



**San Diego County Regional Airport Authority
104274 Triturator Drainage Upgrade**

San Diego International Airport
San Diego, California
DIVISIONS 00-33

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SPECIFICATIONS

DIVISION 00 – INTRODUCTORY INFORMATION, PROPOSAL SUBMITTAL REQUIREMENTS AND CONTRACTING REQUIREMENTS

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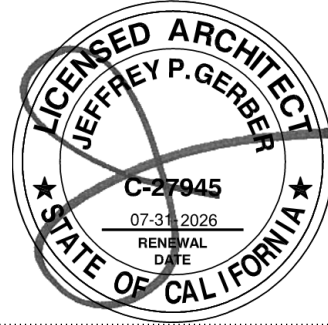
SEAL AND SIGNATURE PAGE

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SPECIFICATIONS

DIVISION 1 - GENERAL REQUIREMENTS

SECTION 00 10 20

OWNER ALLOWANCES

PART 1 – GENERAL

1.1 SUMMARY

- A. The Work includes certain tasks as described below and identified as Owner Allowance Items.

1.2 OWNER ALLOWANCES

- A. Bid Schedule B, Item 1 – Owner Allowance for Reimbursement of Permits and Fees
 - 1. This Owner Allowance is intended to reimburse the Contractor for the cost of permits and fees charged by other public agencies or utilities.
- B. Bid Schedule B, Item 2 – Owner Allowance for Miscellaneous Owner-Directed Scope.
 - 1. This Owner Allowance is intended to reimburse the Contractor for the cost of MEP Systems and Fixtures, Furniture, and Equipment that is not included in the Exhibit A Base Scope of Work.

END OF 00 10 20

SPECIFICATIONS

DIVISION 01 – GENERAL REQUIREMENTS

SECTION 01 73 13 MOBILIZATION

PART 1 - GENERAL

1.1 SUMMARY

- A. As used in this section, "mobilization" includes preparatory work and operations, including but not limited to those necessary for the movement of personnel, equipment, materials, supplies and incidentals to and from the Project Site, for the establishment of all offices, buildings and other facilities necessary for work on the Project, and for all other work and operations which must be performed or costs incurred prior to beginning work on the various items on the Project Site.
- B. This Project may require the Contractor to stop and then restart work to accommodate the nesting season for the California Least Tern (see Special Conditions 4.3). No additional price will be paid for mobilization or demobilization related to the California Least Tern nesting season.
- C. Mobilization shall be limited to ten (10) percent of the Bid Total set forth in the Bid Schedule.

PART 4 – MEASUREMENT AND PAYMENT

- 4.1** The contract Lump Sum price paid for mobilization shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all work involved in mobilization.
- 4.2** Based upon the contract lump sum price for mobilization partial payments will be allowed as follows:
- A. With the first application for payment, 25 percent
 - B. When 25 percent or more of the Contract Price is earned, 25 percent
 - C. When 50 percent or more of the Contract Price is earned, 40 percent
 - D. With the final application for payment, 10 percent

END OF SECTION 01 73 13

SPECIFICATIONS

DIVISION 02 – EXISTING CONDITIONS

SECTION 02 41 19

SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Demolition and removal of selected site elements.

1.2 RELATED DOCUMENTS

1.3 DEFINITIONS

- A. Remove: Detach items from existing construction and dispose of them off-site in accordance with the Contract Documents and Governmental Rules, unless indicated to be removed and salvaged or removed and reinstalled.
- B. Remove and Salvage: Detach items from existing construction and deliver them to Authority ready for reuse.
- C. Remove and Reinstall: Detach items from existing construction, prepare them for reuse, and reinstall them where indicated.
- D. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.4 SUBMITTALS

The following items shall be submitted in accordance with General Conditions Article 3.2.7, Submittals.

- A. Proposed Protection Measures: Submit report, including drawings, that indicates the measures proposed for protecting individuals and property, for environmental protection, for dust control and, for noise control. Indicate proposed locations and construction of barriers.
- B. Schedule of Selective Demolition Activities: Indicate the following:
 - 1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity.
 - 2. Interruption of utility services. Indicate how long utility services will be interrupted.

3. Per General Conditions 3.2.11 coordinate with the Authority for shutoff, capping, and continuation of utility services.
- C. Inventory: After selective demolition is complete, submit a list of items that have been removed and salvaged.
- D. Pre-demolition photographs: Show existing conditions of adjoining construction and site improvements. Submit before Work begins.
- E. Warranties: Documentation indicated that existing warranties are still in effect after completion of selective demolition.
- F. Closeout Submittals:
 1. Inventory: Submit a list of items that have been removed and salvaged.

1.5 REGULATORY REQUIREMENTS

- A. Regulatory Requirements: Comply with the Contract Documents and all applicable Governmental Rules before beginning selective demolition.
- B. Standards: Comply with ANSI A10.6 and NFPA 241.

1.6 QUALIFICATIONS

- A. Demolition Firm Qualifications: An experienced firm that has specialized in demolition work similar in material and extent to that indicated for this Project.

1.7 QUALITY CONTROL

- A. The Contractor shall develop a Quality Control program in accordance with the Contract Documents. The Contractor shall perform all quality control tests and inspections necessary to control the production and construction process applicable to this Specifications section.

1.8 PROJECT CONDITIONS

- A. Before selective demolition, Authority will provide list of items to be removed, salvaged and turned over to them.
- B. Storage or sale of removed items or materials on-site is not permitted.

1.9 PRE-DEMOLITION MEETINGS

- A. Pre-Demolition Conference: Conduct conference at Project Site to review methods and procedures related to selective demolition, including but not limited to the following:
 1. Inspect and discuss condition of construction to be selectively demolished.

2. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
 3. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
 4. Review areas where existing construction is to remain and requires protection.
 5. Review phasing and hours of construction operations.
- Determine items to be salvaged and returned to Authority.

1.10 WARRANTY (Not Used)

1.11 MATERIALS OWNERSHIP

- A. Except as otherwise indicated, including items or materials indicated to be reused, salvaged, reinstalled, otherwise indicated to remain Authority property, or pre-existing Regulated Materials and Pollutants, as set forth in the General Conditions, demolition waste becomes property of Contractor.
- B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Authority that may be uncovered during demolition remain the property of Authority.
 1. Carefully salvage in a manner to prevent damage and promptly return to Authority.

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped before starting selective demolition operations.
- B. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.
- C. When Differing Site Conditions are encountered, including but not limited to structural elements that conflict with intended function or design, investigate and measure the nature and extent of conflict. Promptly submit a written report to the Authority Representative, in accordance with the General Conditions

- D. Survey of Existing Conditions:
1. Inventory and record the condition of items to be removed and salvaged. Provide photographs or video of existing conditions prior to removal .
 2. Before selective demolition or removal of existing building elements that will be reproduced or duplicated in final Work, make permanent record of measurements, materials, and construction details required to make exact reproduction

3.2 PREPARATION

- A. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
1. Comply with requirements for access and protection specified in the Contract Documents.
- B. Temporary Facilities: Provide temporary barricades, fencing and other protection in strict compliance with the Authority's Construction Safety Manual. Ensure all protection prevents injury to people and damage to adjacent buildings and facilities to remain.
1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
 2. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
 3. Cover and protect furniture, furnishings, and equipment that have not been removed.
 4. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in the Contract Documents.
- C. Temporary Shoring: Provide and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.
1. Strengthen or add new supports when required during progress of selective demolition.

