All ends of conduit in valve and pull boxes shall be sealed using a waterproof material that can be easily removed from the conduit openings for the purpose of pulling wire through the conduit.

800-3.2.2 Conductors.

[Add the following:]

All wire splices shall be made using a direct burial waterproof wire connection, pen-tite or approved equal.

Low voltage control wires shall have a single solid copper conductor with colored PVC coating. The pilot control wires shall be color-coded a specific color per controller and the common wires color coded white with a stripe matching the color of the pilot wires.

The electrical system shall be installed in accordance with the National Electrical Code most recently adopted by the City. Connections between the automatic controllers and the electric control valves shall be made with direct burial copper wire AWG-U.F. 600 volt. Pilot wires shall be a different color wire for each automatic controller. Install in accordance with valve manufacturer's specifications and wire chart. In no case shall wire be sized less than #14.

SECTION 801 – INSTALLATION

801-1 GENERAL.

[Add the following:]

The landscape work shall not begin until all other trades have repaired all areas of settlement, erosion, rutting, etc., and the soils have been re-established, re-compacted and refinished to final grades. The County Project Manager shall be notified of all areas where the landscape work is prevented from being executed.

801-2 EARTHWORK AND TOPSOIL PLACEMENT.

801-2.2 Topsoil Preparation and Conditioning

801-2.2.1 General.

[Replace the first sentence with the following:]

The type and thickness of topsoil shall be Class "C". If imported topsoil is needed, it shall be Class "A".

[Add the following:]

After completion of the clearing and grubbing and prior to soil preparation, the Contractor shall provide an Agricultural Soil Suitability Report for all planting areas to determine soil fertility and required nutrient needs. The Contractor, at his own expense, shall submit one (1) site soil sample from a location approved by the County Project Manager to a State certified Agronomic Soil Testing Laboratory to obtain soil information that includes: fertility and suitability analysis with written recommendations for soil amendments including plant container backfill and post plant fertilization needs. Samples are to be taken from the top 6" of soil in areas to receive planting. All test results and recommendations shall be provided to the County Project Manager. The soil report recommendations shall be incorporated at the Contractor's expense.

801-4 PLANTING.

801-4.1 General.

[Add the following:]

All plants of the same species and container size (i.e. the same specification) shall be uniform in size and shape and at the same stage of growth to the satisfaction of the County Project Manager.

The Contractor shall be responsible for managing the site and performing planting, maintenance, and corrective measures to the best advantage of the plant material to promote healthy growth, establishment, and success of the plantings. This shall include providing drainage, irrigation or watering, maintaining a proper soil moisture level, weeding, fertilization, protection, temporary measures to promote establishment, and other reasonable maintenance and construction efforts needed to provide for the successful establishment of the plant materials during the contract period.

Hair roots shall extend to the edge of the container. No plant shall be root-bound.

The Contractor shall not install planting as shown in the Plans when it is obvious in the field that conditions exist which are detrimental to plant survival and growth. Such conditions shall be brought to the attention of the County Project Manager.

No plants shall be transported to planting areas that are not thoroughly wet throughout the ball of earth surrounding the roots. Plants should not be allowed to dry out, nor shall any roots be exposed to the air except during the act of placement. Any plant that, in the opinion of the County Project Manager, is dry or in a wilted condition when delivered or thereafter, whether in place or not, shall not be accepted and shall be replaced at the Contractor's expense.

All inspections herein specified shall be made by the County Project Manager. The Contractor shall request inspection at least 48 hours in advance of the time inspection is required. Inspection shall be required on the following stages of the work:

- a) During preliminary grading, soil preparation, and initial weed eradication.
- b) When plants are spotted for planting, but before planting holes have been excavated.
- c) When finish grading has been completed.
- d) When all specified Work has been completed (prior to the Maintenance and Plant Establishment Period).
- e) Final inspection at the completion of the Maintenance and Plant Establishment period.

The Contractor's failure to obtain inspection shall extend the start and/or finish of the Maintenance and Plant Establishment Period as applicable, unless otherwise agreed to in writing by the County Project Manager.

801-4.5 Tree and Shrub Planting.

[Delete the first sentence of the first paragraph and replace with the following:]

Planting holes shall have vertical sides to the depth of the rootball and shall be two times the width of the rootball.

[Delete the fourth paragraph and replace with the following:]

All planting holes shall be backfilled with prepared soil mix that follow the recommendation as detailed in the Soils Report.

Fertilizer planting tablets 21 gram size and shall be placed with each plant at the following rates:

- a) One tablet per one-gallon container;
- b) Two tablets per five-gallon container;
- c) Four tablets per 15-gallon container;
- d) Eight tablets per 24" box container;
- e) One tablet per each two (2) inches of box size container

[Delete items a, b, c, and e in the fifth paragraph and replace with the following:]

- a) Set plant in the center of the hole with the fullest growth facing the prevailing wind.
- b) Position the plant in the hole so that the top of the rootball is 1" above the finished grade and backfill no higher than halfway up the root ball. Place the recommended number of tablets

evenly around the perimeter of and immediately adjacent to, the root ball at a depth that is between the middle and the bottom of the root ball.

- c) Complete the backfilling, tamp (eliminating all air voids), sloping the soil away from the rootball to finished grade, and water.
- e) Construct a berm 4" above finish grade, extending 4" to 6" beyond edge of root ball, forming a watering basin with a level bottom around each plant.

801-5 IRRIGATION SYSTEM INSTALLATION.

801-5.1 General.

[Add the following:]

The Contractor shall check and verify the water pressure at each Point of Connection (P.O.C.) prior to beginning work. The Contractor shall notify the County Project Manager of any discrepancy between pressure indicated on the Plans and the actual water pressure measured in the field. If the pressure provided at work site or any other conditions create problems that shall prevent proper operation of the irrigation system, the County Project Manager shall be notified before commencement of any work.

[Add to the last paragraph:]

The Contractor shall accurately record on one set of black and white prints (irrigation drawings) all changes in work constituting departures from the original contract drawings, which will become the basis for the As-Built drawings. The As-Built drawings of the irrigation system shall show locations and depths of the following items:

- a) Points of connection.
- b) Routing of pressurized and non-pressurized lines (dimension at a maximum of 100 feet along routing).
- c) All valves.
- d) Quick coupling valves.
- e) Rerouting of control wires.
- f) Other related equipment (as directed by County Project Manager).

Dimensions shall be from two permanent points of reference (monuments, sidewalks, curbs, and pavement). Information needed on the As-Built drawings shall be added on a day-to-day basis as the work is installed. All dimensions noted on the drawings shall be a ¼ inch in size.

The Contractor shall submit the As-Built drawings to the County Project Manager for approval seven days prior to the start of the Maintenance and Establishment Period.

801-5.2 Trench Excavation and Backfill.

[Add the following:]

Mechanical trenching machines shall be of an approved type to cut trenches with straight sides. Pipes shall be supported continuously on the bottom of the trench and shall be laid to an even grade. Trenching excavation shall follow layout approved by the County Project Manager and as indicated on the approved plans.

The Contractor shall not install trenches through proposed tree locations and shall avoid conflict with the root ball.

Trenches located under areas where paving, asphaltic concrete or concrete will be installed shall be backfilled with sand and compacted in layers to 95% compaction, using manual or mechanical tamping devices. The Contractor shall set in place, cap, and pressure test all piping under paving prior to paving work.