3.3 SELECTIVE DEMOLITION, GENERAL

- A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
 - 1. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.
 - 2. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
 - 3. Do not use cutting torches until Work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
 - 4. Maintain adequate ventilation when using cutting torches.
 - 5. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site in accordance with the Contract Documents.
 - 6. Dispose of demolished items and materials promptly in accordance with the Contract Documents.
- B. Removed and Salvaged Items:
 - 1. Clean salvaged items.
 - 2. Pack or crate items after cleaning. Identify contents of containers.
 - 3. Store items in a secure area until delivery to Authority.
 - 4. Transport items to the Authority's storage area on-site.
 - 5. Protect items from damage during transport and storage.
- C. Removed and Reinstalled Items:
 - 1. Clean and repair items to functional condition adequate for intended reuse. Paint equipment to match new equipment.
 - 2. Pack or crate items after cleaning and repairing. Identify contents of containers.
 - 3. Protect items from damage during transport and storage.
 - 4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide

connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

- D. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by the Authority Representative, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.
- E. Holes left after removals shall be restored to a condition equal to or better than the surrounding area. No separate measurement for payment shall be made for restoration after fence removal.

3.4 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

- A. Concrete pavement: Saw-cut perimeter of area to be demolished, then break up and remove.
- B. Saw-cutting Asphalt Pavement: Existing asphalt pavement to be removed shall be cut full depth by a device capable of making a neat, straight and smooth cut without damaging adjacent pavement that is not to be removed.

3.5 DISPOSAL OF DEMOLISHED MATERIALS

- A. General: Except for items or materials indicated to be reused, salvaged, reinstalled, otherwise indicated to remain Authority property, or pre-existing Regulated Materials and Pollutants, as set forth in the Contract Documents, remove demolished materials from Project Site and dispose of them off Airport property, at Otay Landfill in Chula Vista under non-hazardous waste manifest signed by the Contractor's Representative.
- B. Do not allow demolished materials to accumulate on-site.
- C. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- D. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
- E. Comply with requirements specified in related Specifications Sections.
- F. Burning: Do not burn demolished materials.
- G. Items to be demolished are indicated on the Drawings to the extent of information available.
- H. Disposal of the materials described above shall be off site at Otay Landfill in Chula Vista under non-hazardous waste manifest signed by the Contractor's Representative in accordance with Contract Documents. Disposal tipping fees at the landfill shall be paid for by the Authority.

3.6 REMOVAL OF EXISTING PAVEMENT

- A. Cement Concrete: Cement concrete slabs or pavements encountered in the pavement demolition shall be saw-cut full depth and removed in full.
- B. Composite Sections: Composite pavements consisting of a combination of Portland cement concrete and cement treated base shall be saw cut full depth and removed in full.

3.7 REMOVAL OF PAVEMENT MARKINGS

NOT USED

3.8 CLEANING

- A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began, in accordance with the General Conditions.

3.1 SPOIL

- A. Spoil material generated from cold milling operations shall be disposed of off airport property in accordance with Contract Documents, or processed such that it may be reused on site. Every effort should be made by the Contactor to recycle or re-use the material in other projects.

PART 4 – MEASURE AND PAYMENT

- 4.1 Full compensation for section 024119 – Selective Demolition shall be considered as included in the contract lump sum price paid for Bid Schedule A, and no additional compensation will be allowed therefor

END OF SECTION 02 41 19

DIVISION 3 - CONCRETE SECTION

03 30 00

CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

1.2 SUMMARY

- A. This Section specifies cast-in place concrete, including formwork, reinforcement, vapor retarder, joint dowels, concrete materials, mixture design, placement procedures, finishes and all related accessories, for the following:
 - 1. Slabs-on-grade.

1.3 REFERENCES

- A. American Concrete Institute (ACI):
 - 1. ACI 117 – Specifications for Tolerances for Concrete Construction and Materials.
 - 2. ACI 214 - Recommended Practice for Evaluation of Strength Test Results of Concrete.
 - 3. ACI 301 - Specifications for Structural Concrete for Buildings.
 - 4. ACI 302 – Guide for Concrete Floor and Slab Construction.
 - 5. ACI 304 - Guide for Measuring, Mixing, Transporting and Placing Concrete.
 - 6. ACI 305 - Hot Weather Concreting.
 - 7. ACI 306 - Cold Weather Concreting.
 - 8. ACI 308 – Standard Practice for Curing Concrete.
 - 9. ACI 308.1 – Standard Specification for Curing Concrete.
 - 10. ACI 309 - Guide for Consolidation of Concrete.
 - 11. ACI 318 - Building Code Requirements for Structural Concrete.
- B. American National Standards Institute (ANSI): NSF Standard 61.
- C. American Society for Testing and Materials (ASTM).
- D. Concrete Reinforcing Steel Institute (CRSI):
 - 1. Manual of Standard Practice.
 - 2. Placing Reinforcing Bars.

- E. International Building Code (IBC).
- F. National Ready Mixed Concrete Association (NRMCA): Certification of Ready Mixed Concrete Production Facilities.
- G. Portland Concrete Association (PCA): Sandblasting of Concrete Surfaces IS 180T.

1.4 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash and other pozzolans, and ground granulated blast-furnace slag; subject to compliance with requirements.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
 - 1. Concrete Admixtures.
 - 2. Curing Materials.
- B. Shop Drawings: Submit in accordance with ACI 315, "Standards on Details and Detailing of Concrete Reinforcement".
 - 1. Provide detail placing drawings that illustrate fabrication, bending, and placement of reinforcement.
 - 2. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.
- C. Concrete Mix Designs: Each concrete mix design submittal shall contain the following information:
 - 1. Mix Number (which will correspond to mix ticket on trucks delivered to site).
 - 2. Application for which concrete is designed (i.e. – footings, slabs, etc...)
 - 3. Applicable mix performance criteria including:
 - a. Final Design strength at 28 days.
 - b. Unit Weight.
 - c. Air Content.
 - d. Slump (with water only and after addition of WRA and/or HRWRA).
 - 4. Applicable mix ingredients including quantities, ASTM designations, and sources for:
 - a. Cementitious materials.
 - b. Aggregate source, geological type, size, and shape.
 - 1) Include total gradation for combined coarse and fine aggregates for mixes specified to contain Well Graded Aggregate.

- 2) Included calculated Coarseness Factor and Workability Factor for mixes specifying limits on these values.
 - c. Water.
 - 1) Indicate amount of mixing water to be withheld for later addition at Project Site.
 - d. Water cementitious materials ratio, w/cm.
 - e. Admixtures.
 - f. Fibers and other additions.
 - 5. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
- D. Proposed construction joint and saw-cut contraction joint locations for slabs-on-grade.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94 requirements for production facilities and equipment.
- 1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage. Avoid damaging coatings on steel reinforcement.
- B. Joint Sealers and Curing Materials: Deliver in original factory packaging and unopened containers and protect from damage and contamination.

2.1 FORM-FACING MATERIALS

- A. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.
- B. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.
- C. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
 - 1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
- D. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
 - 1. Furnish units that will leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.
 - 2. Furnish ties that, when removed, will leave holes no larger than 1 inch in diameter in concrete surface.

2.2 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615, Grade 60, deformed bars, ASTM A 775

2.3 REINFORCEMENT ACCESSORIES

- A. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, or plastic according to CRSI's "Manual of Standard Practice," and as follows:
 - 1. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.
- B. Supports for slabs-on-grade with steel reinforcement: Use supports with sand plates or horizontal runners.
 - 1. Dayton Richmond: Aztec E-Z Chair – PEZ with E-Z Chair Sand Plate PSP;
 - 2. General Technologies, Inc.: Composite Chairs on Sand Plates;
 - 3. Or equal.

2.4 FABRICATING REINFORCEMENT

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice" and accepted Shop Drawings.
- B. Do not re-bend or straighten steel reinforcement except where specifically accepted.

2.5 CONCRETE MATERIALS

- A. Cementitious and Pozzolan Materials: Use the following materials, of the same type, brand, and source for each required type of concrete and on which selection of concrete proportions was based:
1. Portland Cement: ASTM C 150, Type II/V
 - a. Use white Portland cement where indicated for decorative concrete such as, colored concrete, or other applications noted by the Architect Representative.
 - b. For exposed concrete, use same brand throughout.
 2. Fly Ash: ASTM C 618, Class F, and as specified herein.
 3. Replacement Ratio: Portland cement shall be replaced on an equal mass (not weight) basis. Material replacements shall be expressed as a percent, by mass, of the total cementitious materials content, with proportions selected for 28 day compressive strengths equal to those specified. The change in volume resulting from the substitutions shall be determined and an adjustment in both coarse and fine aggregate proportions shall be determined in order to ensure a unit volume.
 - a. Fly Ash replacement shall not exceed 30% for Class C, 20% for Class F, or as specified for a particular mix design.
- B. Normal-Weight Aggregates: ASTM C 33. Do not use aggregates containing soluble salts or other substances which can cause stains on exposed surfaces. Use aggregates from one source of supply corresponding to that on which selection of concrete proportions was based.
- C. Water: ASTM C 94 and potable.

2.6 ADMIXTURES

- A. General: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use admixtures containing calcium chloride or thiocyanates.
- B. Air-Entraining Admixture (AEA): ASTM C 260.
- C. Water-Reducing Admixture (WRA): ASTM C 494, Type A.
- D. Mid-Range Water-Reducing Admixture (MRWRA): ASTM C 494, Type A.
- E. Polycarboxylate High-Range Water-Reducing Admixture (HRWRA): ASTM C 494, Type F.
- F. Water-Reducing and Retarding Admixture: ASTM C 494, Type B and D.
- G. Non-Corrosive, Non-Chloride Accelerator: ASTM C494, Type C or E.

- H. Prohibited Admixtures: Calcium chloride, thiocyanates or admixtures effectively containing chloride ions (more than 0.05 percent) are not permitted.

2.7 CURING, CLEANING, AND SEALING MATERIALS

- A. Water Cure:
1. Waterproof paper.
 2. Reef Industries: Transguard Economy Grade. (ASTM C 171, 20-mils thick, polypropylene sheet with nonperforated white coating.)
 3. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.
 4. Dayton Bag and Burlap: Burlene.
 5. Reef Industries: Transguard 4000; 42-mil thick, fiber mat with polyethylene sheet backing.
- B. Water: ASTM C 94 and potable.
- C. Clear, Solvent-Borne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A, minimum 25 percent total solids.
1. Available Products:
 - a. ChemMasters; Spray-Cure & Seal Plus.
 - b. Dayton Superior Corporation; Day-Chem Cure and Seal (J-22UV).
 - c. Euclid Chemical Company; Super Diamond Clear.
 - d. L&M Construction Chemicals, Inc.; Lumiseal Plus.
 - e. Meadows, W. R., Inc.; CS-309/30.
 - f. SpecChem, LLC; Cure & Seal 25 UV
- D. Clear, Non-yellowing, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A, minimum 25 percent total solids.
1. Available Products:
 - a. BASF; Kure 1315
 - b. Burke by Edoco; Cureseal 1315 WB.
 - c. ChemMasters; Polyseal WB.
 - d. Euclid Chemical Company; Super Diamond Clear VOX.
 - e. L&M Construction Chemicals, Inc.; Lumiseal WB Plus.
 - f. Meadows, W. R., Inc.; Vocomp-30.
 - g. SpecChem, LLC; Cure & Seal WB 25

2.9 JOINT MATERIALS

- A. Equipment Control joint saw:
1. Available Products:
 - a. Husqvarna Construction Products; Soff-Cut Ultra Early Entry System with Skid Plate.
 - b. Diamond Products Limited; Core Cut First-Cut System
 - c. Or equal.

- B. Expansion Joint Material: ASTM D 1751, asphalt-saturated cellulosic fiber.
 - 1. Available Manufacturers:
 - a. W.R. Meadows.
 - b. BASF.
 - c. Or equal.
- C. Joint Backer Rod: Flexible, compressible, closed-cell polyethylene foam, not less than 10 psi compression deflection.

2.10 RELATED MATERIALS

- A. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.
- B. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:
 - 1. Types **I and II, non-load bearing** for bonding hardened or freshly mixed concrete to hardened concrete.
- C. Under Slab Vapor Retarder: ASTM E1745, Class A.
 - 1. Manufacturers and Products:
 - a. Barrier Bac, Inc., VB250 or VB350.
 - b. Raven Industries, Vapor Block 10 or 15.
 - c. Reef Industries, Inc., Vaporguard.
 - d. Stego Industries, Stego Wrap Vapor Barrier 15 mil.;
 - e. Or equal.
 - 2. Accessories:
 - a. Seam tape: High density polyethylene tape with pressure sensitive adhesive, minimum 4 inches wide.
 - b. Pipe boots: Constructed from vapor barrier membrane and seam tape.

2.11 CONCRETE MIXING

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.
- B. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94, with exceptions specified herein, and ASTM C 1116 where fibers are used, and furnish batch ticket information.
 - 1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.
- C. Admixtures: Use approved admixtures according to manufacturer's written

instructions.

1. Use chemical admixtures in concrete, as required, for placement, workability, durability, and controlled set time.
- D. Air Content: Do not allow air content of hard-troweled finished floors to exceed 3 percent.
- E. Concrete Slump Limits: Measured according to ASTM C 143 at point of placement.
1. 4 inches without water reducing admixtures
 2. 5 inches after addition of WRA or MWRA.
 3. 7 inches after addition of HRWRA.
 4. A tolerance of up to one inch above indicated maximum will be allowed for one batch in any five consecutive batches tested.
 5. If the maximum water-cement ratio is not exceeded, concrete arriving at the jobsite within 60 minutes of the initial batching that has a slump less than the maximum allowed may have water added when accepted by the project inspector.
 6. Water reducing admixtures may be added to increase the slump when water can not be added and additional slump is necessary for workability when accepted by the project inspector.
 7. Water shall not be added to the mix after any supplemental water reducing admixtures have been dosed into the mixer.

PART 3 - EXECUTION

3.1 GENERAL

- A. Work shall conform to ACI 117 and ACI 301, except as modified by requirements of these Contract Documents.

3.2 PREPARATION

- A. Verify actual locations of existing structure, new work previously placed and other construction to which the new work must fit by accurate field measurements before submittal of related Shop Drawings or fabrication; show recorded measurements on Shop Drawings submitted for review. Coordinate fabrication schedule with construction progress to avoid delay of Work. Where work will be connected to existing masonry or concrete, Contractor shall engage a testing agency to pre-locate hidden embeds and reinforcing steel prior to submittal of Shop Drawings. Provide templates and dimensions to fabricator for accurate alignment with existing conditions. Show field conditions impacting the Work on the Shop Drawings, prior to submittal.