The Contractor shall install irrigation sleeves where any irrigation pipe or irrigation control wire passes under paving. Sleeves shall extend 12" beyond the edge of paving. Sleeves shall be two times the diameter of lateral line, mainline, and wire bundle size, and a minimum of 2" size. Install separate sleeves for each use.

Trenches shall not be backfilled prior to approval of all required tests unless specifically directed by County Project Manager for trenches that represent an unsafe situation.

Excavated materials approved for backfilling, consisting of earth, loam, sandy clay, sand, or other approved materials shall be free from clods of earth or stones larger than 1" in diameter, shall be tamped in 4" layers under the pipe and uniformly on both sides extending the full width of the trench and the full length of the pipe. Materials shall be sufficiently damp to permit thorough compaction, free of voids. Backfill shall be mechanically compacted to a dry density equal to adjacent, undisturbed soil in landscaped areas and shall conform to adjacent grades. Under no circumstances shall truck wheels be used to compact soil.

Initial backfill on all lines shall be of fine granular material with no foreign matter larger than 1/2" diameter.

Jetting is not an acceptable method of compacting trenches.

All trenches shall be compacted to the same compaction as the adjoining area and finished flush with adjoining grades. If settlement occurs and subsequent adjustments in pipe, valves, irrigation heads, planting, or other construction is necessary, the Contractor shall make required adjustments without cost to the City.

801-5.4 Installation of Valves, Valve Boxes, and Special Equipment.

[Add the following:]

Install valve boxes in planting areas and according to the Plans. Only one valve per box shall be allowed. Align valve boxes at right angles to the adjacent hardscape whenever possible. Where several valve boxes are located in the same area, arrange them in a uniform and orderly fashion.

When grouped together, allow a minimum of 12" between valves. The valves shall be installed in valve boxes, which shall have enough room on all sides to allow repair personnel to completely re-construct the valves without removing the valve box.

Valve boxes shall have identification numbers hot branded onto the box covers. The letters shall be 2" high and shall be branded using irons specifically designed for this purpose. Heat branding shall not weaken or in any way puncture the valve box cover. Remote control valves shall be branded "RCV" followed by the irrigation controller and valve number (e.g. RCV A-12), ball valves shall be branded "BV", and quick coupler valves shall be branded "QCV".

Identification tags with numbers are required on all valves. Tags shall have black letter with yellow background unless otherwise directed by the County Project Manager. When recycled or reclaimed water is used, the tags shall have black letters with a purple background.

[Delete the third paragraph, fifth paragraph, sixth, and seventh paragraphs.]

801-5.5 Sprinkler Head Installation and Adjustment.

801-5.5.2 Location, Elevation, and Spacing. [Delete the entire section.]

801-5.6 Automatic Control System Installation.

[Add the following:]

Loop 36" of excess wire into each single valve box and into one valve box in each group of valves.

Field splices between the automatic controller and electrical control valves will not be allowed without prior approval of the County Project Manager.

Spare Wires: Two red and one white spare wires shall be run in each direction from furthest valve of furthest valve manifold on each mainline run to each controller.

Automatic Controllers: Controllers shall be installed approximately where shown on the Plans after having verified exact positioning with the County Project Manager. Units shall be installed plumb and in a manner as recommended by the manufacturer in the enclosure.

[Delete the first sentence and the last sentence in the fourth paragraph.]

801-5.7 Flushing and Testing.

801-5.7.1 General.

[Add the following:]

If leaks develop, repair leaking portions and repeat test until entire system is proven to be water-tight.

Tests shall be observed and approved by the County Project Manager prior to backfilling trenches.

801-5.7.2 Pipeline Pressure Test.

801-5.7.2.1 General.

[Add the following:]

Swing joints, emitters, etc. should be installed after the lateral line pressure test.

[Add the following subsections:]

801-5.8 Controller Charts.

Upon completion of the Work, the control system shall be in operating condition with an operational chart mounted in the controller cabinet.

As-Built drawings shall be approved by the County Project Manager before the controller charts are prepared. The Contractor shall provide two controller charts for each controller supplied that show the area covered by the automatic controller on the maximum size sheet which the controller or controller cabinet door shall allow. The chart shall be a reproduction of the As-Built system drawing. However, in the event the controller sequence is not legible when the drawing is reduced, it shall be enlarged or redrawn to a size that shall be readable.

The chart shall be a blackline print and a different color shall be used to show area of coverage for each station.

When completed by the Contractor and approved by the County Project Manager, one of the charts shall be hermetically sealed between two pieces of plastic, each piece being a minimum 20 mils. thick. This chart shall be mounted using Velcro or approved equal type of tape. The other chart shall be given to the County Project Manager.

These charts shall be completed and approved prior to final inspection of the irrigation system.

801-6 MAINTENANCE AND PLANT ESTABLISHMENT.

[In the second sentence of the fifth paragraph and replace with the following:]

The plant establishment period shall be for a period of 90 calendar days unless otherwise specified in the Special Provisions and will be extended by the County Project Manager if the planted areas are improperly maintained, appreciable plant replacement is required, or other corrective work becomes necessary.

The Contractor shall apply post-plant fertilizer at the rate of 20 pounds per 1,000 square feet 30 days after planting and once again at the end of the maintenance and establishment period.

The above fertilization schedule may be revised by the County Project Manager based on the Soils Report or if optimal plant health and growth is not being obtained.

[Add the following subsection:]

801-6.1 Guarantee.

All trees installed under the Contract shall be guaranteed to live and grow for one year from the date of final acceptance of the Work unless decline of the tree is specifically attributable to causes unrelated to installation, plant material quality, and the Contractor's maintenance practices.

All other plant material shall be guaranteed to live and grow for a period of 90 calendar days from the date of final acceptance of the Work unless decline of the plant material is specifically attributable to causes unrelated to installation, plant material quality, and the Contractor's maintenance practices.

Any plant material found to be dead, missing, or in poor condition during the maintenance and establishment period shall be replaced immediately at the Contractor's expense. The County Project Manager shall be the sole judge as to the condition of the material. Replacement shall be made to the same specifications required for the original plantings.

During the guarantee period, should the Contractor fail to expeditiously replace dead plant material upon written notification by the County Project Manager, the City shall cause the work to be corrected and bill the actual costs incurred to the Contractor.

801-8 PAYMENT

[Delete and replace the entire subsection with the following:]

Payment for **Landscape Planting** shall be at the contract **Lump Sum** price shown in the Bid and shall include full compensation for furnishing all labor, tools, materials, equipment, and work involved including, but not be limited to soil preparation, fertilizers, amendments, weed control, finish grading, soil testing, backfill materials, furnishing and installing plant materials, bark mulch, and cleanup.

Payment for **Irrigation System** shall be at the contract **Lump Sum** price shown in the Bid and shall include full compensation for furnishing all labor, tools, materials, equipment, and work involved including, but not be limited to pipes, fittings, sprinklers, valves, automatic control valves, controllers, valve boxes, drain valves, hose bib valves, operating wrenches, riser assemblies, fertilizer injection system, trenching, direct burial wires, electrical connections, wiring and other appurtenances, piping, connections, coordination, testing, cleanup, and adjustments necessary for a complete operating system, ready for immediate use upon completion.

Payment for **Maintenance and Plant Establishment** shall be at the contract **Lump Sum** price shown in the Bid and shall include full compensation for furnishing all labor, tools, materials, equipment, and work involved to complete this work.