3.3 FORMWORK

- A. Design, erect, shore, brace, and maintain formwork, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads. Contractor's licensed specialty structural engineer shall design formwork to satisfy all Authority requirements, applicable Governmental Rules, and all imposed loads.
- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated.
- C. Limit concrete surface irregularities, designated by ACI 347R as abrupt or gradual, as follows:
 - 1. Class C, 1/2 inch for rough-formed finished surfaces.
- D. Construct forms tight enough to prevent loss of concrete mortar.
- E. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.
- F. Chamfer exterior corners and edges of permanently exposed concrete.
- G. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.4 REMOVING AND REUSING FORMS

- A. General: Formwork for sides of footings, foundation walls, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 12 hours after placing concrete, if concrete is hard enough to not be damaged by form-removal operations and curing and protection operations are maintained.
- B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.
- C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by the Architect.

3.5 REINFORCEMENT INSTALLATION

- A. General: Comply with CRSI's "Manual of Standard Practice" and accepted Shop Drawings for placing reinforcement.

- B. Underfloor Vapor Retarders: When chairing reinforcement on top of underfloor vapor retarders, use only supports with integral sand plates.
 - 1. Do not cut or puncture vapor retarder.
 - 2. Repair damage and reseal cuts or punctures in vapor retarder before placing concrete.
- C. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.
- D. Accurately position, support, and secure reinforcement against displacement by formwork, construction, or concrete placement operations. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
- E. Provide bar supports in sufficient number and heavy enough to carry steel they support. Place no bar more than 2 inches beyond last leg of continuous bar support. Do not use bar supports to support runways for concrete buggies, or similar loads.
 - 1. Maximum support bar spacing shall not exceed 48 inches.
- F. Maximum bolster spacing shall not exceed 36 inches for #4 support bar or 48 inches for #5 support bar.
- G. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- H. Steel reinforcement partially embedded in concrete shall not be field bent, except as indicated or permitted by Structural Engineer.
- I. For walls reinforced on both faces, provide spreader bars and chairs to surfaces of forms on each side at spacings not to exceed 8 feet in either direction. For walls with single layer of reinforcing, provide chairs each side at spacings not to exceed 8 feet in either direction.
- J. Install welded wire reinforcement in longest practicable lengths. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.
- K. Install diamond plate dowels in concrete slab-on-grade joints where shown. Install diamond plate dowels per manufacturer's written instructions.

3.6 JOINTS

- A. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a

depth equal to at least one-fourth of concrete thickness as follows where not specifically shown on Drawings:

1. Interior Slabs:
 - a. Spacing shall not exceed 36 times slab thickness; 15 feet on center, maximum.
 - b. Short: long side ratio not less than 2:3.
2. Interior Slabs with Carpeting:
 - a. Spacing shall not exceed 48 times slab thickness; 20 feet on center, maximum.
 - b. Short: long side ratio not less than 2:3
3. Sawed Joints: Form contraction joints with early-entry dry-cut power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.
 - a. Install cuts 0 to 2 hours after final finishing and prior to final set.
 - b. Install joint protector at saw-cut intersections prior to cross cut.
4. Provide cleanly cut, straight joints in toppings over joints in base slab.

3.7 INSTALLING UNDER SLAB VAPOR RETARDER

- A. Install according to membrane manufacturer's current published instructions and ASTM E1643.
- B. Install over level granular base and under reinforcing and slabs on grade.
- C. Lap over footings and seal to foundation walls.
- D. Overlap membrane joints minimum 6 inches and seal continuously with seam tape.
- E. Seal penetrations and pipes with pipe boot fashioned from membrane and sealed with seam tape.
- F. Repair damaged membrane with patches of membrane overlapping damage minimum 6 inches and sealing completely with seam tape.

3.8 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.
- B. Before test sampling and placing concrete, water may be added at Project Site, subject to limitations of ACI 301.
 1. Do not add water to concrete after adding water-reducing admixtures to mixture.

- C. Clean forms, reinforcing and accessories and lubricate forms prior to placing concrete.
- D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
 - 1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
 - 2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
 - 3. Do not allow concrete to drop freely more than 4 feet.
 - 4. Use approved chutes equipped with suitable hoppers for placing where required.
 - 5. Place at rate that concrete is always plastic and flows readily into every space.
- E. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
 - 1. Before concrete slabs on grade are placed, verify that granular base is level and compacted.
 - 2. Sprinkle base to eliminate suction of water from concrete.
 - 3. Allow no freestanding water.
 - 4. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
 - 5. Maintain reinforcement in position on chairs during concrete placement.
 - 6. Do not insert vibrators to bottom of slabs-on-grade with underfloor vapor retarders to avoid damaging this membrane.
 - 7. Screed slab surfaces with a straightedge and strike off to correct elevations.
 - 8. Slope surfaces uniformly to drains where required.
 - 9. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.
- F. Do not use concrete that has partially hardened or been contaminated by foreign materials, nor concrete that has been retempered or remixed after initial set.
- G. Before depositing new concrete on or against concrete that has set at construction joints, clean, wet and apply bonding agent to existing surfaces. Tighten forms prior to resuming pouring.

- H. Exercise care to prevent splashing of forms or reinforcing with concrete above level of concrete being placed.
- I. Clean reinforcement projecting above or out of concrete immediately after completion of particular unit of pour.
- J. Do not place concrete under adverse weather conditions unless adequate protection is provided. Refer to ACI 301, for weather restrictions and placing temperatures.

3.9 FINISHING FLOORS AND SLABS

- A. Finish bare concrete floors (adjacent to floors with other surfacing) so concrete surface is level with other finishes, unless otherwise noted.
- B. Wetting the concrete surface during finishing operations is prohibited.
- C. Power floating with troweling machines equipped with normal trowel blades is prohibited.
- D. Protect finished surfaces from damage. Keep free of abrasive materials.
- E. In areas where water will be present (interior and exterior) place and finish slabs so areas will drain and water will not stand in puddles. Conform to slopes shown. Where elevations and slopes are not indicated, generally slope floors 1/8 inch per foot uniformly to drains, unless otherwise directed by Architect.
- F. Finish and measure surface so gap at any point between concrete surface and an unlevelled, freestanding, 10-foot-long straightedge resting on 2 high spots and placed anywhere on the surface does not exceed 1/8-inch.
- G. General Finishing Requirements: Comply with ACI 302.1R recommendations for screeding, restraighening, and finishing operations for concrete surfaces as appropriate to attain slab finish specified.
 - 1. Utilize wet-screed guides, dry-screed guides, and/or edge forms for initial strikeoff set with optical or laser instruments as appropriate to attain specified Floor Profile Number. Check elevation after initial strikeoff and repeat as necessary.
 - 2. Smooth and restraighen surface using 8 to 10 foot wide bull float, darby, or modified highway straightedge.
 - a. Apply in two directions at 45 degree angle to strip for Overall Floor Flatness, F_F30 or greater.
 - 3. Wait until bleed water sheen has disappeared and concrete can sustain finishing operations employed without digging in or disrupting the levelness of the surface.

4. Float surface with one or more passes using a power float (float shoe blades or pans) or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture.

3.10 FINISHING FORMED SURFACES

- A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
 1. Apply to formed concrete surfaces unless indicated otherwise.
- B. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

3.11 CONCRETE PROTECTING AND CURING

- A. General: Concrete shall be maintained above 50-degrees F and in a moist condition for at least the first seven days after placement. Provide curing and protection immediately after placement in accordance with ACI 301 using materials as specified herein.
- B. Formed Surfaces: Cure formed concrete surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.
- C. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, and other surfaces.
- D. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
 1. Wet Curing: Keep surfaces continuously wet for not less than three days with the following materials:
 - a. Water.
 - b. Continuous water-fog spray.
 - c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
 - d. Protect surface from rapid loss of moisture upon termination of wet curing by covering with moisture-retaining covers for the remainder of the curing period.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
 3. Curing and Sealing Compound: Apply uniformly to floors and slabs in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.
- E. Wet cure or use moisture-retaining covers on all concrete surfaces for first 24 hours, minimum.
1. Continue curing in this manner for as long as Hot Weather Concreting conditions persist.
- F. Curing and Sealing Compounds shall not be used on concrete surfaces to receive adhered coverings without prior manufacturer certification that it will not interfere with bonding of floor covering and warranties of flooring installer are validated.
- G. Moisture Condition of Slabs – Following placement of concrete and climatization of building, check to see that any specified tests for moisture emission have been made and a written report submitted prior to floor covering or coating installation.