TABLE OF CONTENTS

DIVISION 1 GENERAL REQUIREMENTS

01 10 00

Summary

DIVISION 26 ELECTRICAL

26 05 00

Common Work Results for Electrical

26 05 19

Low-Voltage Electrical Power Conductors and Cables

26 05 26

Grounding and Bonding for Electrical Systems

26 05 33

Raceway And Boxes For Electrical Systems

26 05 53

Identification for Electrical Systems

26 27 26

Wiring Devices

26 56 00

LED Exterior Lighting

END OF SECTION

SECTION 260519 – COMMON WORK RESULTS FOR ELECTRICAL

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Electrical equipment coordination and installation.
2. Sleeves for raceways and cables.
3. Sleeve seals.
4. Grout.
5. Common electrical installation requirements.

1.3 DEFINITIONS

- A. EPDM: Ethylene-propylene-diene terpolymer rubber.
- B. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

- A. Product Data: For sleeve seals.

1.5 COORDINATION

- A. Coordinate arrangement, mounting, and support of electrical equipment:

1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
3. To allow right of way for piping and conduit installed at required slope.
4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.

- B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.
- C. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed.
- D. Coordinate sleeve selection and application with selection and application of firestopping specified.

PART 2 - PRODUCTS

2.1 SLEEVES FOR RACEWAYS AND CABLES

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- C. Sleeves for Rectangular Openings: Galvanized sheet steel.
 - 1. Minimum Metal Thickness:
 - a. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and no side more than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
 - b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches (1270 mm) and 1 or more sides equal to, or more than, 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

2.2 SLEEVE SEALS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Metraflex Co.
 - d. Pipeline Seal and Insulator, Inc.
 - 2. Sealing Elements: EPDM, NBR interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
 - 3. Pressure Plates: Plastic. Include two for each sealing element.

4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.3 GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

- A. Comply with NECA 1.
- B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.
- C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- E. Right of Way: Give to piping systems installed at a required slope.

3.2 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Electrical penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- E. Cut sleeves to length for mounting flush with both surfaces of walls.
- F. Extend sleeves installed in floors **2 inches** above finished floor level.

- G. Size pipe sleeves to provide **1/4-inch** annular clear space between sleeve and raceway or cable, unless indicated otherwise.
- H. Seal space outside of sleeves with grout for penetrations of concrete and masonry
 - 1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.
- I. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials as shown on drawings.
- J. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- K. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for **1-inch** annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- L. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for **1-inch** annular clear space between raceway or cable and sleeve for installing mechanical sleeve seals.

3.3 SLEEVE-SEAL INSTALLATION

- A. Install to seal exterior wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.4 FIRESTOPPING

- A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electrical installations to restore original fire-resistance rating of assembly.

END OF SECTION 260500

SECTION 260519 – LOW-VOLTAGE POWER CONDUCTORS AND CABLES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Building wires and cables rated 600 V and less.
 - 2. Connectors, splices, and terminations rated 600 V and less.
 - 3. Sleeves and sleeve seals for cables.

1.3 DEFINITIONS

- A. EPDM: Ethylene-propylene-diene terpolymer rubber.
- B. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Qualification Data: For testing agency.
- C. Field quality-control test reports.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
 - 1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

- 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 CEC.

1.6 COORDINATION

- A. Set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Alcan Products Corporation; Alcan Cable Division
 - 2. American Insulated Wire Corp.; a Leviton Company.
 - 3. General Cable Corporation.
 - 4. Senator Wire & Cable Company.
 - 5. Southwire Company.
- B. Copper Conductors: Comply with NEMA WC 70.

2.2 CONNECTORS AND SPLICES

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. AFC Cable Systems, Inc.
 - 2. Hubbell Power Systems, Inc.
 - 3. O-Z/Gedney; EGS Electrical Group LLC.
 - 4. 3M; Electrical Products Division.
 - 5. Tyco Electronics Corp.
- B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

2.3 SLEEVES FOR CABLES

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

2.4 SLEEVE SEALS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Advance Products & Systems, Inc.
 2. Calpico, Inc.
 3. Metraflex Co.
 4. Pipeline Seal and Insulator, Inc.
- B. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and cable.
1. Sealing Elements: EPDM, NBR interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
 2. Pressure Plates: Plastic. Include two for each sealing element.
 3. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Service Entrance: By SDG&E.
- B. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type XHHW, single conductors in raceway.
- C. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type XHHW, single conductors in raceway.
- D. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, single conductors in raceway. See Section 260553 for Color Coding requirements.
- E. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway.

- F. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.
- G. Class 1 Control Circuits: Type THHN-THWN, in raceway.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.
- B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- E. Support cables as required by Code.
- F. Identify and color-code conductors and cables according to Division 26 Section "Identification for Electrical Systems."
- G. Unless specifically shown otherwise, provide branch circuit and feeder homeruns with not more than three phase conductors, three neutral conductors and one ground conductor in a single raceway. The use of gutters or junction boxes to gather several homeruns into a large conduit to the panel will not be permitted.
- H. Provide separate neutral wire with each branch circuit. See Section 260553 "Identification for Electrical Systems" for Color Coding requirements.

3.4 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A.
- B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least **6 inches (150 mm)** of slack.

3.5 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.

- B. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- C. Rectangular Sleeve Minimum Metal Thickness:
 - 1. For sleeve rectangle perimeter less than **50 inches (1270 mm)** and no side greater than **16 inches (400 mm)**, thickness shall be **0.052 inch (1.3 mm)**.
 - 2. For sleeve rectangle perimeter equal to, or greater than, **50 inches (1270 mm)** and 1 or more sides equal to, or greater than, **16 inches (400 mm)**, thickness shall be **0.138 inch (3.5 mm)**.
- D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- E. Cut sleeves to length for mounting flush with both wall surfaces.
- F. Extend sleeves installed in floors **2 inches (50 mm)** above finished floor level.
- G. Size pipe sleeves to provide **1/4-inch (6.4-mm)** annular clear space between sleeve and cable unless sleeve seal is to be installed.
- H. Seal space outside of sleeves with grout for penetrations of concrete and masonry.
- I. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at cable penetrations as shown on drawings.
- J. Roof-Penetration Sleeves: Seal penetration of individual cables with flexible boot-type flashing units applied in coordination with roofing work.
- K. Aboveground Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Size sleeves to allow for **1-inch (25-mm)** annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- L. Underground Exterior-Wall Penetrations: Install cast-iron "wall pipes" for sleeves. Size sleeves to allow for **1-inch (25-mm)** annular clear space between cable and sleeve for installing mechanical sleeve seals.

3.6 SLEEVE-SEAL INSTALLATION

- A. Install to seal underground exterior-wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for cable material and size. Position cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.7 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly.

3.8 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections and prepare test reports.
- B. Perform tests and inspections and prepare test reports.
- C. Tests and Inspections:
 - 1. After installing conductors and cables and before electrical circuitry has been energized, test for compliance with requirements.
 - 2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
- D. Test Reports: Prepare a written report to record the following:
 - 1. Test procedures used.
 - 2. Test results that comply with requirements.
 - 3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.
- E. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION 260519

SECTION 260526 – GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes methods and materials for grounding systems and equipment.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Other Informational Submittals: Plans showing dimensioned as-built locations of grounding features specified in Part 3 "Field Quality Control" Article, including the following:
 - 1. Ground rods.
- C. Qualification Data: For testing agency and testing agency's field supervisor.
- D. Field quality-control test reports.