3.12 FIELD QUALITY CONTROL

- A. Contractor will assign an individual to monitor reinforcement position during concrete placement and reposition bars that are displaced due to construction activity.
- B. The Authority will engage a qualified testing and inspection agency to provide special inspection and testing services and prepare reports in accordance with the current version of the California Building Code.
- C. Contractor will cooperate with and assist testing agency in obtaining representative concrete samples as concrete is placed for determining slump and air entrainment and casting test cylinders.
1. Provide suitable space on site for storage for field condition test cylinders.
 2. If testing agency is not available, cast compression test cylinders as concrete is placed, determine and record slump of concrete, determine and record air content of concrete and submit cylinders and information to the testing agency.

3.13 EVALUATION OF TEST RESULTS

- A. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
- B. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
- C. Test results shall be reported in writing to Architect, concrete supplier, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
- D. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
- E. Additional Tests: Testing and inspecting agency shall make additional tests of concrete at the expense of the Contractor when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42 or by other methods as directed by Architect.
- F. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- G. Correct deficiencies in the Work that test reports and inspections indicate does not comply with the Contract Documents.
- H. Fill core holes with concrete specified for location.

PART 4 - METHOD OF MEASUREMENT AND BASIS OF PAYMENT

- 4.1** Full compensation for Section 033000 Cast-In-Place Concrete shall be considered as included in the Contract lump sum price paid for Bid Schedule A, and no additional compensation will be allowed therefor.

END OF SECTION 03 30 00

SPECIFICATIONS

DIVISION 07 – THERMAL AND MOISTURE PROTECTION

SECTION 07 92 00

JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Silicone joint sealants.
- B. Related Sections:
 - 1. Division 04 Section "Unit Masonry" for masonry control and expansion joint fillers and gaskets.
 - 2. Division 09 Section "Gypsum Board" for sealing perimeter joints.
 - 3. Division 09 Section "Tiling" for sealing tile joints.
 - 4. Division 09 Section "**Acoustical Panel Ceilings**" for sealing edge moldings at perimeters with acoustical sealant.

1.2 PRECONSTRUCTION TESTING

- A. Preconstruction Compatibility and Adhesion Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.
 - 1. Use **ASTM C 1087** to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
 - 2. Submit not fewer than **eight** pieces of each kind of material, including joint substrates, shims, joint-sealant backings, secondary seals, and miscellaneous materials.
 - 3. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
 - 4. For materials failing tests, obtain joint-sealant manufacturer's written instructions for corrective measures including use of specially formulated primers.
 - 5. Testing will not be required if joint-sealant manufacturers submit joint preparation data that are based on previous testing, not older

than 24 months, of sealant products for adhesion to, and compatibility with, joint substrates and other materials matching those submitted.

- B. Preconstruction Field-Adhesion Testing: Before installing sealants, field test their adhesion to Project joint substrates as follows:
1. Locate test joints where indicated on Project or, if not indicated, as directed by Authority Representative.
 2. Conduct field tests for each application indicated below:
 - a. Each kind of sealant and joint substrate indicated.
 3. Notify Authority Representative seven Days in advance of dates and times when test joints will be erected.
 4. Arrange for tests to take place with joint-sealant manufacturer's technical representative present.
 - a. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.
 - 1) For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
 5. Report whether sealant failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. For sealants that fail adhesively, retest until satisfactory adhesion is obtained.
 6. Evaluation of Preconstruction Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing, in absence of other indications of noncompliance with requirements, will be considered satisfactory. Do not use sealants that fail to adhere to joint substrates during testing.

1.3 SUBMITTALS

- A. Product Data: For each joint-sealant product indicated.
- B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

- C. Samples for Verification: For each kind and color of joint sealant required, provide Samples with joint sealants in 1/2-inch- (13-mm-) wide joints formed between two 6-inch- (150-mm-) long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.
- D. Joint-Sealant Schedule: Include the following information:
 - 1. Joint-sealant application, joint location, and designation.
 - 2. Joint-sealant manufacturer and product name.
 - 3. Joint-sealant formulation.
 - 4. Joint-sealant color.
- E. Qualification Data: For qualified **Installer**.
- F. Product Certificates: For each kind of joint sealant and accessory, from manufacturer.
- G. Sealant, Waterproofing, and Restoration Institute (SWRI) Validation Certificate: For each sealant specified to be validated by SWRI's Sealant Validation Program.
- H. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that sealants comply with requirements.
- I. Preconstruction Compatibility and Adhesion Test Reports: From sealant manufacturer, indicating the following:
 - 1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
 - 2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.
- J. Preconstruction Field-Adhesion Test Reports: Indicate which sealants and joint preparation methods resulted in optimum adhesion to joint substrates based on testing specified in "Preconstruction Testing" Article.
- K. Field-Adhesion Test Reports: For each sealant application tested.
- L. Warranties: Sample of special warranties.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

- B. Source Limitations: Obtain each kind of joint sealant from single source from single manufacturer.
- C. Product Testing: Test joint sealants using a qualified testing agency.
 - 1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.
 - 2. Test according to SWRI's Sealant Validation Program for compliance with requirements specified by reference to ASTM C 920 for adhesion and cohesion under cyclic movement, adhesion-in-peel, and indentation hardness.
- D. Mockups: Install sealant in mockups of assemblies specified in other Sections that are indicated to receive joint sealants specified in this Section. Use materials and installation methods specified in this Section.
- E. Preinstallation Conference: Conduct conference at **Project Site**.

1.5 PROJECT CONDITIONS

- A. Do not proceed with installation of joint sealants under the following conditions:
 - 1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F (5 deg C).
 - 2. When joint substrates are wet.
 - 3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
 - 4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.6 WARRANTY

- A. Special Manufacturer's Warranty: Manufacturer's standard form in which joint-sealant manufacturer agrees to furnish joint sealants to repair or replace those that do not comply with performance and other requirements specified in this section within specified warranty period.
 - 1. Warranty Period: Two years.
- B. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:

1. Movement of the structure caused by structural settlement or errors attributable to design or construction resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
2. Disintegration of joint substrates from natural causes exceeding design specifications.
3. Mechanical damage caused by individuals, tools, or other outside agents.
4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.
- B. VOC Content of Interior Sealants: Provide sealants and sealant primers for use inside the weatherproofing system that comply with the following limits for VOC content when calculated according to 40 CFR 59, Part 59, Subpart D (EPA Method 24):
 1. Architectural Sealants: 250 g/L.
 2. Sealant Primers for Nonporous Substrates: 250 g/L.
 3. Sealant Primers for Porous Substrates: 775 g/L.
- C. Liquid-Applied Joint Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied joint sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.
 1. Suitability for Immersion in Liquids. Where sealants are indicated for Use I for joints that will be continuously immersed in liquids, provide products that have undergone testing according to ASTM C 1247. Liquid used for testing sealants is deionized water, unless otherwise indicated.
- D. Stain-Test-Response Characteristics: Where sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.