1.4 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
 - 1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association to supervise on-site testing specified in Part 3.
- 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 UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 CONDUCTORS

- A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
 - 1. Solid Conductors: ASTM B 3.
 - 2. Stranded Conductors: ASTM B 8.
 - 3. Tinned Conductors: ASTM B 33.
 - 4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch (6 mm) in diameter.
 - 5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
 - 6. Bonding Jumper: Copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.
 - 7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.
- C. Grounding Bus: Rectangular bars of annealed copper, 1/4 by 2 inches (6 by 50 mm) in cross section, unless otherwise indicated; with insulators.

2.2 CONNECTORS

- A. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.
- B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, bolted pressure-type, with at least two bolts.
 - 1. Pipe Connectors: Clamp type, sized for pipe.
- C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.3 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel; 3/4 inch by 10 feet (19 mm by 3 m) in diameter.

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger, unless otherwise indicated.
- B. Underground Grounding Conductors: Install bare copper conductor, No. 2/0 AWG minimum.
 - 1. Bury at least 24 inches (600 mm) below grade.
 - 2. Duct-Bank Grounding Conductor: Bury 12 inches (300 mm) above duct bank when indicated as part of duct-bank installation.
- C. Grounding Bus: Install in electrical and telephone equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
 - 1. Install bus on insulated spacers 1 inch (25 mm), minimum, from wall 6 inches (150 mm) above finished floor, unless otherwise indicated.
 - 2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, down to specified height above floor, and connect to horizontal bus.
- D. Conductor Terminations and Connections:
 - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
 - 2. Underground Connections: Exothermically Welded connectors.
 - 3. Connections to Structural Steel: Exothermically Welded connectors.

3.2 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.
- B. Install insulated equipment grounding conductors with the following items, in addition to those required by CEC:
 - 1. Feeders and branch circuits.
 - 2. Lighting circuits.
 - 3. Receptacle circuits.
 - 4. Single-phase motor and appliance branch circuits.
 - 5. Three-phase motor and appliance branch circuits.
 - 6. Flexible raceway runs.
 - 7. Busway Supply Circuits: Install insulated equipment grounding conductor from grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.
- C. Signal and Communication Equipment: For telephone, alarm, voice and data, and other communication equipment, provide No. 4 AWG minimum insulated grounding conductor in

raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.

1. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-2-by-12-inch (6-by-50-by-300-mm) grounding bus.
2. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.

3.3 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Ground Rods: Drive rods until tops are 6 inches (150 mm) below finished floor or final grade, unless otherwise indicated.
 1. Interconnect ground rods with grounding electrode conductor 24" below grade and as otherwise indicated. Make connections without exposing steel or damaging coating, if any.
 2. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.
- C. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.
 1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install so vibration is not transmitted to rigidly mounted equipment.
 3. Use exothermic-welded connectors for outdoor locations, but if a disconnect-type connection is required, use a bolted clamp.
- D. Grounding and Bonding for Piping:
 1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes, using a bolted clamp connector or by bolting a lug-type connector to a pipe flange, using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
 2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
 3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

- E. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install tinned bonding jumper to bond across flexible duct connections to achieve continuity.
- F. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than **60 feet (18 m)** apart.
- G. Provide grounding for AT&T and Cox cable, per utilities standards.
- H. Ufer Ground (Concrete-Encased Grounding Electrode): Fabricate according to NFPA 70, using a minimum of **20 feet (6 m)** of bare copper conductor not smaller than No. 4 AWG.
 - 1. If concrete foundation is less than **20 feet (6 m)** long, coil excess conductor within base of foundation.
 - 2. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building grounding grid or to grounding electrode external to concrete.

3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing and inspecting agency to perform the following field tests and inspections and prepare test reports:
- B. Perform the following tests and inspections and prepare test reports:
 - 1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
 - 2. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at individual ground rods. Make tests at ground rods before any conductors are connected.
 - a. Measure ground resistance not less than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
 - b. Perform tests by fall-of-potential method according to IEEE 81.
 - 3. Prepare dimensioned drawings locating each test well, ground rod and ground rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.
- C. Report measured ground resistances that exceed the following values:
 - 1. Power and Lighting Equipment or System with Capacity 500 kVA and Less: 10 ohms.
 - 2. Power Distribution Units or Panelboards Serving Electronic Equipment: 3 ohm(s).
 - 3. Manhole Grounds: 10 ohms.

- D. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION 260526

SAMPLE

SECTION 260533 - RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. EPDM: Ethylene-propylene-diene terpolymer rubber.
- C. FMC: Flexible metal conduit.
- D. LFMC: Liquidtight flexible metal conduit.
- E. LFNC: Liquidtight flexible nonmetallic conduit.
- F. NBR: Acrylonitrile-butadiene rubber.
- G. RNC: Rigid nonmetallic conduit.

1.4 SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
- B. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
 - 1. Structural members in the paths of conduit groups with common supports.

2. HVAC and plumbing items and architectural features in the paths of conduit groups with common supports.
- C. **Manufacturer Seismic Qualification Certification:** Submit certification that enclosures and cabinets and their mounting provisions, including those for internal components, will withstand seismic forces. Include the following:
 1. **Basis for Certification:** Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - a. The term "withstand" means "the cabinet or enclosure will remain in place without separation of any parts when subjected to the seismic forces specified."
 - b. Cabinet or enclosure shall be seismically braced for zone IV as defined in the California Codes and Regulations.
- D. **Qualification Data:** For professional engineer and testing agency.
- E. Source quality-control test reports.

1.5 QUALITY ASSURANCE

- A. **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.
- B. Comply with CEC.

PART 2 - PRODUCTS

2.1 METAL CONDUIT AND TUBING

- A. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
 1. AFC Cable Systems, Inc.
 2. Alflex Inc.
 3. Allied Tube & Conduit; a Tyco International Ltd. Co.
 4. Anamet Electrical, Inc.; Anaconda Metal Hose.
 5. Electri-Flex Co.
 6. Manhattan/CDT/Cole-Flex.
 7. Maverick Tube Corporation.
 8. O-Z Gedney; a unit of General Signal.
 9. Wheatland Tube Company.

- B. Rigid Steel Conduit: ANSI C80.1.
- C. EMT: ANSI C80.3.
- D. FMC: Zinc-coated steel.
- E. LFMC: Flexible steel conduit with PVC jacket.
- F. Fittings for Conduit (Including all Types and Flexible and Liquidtight), EMT, and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.
 - 1. Fittings for EMT: , compression type.
- G. Joint Compound for Rigid Steel Conduit or IMC: Listed for use in cable connector assemblies, and compounded for use to lubricate and protect threaded raceway joints from corrosion and enhance their conductivity.

2.2 NONMETALLIC CONDUIT AND TUBING

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following.
- B. Manufactures: Subject to compliance with requirements, provide product by one of the following:
 - 1. AFC Cable Systems, Inc.
 - 2. Anamet Electrical, Inc.; Anaconda Metal Hose.
 - 3. Arnco Corporation.
 - 4. CANTEX Inc.
 - 5. CertainTeed Corp.; Pipe & Plastics Group.
 - 6. Condux International, Inc.
 - 7. ElecSYS, Inc.
 - 8. Electric-Flex Co.
 - 9. Lamson & Sessions; Carlon Electrical Products.
 - 10. Manhattan/CDT/Cole-Flex.
 - 11. RACO; a Hubbell Company.
 - 12. Thomas & Betts Corporation.
- C. RNC: NEMA TC 2 Type EPC-40-PVC unless otherwise indicated.
- D. Fittings for RNC: NEMA TC 3; match to conduit or tubing type and material.

2.3 OPTICAL FIBER/COMMUNICATIONS CABLE RACEWAY AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Arnco Corporation.
 2. Endot Industries Inc.
 3. IPEX Inc.
 4. Lamson & Sessions; Carlon Electrical Products.
- B. Description: Comply with UL 2024; flexible type, approved for plenum and riser installation.

2.4 BOXES, ENCLOSURES, AND CABINETS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
 2. EGS/Appleton Electric.
 3. Erickson Electrical Equipment Company.
 4. Hoffman.
 5. Hubbell Incorporated; Killark Electric Manufacturing Co. Division.
 6. O-Z/Gedney; a unit of General Signal.
 7. RACO; a Hubbell Company.
 8. Robroy Industries, Inc.; Enclosure Division.
 9. Scott Fetzer Co.; Adalet Division.
 10. Spring City Electrical Manufacturing Company.
 11. Thomas & Betts Corporation.
 12. Walker Systems, Inc.; Wiremold Company (The).
 13. Woodhead, Daniel Company; Woodhead Industries, Inc. Subsidiary.
- B. Sheet Metal Outlet and Device Boxes: NEMA OS 1.
- C. Cast-Metal Outlet and Device Boxes: NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.
- D. Metal Floor Boxes: Cast metal, fully adjustable, rectangular.
- E. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- F. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous-hinge cover with flush latch, unless otherwise indicated.
1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
- G. Cabinets:

1. NEMA 250, Type 1, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
2. Hinged door in front cover with flush latch and concealed hinge.
3. Key latch to match panelboards.
4. Metal barriers to separate wiring of different systems and voltage.
5. Accessory feet where required for freestanding equipment.

2.5 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

A. Description: Comply with SCTE 77.

1. Color of Frame and Cover: Gray
2. Configuration: Units shall be designed to flush burial and have integral closed bottom, unless otherwise indicated.
3. Cover: Weatherproof Galvanized Steel, secured by temper-resistant locking devices and having structural load rating consistent with enclosure.
4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
5. Cover Legend: Molded lettering "ELECTRIC", "TELEPHONE" as indicated for each service.
6. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
7. Handholes 12 inches wide by 24 inches long (300 mm wide by 600 mm long) and larger shall have inserts for cable racks and pulling-in irons installed before concrete is poured.
8. Handholes shall be traffic rated.

2.6 SLEEVES FOR RACEWAYS

A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

2.7 SLEEVE SEALS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Advance Products & Systems, Inc.
2. Calpico, Inc.
3. Metraflex Co.
4. Pipeline Seal and Insulator, Inc.

B. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and cable.

1. Sealing Elements: EPDM, NBR interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
2. Pressure Plates: Plastic. Include two for each sealing element.
3. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.8 SOURCE QUALITY CONTROL FOR UNDERGROUND ENCLOSURES

- A. Handhole and Pull-Box Prototype Test: Test prototype of handholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.
 1. Tests of materials shall be performed by a independent testing agency.
 2. Strength tests of complete boxes and covers shall be by either an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacture.
 3. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012, and traceable to NIST standards.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

- A. Outdoors: Apply raceway products as specified below, unless otherwise indicated:
 1. Exposed Conduit: Rigid steel conduit.
 2. Concealed Conduit, Aboveground: Rigid steel conduit.
 3. Underground Conduit: RNC, Type EPC-40-PVC, direct buried.
 4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
 5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.
- B. Comply with the following indoor applications, unless otherwise indicated:
 1. Exposed, Not Subject to Physical Damage: EMT.
 2. Exposed, Not Subject to Severe Physical Damage: EMT.
 3. Exposed and Subject to Severe Physical Damage: Rigid steel conduit. Includes raceways in the following locations:
 - a. Kitchen
 - b. Mechanical rooms.
 4. Concealed in Ceilings and Interior Walls and Partitions: EMT.

5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
 6. Damp or Wet Locations: Rigid steel conduit.
 7. Raceways for Optical Fiber or Communications Cable in Spaces Used for Environmental Air: EMT.
 8. Raceways for Optical Fiber or Communications Cable Risers in Vertical Shafts: EMT.
 9. Raceways for Concealed General Purpose Distribution of Optical Fiber or Communications Cable: EMT.
 10. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4, in damp or wet locations.
- C. Minimum Raceway Size: 3/4-inch (21-mm) trade size.
- D. Raceway Fittings: Compatible with raceways and suitable for use and location.
1. Rigid Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.

3.2 INSTALLATION

- A. Comply with NECA 1 for installation requirements applicable to products specified in Part 2 except where requirements on Drawings or in this Article are stricter.
- B. Keep raceways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- C. Complete raceway installation before starting conductor installation.
- D. Support raceways as required and in compliance with code.
- E. Arrange stub-ups so curved portions of bends are not visible above the finished slab.
- F. Install no more than the equivalent of three 90-degree bends in any conduit run except for communications conduits, for which fewer bends are allowed.
- G. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.
- H. Raceways Embedded in Slabs:
 1. Run conduit larger than 1-inch (27-mm) trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.
 2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.

- I. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- J. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.
- K. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than **200-lb (90-kg)** tensile strength. Leave at least **12 inches (300 mm)** of slack at each end of pull wire.
- L. Raceways for Optical Fiber and Communications Cable: Install raceways, as follows:
 - 1. **3/4-Inch (19-mm)** Trade Size and Smaller: Install raceways in maximum lengths of **50 feet (15 m)**.
 - 2. **1-Inch (25-mm)** Trade Size and Larger: Install raceways in maximum lengths of **75 feet (23 m)**.
 - 3. Install with a maximum of two 90-degree bends or equivalent for each length of raceway unless Drawings show stricter requirements. Separate lengths with pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.
- M. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:
 - 1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 - 2. Where otherwise required by CEC.
- N. Flexible Conduit Connections: Use maximum of **72 inches (1830 mm)** of flexible conduit for recessed and semirecessed lighting fixtures, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
 - 1. Use LFMC in damp or wet locations subject to severe physical damage.
 - 2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.
- O. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall.
- P. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom for pipe less than **6 inches (150 mm)** in nominal diameter.
2. Install backfill.
3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within **12 inches (300 mm)** of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction.
4. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through the floor, unless otherwise indicated. Encase elbows for stub-up ducts throughout the length of the elbow.
5. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.
 - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with **3 inches (75 mm)** of concrete.
 - b. For stub-ups at equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of **60 inches (1500 mm)** from edge of equipment pad or foundation. Install insulated grounding bushings on terminations at equipment.
6. Warning Planks: Bury warning planks approximately **12 inches (300 mm)** above direct-buried conduits, placing them **24 inches (600 mm)** o.c. Align planks along the width and along the centerline of conduit.

3.4 INSTALLATION OF UNDERGROUND HANHOLES AND BOXES

- A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.
- B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch (12.5 –mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.
- C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch (25 mm) above finished grade.
- D. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare spaces for future cables, but short enough to preserve adequate working clearances in the enclosure.