- E. Suitability for Contact with Food: Where sealants are indicated for joints that will come in repeated contact with food, provide products that comply with 21 CFR 177.2600.
- F. Colors of Exposed Joint Sealants: **As selected by the Authority Representative from manufacturer's full range.**

2.2 SILICONE JOINT SEALANTS

- A. Single-Component, Nonsag, Neutral-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 100/50, for Use NT.
 - 1. Products: Subject to compliance with requirements, **provide one of the following:**
 - a. Dow Corning Corporation; **790.**
 - b. GE Advanced Materials - Silicones; SilPruf LM SCS2700.
 - c. May National Associates, Inc.; **Bondaflex Sil 290.**
 - d. Pecora Corporation; **301 NS.**
 - e. Sika Corporation, Construction Products Division; SikaSil-C990.
 - f. Tremco Incorporated; **Spectrem 1.**
 - g. Or Equal

2.3 JOINT SEALANT BACKING

- A. General: Provide sealant backings of material that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Cylindrical Sealant Backings: ASTM C 1330, **Type C (closed-cell material with a surface skin)**, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
- C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

2.4 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected according to the Contract Documents.

3.2 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
 - 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
 - 2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after

cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:

- a. Concrete.
 - b. Masonry.
 - c. Unglazed surfaces of ceramic tile.
3. Remove laitance and form-release agents from concrete.
 4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:
 - a. Metal.
 - b. Glass.
 - c. Porcelain enamel.
 - d. Glazed surfaces of ceramic tile.
- B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

1. Do not leave gaps between ends of sealant backings.
 2. Do not stretch, twist, puncture, or tear sealant backings.
 3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.
- D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
1. Place sealants so they directly contact and fully wet joint substrates.
 2. Completely fill recesses in each joint configuration.
 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
1. Remove excess sealant from surfaces adjacent to joints.
 2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
 3. Provide concave joint profile per Figure 8A in ASTM C 1193, unless otherwise indicated.
 4. Provide flush joint profile where indicated per Figure 8B in ASTM C 1193.
 5. Provide recessed joint configuration of recess depth and at locations indicated per Figure 8C in ASTM C 1193.
 - a. Use masking tape to protect surfaces adjacent to recessed tooled joints.

3.4 FIELD QUALITY CONTROL

- A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:
1. Extent of Testing: Test completed and cured sealant joints as follows:

- a. Perform **10** tests for the first **1000 feet (300 m)** of joint length for each kind of sealant and joint substrate.
 - b. Perform 1 test for each **1000 feet (300 m)** of joint length thereafter or 1 test per each floor per elevation.
 2. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.
 - a. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
 3. Inspect tested joints and report on the following:
 - a. Whether sealants filled joint cavities and are free of voids.
 - b. Whether sealant dimensions and configurations comply with specified requirements.
 - c. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine if adhesion passes sealant manufacturer's field-adhesion hand-pull test criteria.
 4. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant fill, sealant configuration, and sealant dimensions.
 5. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.
- B. Evaluation of Field-Adhesion Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.5 CLEANING

- A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by the manufacturers of the joint sealants and of products in which joints occur.

3.6 PROTECTION

- A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

3.7 JOINT-SEALANT SCHEDULE

- A. Joint-Sealant Application: Exterior joints in horizontal traffic surfaces.
 - 1. Joint Locations:
 - a. Isolation and contraction joints in cast-in-place concrete slabs.
 - b. Joints between different materials listed above.
 - c. Other joints as indicated.
 - 2. Silicone Joint Sealant: **Single component, nonsag, traffic grade, neutral curing.**
 - 3. Joint-Sealant Color: **As selected by the Authority Representative from manufacturer's full range of colors.**
- B. Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal nontraffic surfaces.
 - 1. Joint Locations:
 - a. Construction joints in cast-in-place concrete.
 - b. Control and expansion joints in unit masonry.
 - c. Joints between metal panels.
 - d. Joints between different materials listed above.
 - e. Perimeter joints between materials listed above and frames of **doors, windows and louvers.**
 - f. Control and expansion joints in **ceilings and other overhead surfaces.**

- g. Other joints as indicated.
 - 2. Silicone Joint Sealant: **Single component, nonsag, neutral curing, Class 100/50.**
 - 3. Joint-Sealant Color: **As selected by the Authority Representative from manufacturer's full range of colors.**
 - C. Joint-Sealant Application: Interior joints in horizontal traffic surfaces.
 - 1. Joint Locations:
 - a. Isolation joints in cast-in-place concrete slabs.
 - b. Control and expansion joints in tile flooring.
 - c. Other joints as indicated.
 - 2. Silicone Joint Sealant: **Single component, nonsag, traffic grade, neutral curing.**
 - 3. Joint-Sealant Color: **As selected by the Authority Representative from manufacturer's full range of colors.**
 - D. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces.
 - 1. Joint Locations:
 - a. Control and expansion joints on exposed interior surfaces of exterior walls.
 - b. Perimeter joints of exterior openings where indicated.
 - c. Tile control and expansion joints.
 - d. Vertical joints on exposed surfaces of **walls and partitions.**
 - e. Perimeter joints between interior wall surfaces and frames of **interior doors, windows and elevator entrances.**
 - f. Other joints as indicated.
 - 2. Joint Sealant: **Acrylic based.**
 - 3. Joint-Sealant Color: **As selected by the Authority Representative from manufacturer's full range of colors.**
 - E. Joint-Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces.
 - 1. Joint Sealant Location:
 - a. Joints between plumbing fixtures and adjoining walls, floors, and counters.
 - b. Tile control and expansion joints where indicated.

- c. Other joints as indicated.
- 2. Joint Sealant: **Mildew resistant, single component, nonsag, neutral curing, Silicone.**
- 3. Joint-Sealant Color: **As selected by the Authority Representative from manufacturer's full range of colors.**

PART 4 - METHOD OF MEASUREMENT AND BASIS OF PAYMENT

- 4.1** Full compensation for Section 079200 – Joint Sealants shall be considered as included in the Contract lump sum price paid for Bid Schedule A, and no additional compensation will be allowed therefor.

END OF SECTION 07 92 00

COMMON WORK RESULTS FOR PLUMBING GENERAL

1.1 WORK INCLUDED

- A. Contractor shall be responsible for filling out any required paperwork to receive rebates from local utility companies for energy-efficient equipment.

1.2 RELATED SECTIONS

- A. Section 22 05 00 specifies conditions, procedures, equipment and material particular to the plumbing work and applies to all plumbing work of the Contract Documents.

1.3 REFERENCES

- A. The installation shall meet or exceed current applicable Governmental Rules in effect at the building site.
- B. Codes and standards are considered minimum acceptable construction but the reference to Codes and Standards shall not permit a lower grade of construction where Drawings and Specifications call for workmanship and materials in excess of those references.
- C. The latest and most up to date version shall be considered as the minimum requirements. A partial list of governing codes follows:
 - 1. Americans with Disabilities Act
 - 2. California State and Local Building Codes and Ordinances
 - 3. California Plumbing Codes
 - 4. California Fire Codes and Regulations
 - 5. California Mechanical Code
 - 6. California Electrical Code
 - 7. California State and Local Electrical Installation Codes
 - 8. Municipal Water and Sewer Regulations

9. Occupational Safety and Health Administration Regulations
 10. Underwriter's Laboratories
 11. Authority's Insurance Carrier
- D. The following is a list of organizations and their abbreviations where referred to in the Specifications as standards of construction.
1. ADA - Americans with Disabilities Act
 2. ACI - American Concrete Institute
 3. ACGHI - American Conference of Governmental Industrial Hygienists
 4. AISC - American Institute of Steel Construction
 5. ANSI - American National Standards Institute
 6. ASHRAE - American Society of Heating, Refrigerating and Air Conditioning Engineers
 7. ASME - American Society Mechanical Engineers
 8. ASPE - American Society of Plumbing Engineers
 9. ASTM - American Society for Testing and Materials
 10. AWWA - American Water Works Association
 11. AWS - American Welding Association
 12. FM - Factory Mutual
 13. NFPA - National Fire Protection Association
 14. OSHA - Occupational Safety and Health Administration
 15. PDI - Plumbing and Draining Institute
 16. UL - Underwriters' Laboratories, Inc.