- E. Field-cut openings for conduit according to enclosed manufacture's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

3.5 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- B. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- C. Rectangular Sleeve Minimum Metal Thickness:
 - 1. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and no side greater than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
 - 2. For sleeve cross-section rectangle perimeter equal to, or greater than, 50 inches (1270 mm) and 1 or more sides equal to, or greater than, 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).
- D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- E. Cut sleeves to length for mounting flush with both surfaces of walls.
- F. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level.
- G. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and raceway unless sleeve seal is to be installed or unless seismic criteria require different clearance.
- H. Seal space outside of sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies.
- I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway, using joint sealant appropriate for size, depth, and location of joint.
- J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway penetrations. Install sleeves and seal with firestop materials as shown on drawings.
- K. Roof-Penetration Sleeves: Seal penetration of individual raceways with flexible, boot-type flashing units applied in coordination with roofing work.

- L. Aboveground, Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- M. Underground, Exterior-Wall Penetrations: Install cast-iron "wall pipes" for sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between raceway and sleeve for installing mechanical sleeve seals.

3.6 SLEEVE-SEAL INSTALLATION

- A. Install to seal underground, exterior wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for raceway material and size. Position raceway in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.7 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly.

3.8 PROTECTION

- A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.
 - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 - 2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 260533

SECTION 260553 – IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Identification for raceways.
2. Identification of power and control cables.
3. Identification for conductors.
4. Underground-line warning tape.
5. Warning labels and signs.
6. Instruction signs.
7. Equipment identification labels.
8. Miscellaneous identification products.

1.3 SUBMITTALS

- A. Product Data: For each electrical identification product indicated.
- B. Samples: For each type of label and sign to illustrate size, colors, lettering style, mounting provisions, and graphic features of identification products.
- C. Identification Schedule: An index of nomenclature of electrical equipment and system components used in identification signs and labels.

1.4 QUALITY ASSURANCE

- A. Comply with ANSI A13.1.
- B. Comply with CEC.
- C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.
- D. Comply with ANSI Z535.4 for safety signs and labels.

- E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

1.5 COORDINATION

- A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual; and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.
- B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- C. Coordinate installation of identifying devices with location of access panels and doors.
- D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 POWER RACEWAY IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway size.
- B. Colors for Raceways Carrying Circuits at 600 V or Less:
 - 1. Black letters on an orange field.
 - 2. Legend: Indicate voltage.
- C. Self-Adhesive Vinyl Labels for Raceways Carrying Circuits at 600 V or Less: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

2.2 POWER AND CONTROL CABLE IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.
- B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

2.3 CONDUCTOR IDENTIFICATION MATERIALS

- A. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

2.4 UNDERGROUND-LINE WARNING TAPE

- A. Tape:
 - 1. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
 - 2. Printing on tape shall be permanent and shall not be damaged by burial operations.
 - 3. Tape material and ink shall be chemically inert, and not subject to degrading with exposed to acids, alkalis, and other destructive substances commonly found in soils.
- B. Color and Printing:
 - 1. Comply with ANSI Z535.1 through ANSI Z535.5.
 - 2. Inscriptions for Red-Colored Tapes: ELECTRIC LINE, HIGH VOLTAGE.
 - 3. Inscriptions for Orange-Colored Tapes: TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE.

2.5 WARNING LABELS AND SIGNS

- A. Comply with CEC and 29 CFR 1910.145.
- B. Self-Adhesive Warning Labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.
- C. Baked-Enamel Warning Signs:
 - 1. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.
 - 2. 1/4-inch (6.4-mm) grommets in corners for mounting.
 - 3. Nominal size, 7 by 10 inches (180 by 250 mm).
- D. Warning label and sign shall include, but are not limited to, the following legends:
 - 1. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES (915 MM)."

2.6 INSTRUCTION SIGNS

- A. Engraved, laminated acrylic or melamine plastic, minimum **1/16 inch (1.6 mm)** thick for signs up to **20 sq. inches (129 sq. cm)** and **1/8 inch (3.2 mm)** thick for larger sizes.
 - 1. Engraved legend with black letters on white face.
 - 2. Punched or drilled for mechanical fasteners.
 - 3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.7 EQUIPMENT IDENTIFICATION LABELS

- A. Self-Adhesive, Engraved, Laminated Acrylic or Melamine Label: Adhesive backed, with white letters on a dark-gray background. Minimum letter height shall be **3/8 inch (10 mm)**.

2.8 CABLE TIES

- A. General-Purpose Cable Ties: Fungus inert, self extinguishing, one piece, self locking, Type 6/6 nylon.
 - 1. Minimum Width: **3/16 inch (5 mm)**.
 - 2. Tensile Strength at **73 deg F (23 deg C)**, According to ASTM D 638: **12,000 psi (82.7 MPa)**.
 - 3. Temperature Range: **Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C)**.
 - 4. Color: Black except where used for color-coding.

2.9 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Paint: Comply with requirements in Division 09 painting Sections for paint materials and application requirements. Select paint system applicable for surface material and location (exterior or interior).
- B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Verify identity of each item before installing identification products.
- B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

- C. Apply identification devices to surfaces that require finish after completing finish work.
- D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.
- E. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
- F. System Identification Color-Coding Bands for Raceways and Cables: Each color-coding band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot (15-m) maximum intervals in straight runs, and at 25-foot (7.6-m) maximum intervals in congested areas.
- G. Cable Ties: For attaching tags. Use general-purpose type.
- H. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches (150 to 200 mm) below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches (400 mm) overall.

3.2 IDENTIFICATION SCHEDULE

- A. Color Coding: Conductors and cables shall be color coded by the manufacturer for the entire length. Wrapping color tapes are not permitted. Color coding shall be as follows:

	<u>120/208V System</u>	<u>277/480V System</u>
Phase A:	Black	Brown
Phase B:	Red	Orange
Phase C:	Blue	Yellow
Neutral:	White	Grey
Ground:	Green	Green
Isolated Ground:	Green/Yellow Stripe	Green/Yellow stripe

- B. Neutral Wires shall have color spiral to match associated phase.
- C. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.

1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
 2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
 3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.
- D. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.
1. Limit use of underground-line warning tape to direct-buried cables.
 2. Install underground-line warning tape for both direct-buried cables and cables in raceway.
- E. Workspace Indication: Install floor marking tape to show working clearances in the direction of access to live parts. Workspace shall be as required by NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.
- F. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive warning labels.
1. Comply with 29 CFR 1910.145.
 2. Identify system voltage with black letters on an orange background.
 3. Apply to exterior of door, cover, or other access.
 4. For equipment with multiple power or control sources, apply to door or cover of equipment including, but not limited to, the following:
 - a. Power transfer switches.
 - b. Controls with external control power connections.
- G. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.
- H. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.
1. Labeling Instructions:
 - a. Indoor Equipment: Self-adhesive, engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with **1/2-inch- (13-mm-)**

high letters on 1-1/2-inch- (38-mm-) high label; where two lines of text are required, use labels 2 inches (50 mm) high.

- b. Outdoor Equipment: Engraved, laminated acrylic or melamine label.
- c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
- d. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.

2. Equipment to Be Labeled:

- a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be self-adhesive, engraved, laminated acrylic or melamine label.
- b. Enclosures and electrical cabinets.
- c. Access doors and panels for concealed electrical items.
- d. Switchboards.
- e. Disconnect switches.

END OF SECTION 260553

SAMPLE

SECTION 262726 – WIRING DEVICES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Receptacles, receptacles with integral GFCI, and associated device plates.
 - 2. Snap Switch
 - 3. Wall-switch.

1.3 DEFINITIONS

- A. EMI: Electromagnetic interference.
- B. GFCI: Ground-fault circuit interrupter.
- C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.
- D. RFI: Radio-frequency interference.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Field quality-control test reports.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of wiring device and associated wall plate through one source from a single manufacturer. Insofar as they are available, obtain all wiring devices and associated wall plates from a single manufacturer and one source.

- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in CEC, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with CEC.

1.6 COORDINATION

- A. Receptacles for Owner-Furnished Equipment: Match plug configurations.
 - 1. Cord and Plug Sets: Match equipment requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:
 - 1. Cooper Wiring Devices; a division of Cooper Industries, Inc. (Cooper).
 - 2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
 - 3. Leviton Mfg. Company Inc. (Leviton).
 - 4. Pass & Seymour/Legrand; Wiring Devices & Accessories (Pass & Seymour).

2.2 STRAIGHT BLADE RECEPTACLES

- A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Cooper; 5351 (single), 5352 (duplex).
 - b. Hubbell; HBL5351 (single), CR5352 (duplex).
 - c. Leviton; 5891 (single), 5352 (duplex).
 - d. Pass & Seymour; 5381 (single), 5352 (duplex).

2.3 GFCI RECEPTACLES

- A. General Description: Straight blade, non-feed-through type. Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 943, Class A, and include indicator light that is lighted when device is tripped.
- B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; GF20.
 - b. Pass & Seymour; 2084.

2.4 CORD AND PLUG SETS

- A. Description: Match voltage and current ratings and number of conductors to requirements of equipment being connected.
 1. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and equipment-rating ampacity plus a minimum of 30 percent.
 2. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

2.5 SNAP SWITCHES

- A. Comply with NEMA WD 1 and UL 20.
- B. Switches, 120 V, 20 A:
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 2221 (single pole), 2222 (two pole), 2223 (three way), 2224 (four way).
 - b. Hubbell; CS1221 (single pole), CS1222 (two pole), CS1223 (three way), CS1224 (four way).
 - c. Leviton; 1221-2 (single pole), 1222-2 (two pole), 1223-2 (three way), 1224-2 (four way).
 - d. Pass & Seymour; 20AC1 (single pole), 20AC2 (two pole), 20AC3 (three way), 20AC4 (four way)

2.6 WALL PLATES

- A. Single and combination types to match corresponding wiring devices.
 1. Plate-Securing Screws: Metal with head color to match plate finish.
 2. Material for Finished Spaces: Smooth, high-impact thermoplastic.
 3. Material for Unfinished Spaces: Smooth, high-impact thermoplastic.
 4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in "wet locations."
- B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with type 3R weather-resistant, die-cast aluminum with lockable cover.

2.7 FINISHES

- A. Color: Wiring device color shall be white. Switched receptacles (Title 24) shall be gray. Wiring devices on Emergency Power shall be red color.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.
- B. Coordination with Other Trades:
 - 1. Take steps to insure that devices and their boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of the boxes.
 - 2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
 - 3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
 - 4. Install wiring devices after all wall preparation, including painting, is complete.
- C. Conductors:
 - 1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
 - 2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
 - 3. The length of free conductors at outlets for devices shall meet provisions of CEC, Article 300, without pigtails.
- D. Device Installation:
 - 1. Replace all devices that have been in temporary use during construction or that show signs that they were installed before building finishing operations were complete.
 - 2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
 - 3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
 - 4. Connect devices to branch circuits using pigtails that are not less than **6 inches (152 mm)** in length.
 - 5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw.
 - 6. Use a torque screwdriver when a torque is recommended or required by the manufacturer.

7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the right.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Dimmers:

1. Install dimmers within terms of their listing.
2. Verify that dimmers used for fan speed control are listed for that application.
3. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device listing conditions in the written instructions.

H. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

I. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

3.2 IDENTIFICATION

A. Comply with Division 26 Section "Identification for Electrical Systems."

1. Receptacles: Identify panelboard and circuit number from which served. Use hot, stamped or engraved machine printing with white-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

1. Test Instruments: Use instruments that comply with UL 1436.
2. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated LED indicators of measurement.

B. Tests for Convenience Receptacles:

1. Line Voltage: Acceptable range is 105 to 132 V.

2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is not acceptable.
3. Ground Impedance: Values of up to 2 ohms are acceptable.
4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
5. Using the test plug, verify that the device and its outlet box are securely mounted.
6. The tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

END OF SECTION 262726

SAMPLE

SECTION 26 56 19 - EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Exterior solid-state luminaires that are designed for and exclusively use LED lamp technology.
2. Luminaire supports.
3. Luminaire-mounted photoelectric relays.
4. Luminaire mounted motion sensors.

1.2 DEFINITIONS

- A. BUG: Backlight, Uplight and Glare
- B. CCT: Correlated color temperature.
- C. CRI: Color rendering index.
- D. Fixture: See "Luminaire."
- E. IP: International Protection or Ingress Protection Rating.
- F. Lumen: Measured output of lamp and luminaire, or both.
- G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.3 SUBMITTALS

A. Product Data: For each type of luminaire.

1. Arrange in order of luminaire designation.
2. Include data on features, accessories, and finishes.
3. Include physical description and dimensions of luminaire.
4. Lamps, include life, output (lumens, CCT, and CRI), and energy-efficiency data.
5. Photometric data and adjustment factors based on laboratory tests, complying with IES Lighting Measurements Testing and Calculation Guides, of each luminaire type. The adjustment factors shall be for lamps and accessories identical to those indicated for the luminaire as applied in this Project.

- a. Manufacturer's Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the NVLAP for Energy Efficient Lighting Products.
 6. Wiring diagrams for power, control, and signal wiring.
 7. Photoelectric relays.
 8. Motion sensors.
 9. Means of attaching luminaires to supports and indication that the attachment is suitable for components involved.
- B. Shop Drawings: For nonstandard or custom luminaires.
1. Include plans, elevations, sections, and mounting and attachment details.
 2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, and required clearances, method of field assembly, components, and location and size of each field connection.
 3. Include diagrams for power, signal, and control wiring.
- C. Sustainable Design Submittals:
1. Product Data: BUG ratings.
 2. Product Data: Luminaire calculations.
 3. Product Data: Indicating luminaire is certified by **ENERGY STAR**.
- D. Samples: For each luminaire and for each color and texture indicated with factory-applied finish.
- E. Product Schedule: For luminaires and lamps. Use same designations indicated on Drawings.
- F. Delegated-Design Submittal: For luminaire supports.
1. Include design calculations for luminaire supports and seismic restraints.
- G. Coordination Drawings: Site Plans, drawn to scale (1"=40'-0"), on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Luminaires.
 2. Structural members to which equipment and luminaires will be attached.
 3. Underground utilities and structures.
 4. Existing underground utilities and structures.
 5. Above-grade utilities and structures.
 6. Existing above-grade utilities and structures.
 7. Building features.
 8. Vertical and horizontal information.
 9. Point to point Foot Candle (FC) calculations showing minimum, maximum and average FCs.
- H. Seismic Qualification Certificates: For luminaires, 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. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

I. Product Certificates: For each type of the following:

1. Luminaire.
2. Photoelectric relay.
3. Motion sensor

J. Product Test Reports: For each luminaire, for tests performed by an independent qualified testing agency.

K. Source quality-control reports.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For luminaires and photoelectric relays to include in operation and maintenance manuals.