1.4 MATERIALS

- A. Provide materials for similar uses of same type and manufacturer.
- B. Provide equipment with manufacturer's label showing performance

characteristics. Use identifying size number only when it is not practicable or customary to show performance characteristics.

- C. Provide pipe, fittings, and other pipe appurtenances, which bear the manufacturer's name or trademark.
- D. Unless otherwise specified herein, install equipment and fixtures in accordance with the manufacturer's recommendations, including recommended service and removal clearances.

1.5 SUBMITTALS

- A. Equipment, Material and Submittal Documents.
 - 1. Specified Manufacturer
 - a. Manufacturers of products are listed in individual sections. Where multiple manufacturers are listed, the first manufacturer indicated has been used for the basis of the Construction Documents. When specific models are specified it is intended that the standard features of the specified manufacturer's model are to be included.
 - 2. Submit Shop Drawings and product data grouped to include complete submittals of related systems, products, and accessories in a single submittal.
 - 3. Mark dimensions and values in units to match those specified.
- B. Equipment provided shall be of type and manufacture that has local representation and a local replacement and service outlet to give complete coverage on parts and service.

1.6 SHOP DRAWINGS

- A. Carefully examine all Shop Drawings noting capacity, arrangement and physical dimensions and mark the Drawings as being reviewed and approved prior to submitting to the Authority Representative. Where catalog data is submitted which includes items that do not apply to this project, those items shall be clearly marked out or relevant items clearly noted. Any deviations from the Contract Documents shall be so noted by the Contractor.

- B. The Contractor shall verify that equipment proposed to be furnished will fit in the available space. Conflicts shall be brought to the Authority Representative's attention prior to ordering the equipment.
- C. Each Shop Drawing shall include the project name, names of the Architect, Engineer, Contractor, manufacturer, and supplier. Also include the name, address and telephone number of the contact representative. Each shop drawing shall clearly call out the Section number of where the equipment is specified. Shop Drawings not including the above information will be returned without review for resubmittal.
- D. Submit Shop Drawings electronically via full size pdf file. Shop Drawings are to be reviewed by the Engineer and returned to the Contractor as reviewed submittals before purchasing equipment or before fabrication or erection of materials is started, except under special circumstances as determined by the Engineer.
- E. If returned Shop Drawings are marked "REVIEWED", no additional submittals required. If marked "REVISE AND RESUBMIT", changes noted on the Shop Drawings are to be made and the Drawings resubmitted for review. If marked "REJECTED", the equipment submitted is unacceptable and different equipment or materials need to be submitted. Only one rejected shop drawing will be returned to the Contractor. If the shop drawing is marked "MAKE CORRECTIONS NOTED", the changes noted on the Shop Drawings are to be incorporated, with no further resubmittal required.

1.7 EXECUTION

A. INSTALLATION OF WORK

- 1. Arrange work symmetrically to building lines, lights, and tile pattern in the most direct, straight and mechanical manner possible and properly graded. Lay out work and provide offsets; conform to structure; avoid obstructions; preserve headroom; and keep openings and passageways clear.
- 2. Where piping heights are not indicated, provide a minimum clearance of 8 feet from floor to the bottom surface of work (including insulation) in mechanical areas.

3. Ensure that work is quickly and easily accessible. Locate the portions of systems above ceilings requiring maintenance where service can be accommodated directly from a ladder. Reaching across obstructions such as other piping, light fixtures, or casework is not acceptable.
4. Prepare Drawings showing proposed rearrangement of Work to meet Project conditions, including changes to Work specified in other Sections. Obtain permission of the Authority Representative before proceeding.
5. Install piping and equipment so it does not enter or pass through electrical spaces and rooms. Exception: fire sprinkler work serving this room only.

B. EQUIPMENT CLEARANCE

1. The Contractor shall not install piping for plumbing, fire protection, process piping or any other piping systems which is located in the manufacturer's recommended service clearance area of any mechanical or electrical or plumbing systems.

C. SAFETY REQUIREMENTS

1. The Contractor shall be responsible for initiating, maintaining and supervising all safety precautions required in connection with their work, including regulations of the Occupational Safety and Health Administration (OSHA), the Authority, and applicable Governmental Rules.

D. FIRE SAFETY PRECAUTIONS

1. The Contractor shall provide adequate protection, in accordance with the Contract Documents and applicable Governmental Rules, to all areas where cuttings, welding, brazing and sweating operations are performed in the vicinity of or accessible to combustible material to make certain that sparks or hot slag does not reach the combustible materials and thus start a fire.
2. When it is necessary to do cutting, welding, brazing or sweating close to wood construction, in pipe shafts, or other locations where combustible materials cannot be removed or adequately protected,

the employer shall employ adequate protection to those areas such as fire blankets and proper fire extinguishers.

E. COORDINATION

1. In addition to the requirements in the General Conditions, consult the Contract Drawings and Specifications of Division 26 and other trades for correlating information and layout work so that it will not interfere with other trades. Verify all dimensions and conditions; i.e., finished ceiling heights, footing and foundation elevations, beam depths, etc., with architectural and structural drawings. If design or physical conflicts occur that cannot be resolved through field coordination, the Contractor shall immediately notify the Authority Representative via a formal Request for Information (RFI) for resolution.
2. The Contractor shall make all connections at the terminal points of the Work. Piping and equipment, etc. may be shown with excess clearances for clarity. Group pipe and arrange piping and equipment to present a neat appearance and to avoid blocking passageways while allowing sufficient space for operation of valves, cleaning strainers, etc. The piping that is to be insulated shall be insulated individually with the covering extending completely around each pipe without a reduction in thickness while maintaining a separation or gap between piping, etc.
3. It is the intent of these Plans and Specifications that most piping will be concealed. Where they are exposed, they shall be run as close to ceilings and/or walls as possible and installed parallel with adjacent structural or architectural elements. Minimize number of fittings and joints in exposed piping. Clean and test all piping before insulating and concealing it.
4. In general, piping is shown on Drawings as intended to be installed, but the Drawings may show this schematically for clarification and without every rise and offset required during the actual installation. Install piping as necessary to accommodate the building structure and components of other trades, providing a reasonable number of offsets as necessary.

F. PROTECTION

1. Cover openings and equipment, where set, to prevent obstruction to pipes, breakage, misuse or disfigurement of equipment. Cover openings in equipment immediately upon uncrating or receipt at the job site. The openings shall remain covered until permanent connection is made and/or the equipment is put into operation.
2. The Contractor shall keep clean all installed materials installed until final acceptance of the entire building by the Authority. The Contractor shall properly cover and protect the equipment from damage due to water, spray-on fireproofing, construction debris, etc.

G. ELECTRICAL EQUIPMENT AND ELECTRICAL ROOM PRECAUTIONS

1. In no case shall piping be installed above switchboards, panelboards, control panels, motor control centers, individual motor controllers, etc.