1. Provide a list of all types used on Project. Use ANSI and manufacturers' codes.
2. Provide a list of all photoelectric relay types used on Project; use manufacturers' codes.

B. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Glass, Acrylic, and Plastic Lenses, Covers, and Other Optical Parts: One for every 100 of each type and rating installed. Furnish at least two of each type.
2. Diffusers and Lenses: One for every 100 of each type and rating installed. Furnish at least two of each type.
3. Globes and Guards: One for every 20 of each type and rating installed. Furnish at least two of each type.

1.5 QUALITY ASSURANCE

A. Contractor shall ensure that the manufacturer has a minimum of 10 years' experience in the production of Exterior Lighting similar to the type and size specified in this project.

B. Manufacturer shall have ISO 9001 Certification.

C. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturers' laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.

D. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

- E. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.
- F. Mockups: For exterior luminaires, complete with power and control connections.
 - 1. Obtain University Representative's approval of luminaires in mockups before starting installations.
 - 2. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed work.
 - 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless University Representative's specifically approves such deviations in writing.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering prior to shipping.

1.7 FIELD CONDITIONS

- A. Verify existing and proposed utility structures prior to the start of work associated with luminaire installation.
- B. Mark locations of exterior luminaires for approval by University's Representative prior to the start of luminaire installation.

1.8 WARRANTY

- A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period. Warranty shall cover both materials and labors.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures, including luminaire support components.
 - b. Faulty operation of luminaires and accessories.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - 2. Warranty Period: Minimum of five (5) years from date of Substantial Completion:

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Luminaires and lamps shall be labeled vibration and shock resistant.

EXTERIOR LIGHTING

1. The term "withstand" means "the luminaire will remain in place without separation of any parts when subjected to the seismic forces specified and the luminaire will be fully operational during and after the seismic event."

2.2 LUMINAIRE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: UL Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.
- C. UL Compliance: Comply with UL 1598 and listed for wet location.
- D. CRI of minimum: Shown on drawings. CCT : Shown on drawings.
- E. L70 lamp life of 50,000 hours.
- F. Lamps dimmable from 100 percent to 10 percent of maximum light output.
- G. Internal driver.
- H. Nominal Operating Voltage: Shown on drawings.
- I. Lamp Rating: Lamp marked for outdoor use and in enclosed locations.

2.3 PHOTOELECTRIC RELAYS

- A. Manufacturers: Refer to fixture schedule on drawings
- B. Comply with UL 773 or UL 773A.

2.4 LUMINAIRE-MOUNTED MOTION SENSORS:

- A. Manufacturers: Refer to fixture schedule shown on drawings.
- B. Comply with UL 773 or 773A
- C. Motion sensors: Factory mounted on walkway and parking lot light fixtures designed to reduce lighting output by 50% when there is no motion within the specified range. Sensor sensitivity shall be field adjustable. Sensor shall be suitable for the harsh coastal environment and shall have been factory tested to prove its performance. Refer to drawings for additional information.

2.5 MATERIALS

- A. Metal Parts: Free of burrs and sharp corners and edge

EXTERIOR LIGHTING

- B. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses.
- C. Diffusers and Globes:
 - 1. Acrylic Diffusers: 100 percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
 - 2. Glass: Annealed crystal glass unless otherwise indicated.
 - 3. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.
- D. Lens and Refractor Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.
- E. Reflecting surfaces shall have minimum reflectance as follows unless otherwise indicated:
 - 1. White Surfaces: 85 percent.
 - 2. Specular Surfaces: 83 percent.
 - 3. Diffusing Specular Surfaces: 75 percent.
- F. Housings:
 - 1. Rigidly formed, weather- and light-tight enclosure that will not warp, sag, or deform in use.
 - 2. Provide filter/breather for enclosed luminaires.
- G. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
 - 1. Label shall include the following lamp characteristics:
 - a. "USE ONLY" and include specific lamp type.
 - b. Lamp diameter, shape, size, wattage and coating.
 - c. CCT and CRI for all luminaires.

2.6 FINISHES

- A. Variations in Finishes: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- B. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finishes process and color of pole or support materials.

- C. Factory-Applied Finish for Aluminum Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
 2. Natural Satin Finish: Provide fine, directional, medium satin polish (AA-M32); buff complying with AA-M20 requirements; and seal aluminum surfaces with clear, hard-coat wax.
 3. Class I, Clear-Anodic Finish: AA-M32C22A41 (Mechanical Finish: Medium satin; Chemical Finish: Etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.
 4. Class I, Color-Anodic Finish: AA-M32C22A42/A44 (Mechanical Finish: Medium satin; Chemical Finish: Etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker), complying with AAMA 611.
 - a. Color: as indicated on drawings, fixture schedule.
- D. Factory-Applied Finish for Steel Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1 or SSPC-SP 8.
 2. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.
 - a. Color: As selected from manufacturer's standard catalog of colors.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for luminaire electrical conduit to verify actual locations of conduit connections before luminaire installation.
- C. Examine walls, roofs, and canopy ceilings and overhang ceilings for suitable conditions where luminaires will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected

3.2 GENERAL INSTALLATION REQUIREMENTS

- A. Comply with NECA 1.
- B. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.
- C. Install lamps in each luminaire.
- D. Fasten luminaire to structural support.
- E. Supports:
 - 1. Sized and rated for luminaire weight.
 - 2. Able to maintain luminaire position after cleaning and relamping.
 - 3. Support luminaires without causing deflection of finished surface.
 - 4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.
- F. Wiring Method: Install cables in raceways. Conceal raceways and cables.
- G. Install luminaires level, plumb, and square with finished grade unless otherwise indicated or install luminaires at height and aiming angle as indicated on Drawings.
- H. Coordinate layout and installation of luminaires with other construction.
- I. Adjust luminaires that require field adjustment or aiming. Include adjustment of photoelectric device to prevent false operation of relay by artificial light sources, favoring a north orientation.
- J. Comply with requirements in Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables" and 260533 "Raceways and Boxes for Electrical Systems" for wiring connections and wiring methods.

3.3 CORROSION PREVENTION

- A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.
- B. Steel Conduits: Comply with Section 26 05 33 "Raceways and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

3.4 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

EXTERIOR LIGHTING

3.5 FIELD QUALITY CONTROL

- A. Inspect each installed luminaire for damage. Replace damaged luminaires and components.
- B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
 - 1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
 - 2. Verify operation of photoelectric controls and motion sensors.
- C. Illumination Tests:
 - 1. Measure light intensities at night. Use photometers with calibration referenced to NIST standards. Comply with the following IES testing guide(s):
 - a. IES LM-5.
 - b. IES LM-50.
 - c. IES LM-52.
 - d. IES LM-64.
 - e. IES LM-72.
- D. Luminaire will be considered defective if it does not pass tests and inspections.
- E. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

3.6 DEMONSTRATION

- A. Train University's maintenance personnel to adjust, operate, and maintain luminaires and photocell relays.

3.7 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied conditions at no additional cost to University. Make up to two (2) visits to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.
 - 1. During adjustment visits, inspect all luminaires. Replace lamps or luminaires that are defective.
 - 2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
 - 3. Adjust the aim of luminaires in the presence of the University's Representative.

END OF SECTION 26 56 19