H. CLEANING UP

1. Remove labels from plumbing fixtures and other equipment with the exception of those required by U.L., FM, ETL, or other testing laboratories and those required by this Specification.

I. INSTALLATION PROCEDURES

1. The Contractor shall install all material and equipment in accordance with the manufacturer's printed recommendations and instructions except where revised on the Contract Documents. The Contractor shall maintain copies of the printed manufacturer's installation instructions on the site for review as required.
2. Install equipment and materials to provide required access for servicing and maintenance. Coordinate final equipment location with required access panels and doors. Allow ample space for removal of all parts that require replacement or servicing.

J. START-UP OF SYSTEMS

1. All equipment prior to start-up shall be fully lubricated, charged, filled, etc., pursuant to the manufacturer's recommendations. All

bearings and other machine parts requiring lubrication shall have an accessible means for lubrication. Where lubrication fittings on equipment or parts are concealed and/or not easily accessible, extend the fittings to an accessible position (accessible without the opening of an

enclosure, etc.) using galvanized pipe or copper tubing. Properly identify each grease fitting which is remotely situated with the part to be lubricated i.e. fan bearing, motor bearing, etc. Install "Zerk" type grease gun fittings on all equipment requiring greasing.

2. Prior to final review of plumbing systems, each system shall be run through all operating modes to verify proper operation. After the Contractor has verified that all systems are operating properly, notify the Authority Representative in writing that all systems are functioning properly, including the date and method of testing in the notification.
3. After proper operation has been verified for each system, instruct the Authority's designated personnel in the operation of each plumbing system immediately prior to acceptance by the Authority. Present to the Authority for their signature a form that includes the system operated, date of instruction, and Authority's and Contractor's personnel present. Give copy of signed form to the Authority Representative.

PART 2 – METHOD OF MEASUREMENT AND BASIS OF PAYMENT

4. Full compensation for Section 220500 Common Work Results for Plumbing shall be considered as included in the Contract lump sum price paid for Bid Schedule A, and no additional compensation will be allowed therefor.

END OF SECTION

SECTION 22 10 05 PLUMBING PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Pipe, pipe fittings, specialties, and connections for piping systems.
 - 1. Sanitary sewer.

1.2 REFERENCE STANDARDS

- A. ASME B16.23 - Cast Copper Alloy Solder Joint Drainage Fittings - DWV 2022.
- B. ASTM D2564 - Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems 2022.
- C. ASTM D2665 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings 2022.
- D. ASTM D2855 - Standard Practice for the Two-Step (Primer & Solvent Cement) Method of Joining Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Piping Components with Tapered Sockets 2022.
- E. ASTM D3034 - Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings 2022.
- F. CISPI 301 - Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste and Vent Piping Applications 2022.
- G. CISPI 310 - Specification for Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications 2022.
- H. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation 2022.
- I.

1.3 SUBMITTALS

- A. Product Data: Provide data on pipe materials, pipe fittings, and accessories. Provide manufacturer's catalog information.

1.4 QUALITY ASSURANCE

- A. Perform work in accordance with applicable codes.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- B. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the Work, and isolating parts of completed system.

1.6 FIELD CONDITIONS

- A. Do not install underground piping when bedding is wet.

PART 2 PRODUCTS

2.1 SANITARY SEWER PIPING, BURIED WITHIN 5 FEET OF BUILDING

- A. PVC Pipe: ASTM D2665 or ASTM D3034.
 - 1. Fittings: PVC.
 - 2. Joints: Solvent welded, with ASTM D2564 solvent cement.

2.2 SANITARY SEWER PIPING, ABOVE GRADE

- A. Cast Iron Pipe: CISPI 301, hubless, service weight.
 - 1. Fittings: Cast iron.
 - 2. Joints: CISPI 310, neoprene gaskets and stainless steel clamp-and-shield assemblies.

2.3 PIPE HANGERS AND SUPPORTS

- A. Provide hangers and supports that comply with MSS SP-58.

1. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.
 2. Vertical Pipe Support: Steel riser clamp.
- B. Plumbing Piping - Drain, Waste, and Vent:
1. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.
 2. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that excavations are to required grade, dry, and not over-excavated.

3.2 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt, on inside and outside, before assembly.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.
- C. Install piping to maintain headroom, conserve space, and not interfere with use of space.
- D. Group piping whenever practical at common elevations.
- E. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.
- F. PVC Pipe: Make solvent-welded joints in accordance with ASTM D2855.

3.4 TOLERANCES

- A. Drainage Piping: Establish invert elevations within 1/2 inch vertically of location indicated and slope to drain at minimum of 1/8 inch per foot slope. Drain at slope of 1/4 inch per foot where possible.

PART 4 - METHOD OF MEASUREMENT AND BASIS OF PAYMENT

- 4.1** Full compensation for Section 221005 Plumbing Piping shall be considered as included in the Contract lump sum price paid for Bid Schedule A, and no additional compensation will be allowed therefor.

END OF SECTION

**SECTION 22 10 06
PLUMBING PIPING SPECIALTIES**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Drains.

1.2 REFERENCE STANDARDS

- A. ASME A112.6.3 - Floor and Trench Drains 2022.

1.3 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide component sizes, rough-in requirements, service sizes, and finishes.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Accept specialties on site in original factory packaging. Inspect for damage.

PART 2 PRODUCTS

2.1 DRAINS

- A. Floor Drain (FD-1):
 - 1. ASME A112.6.3; lacquered cast iron, two piece body with double drainage flange, weep holes, reversible clamping collar, and round, adjustable nickel-bronze strainer.
 - 2. Manufacturers:
 - a. Zurn Industries, LLC | Specification Drainage Operation, Z415B
 - b. Mifab Industries

c. Jay R Smith

d. Or Equal.

B. Trench Drain (TD-1):

1. 6 inch wide pre-sloped trench drainage system. High density polyethylene structural composite drain channel with .75% bottom slope.
2. All sections are 80-inch modular lengths with integral top frame, inter-locking ends and radiused bottom. Combination tie-down/leveling devices at 20-inch intervals.
3. Furnished with heavy-duty Dura-coated cast iron grate frame and Grate System shall be 120-inches long, 6-inches wide and have a 4-inch clear opening.
 - a. Trench Width: 12 inches.
 - b. Trench Section Length: 39 inches and 19-1/2 inches.
 - c. Grating Support Rail: Stainless steel.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.

PART 4 - METHOD OF MEASUREMENT AND BASIS OF PAYMENT

- 4.1** Full compensation for Section Plumbing Piping Specialties shall be considered as included in the Contract lump sum price paid for Bid Schedule A, and no additional compensation will be allowed therefor.

END OF SECTION

SECTION 22 30 00
PLUMBING EQUIPMENT

PART 1- GENERAL

1.1 SECTION INCLUDES

- A. Triturator

1.2 SUBMITTALS

- A. Product Data:
 - 1. Provide electrical characteristics and connection requirements.
- B. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Authority's name and registered with manufacturer.

1.3 QUALITY ASSURANCE

- A. Certifications:
 - 1. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Provide temporary inlet and outlet caps. Maintain caps in place until installation.

PART 2 - PRODUCTS

2.1 TRITURATOR

A. Triturator (TR-2):

1. Triturator is a self-contained, above grade and automated station for disposal of airplane lavatory sewage, referred to as blue water. Using dual shafted cutting blades to reduce solids to small particles, it can shred items such as rags, diapers, silverware, plastics and latex.
2. Standard features:
 - a. IPEC # ARS1204 Inline, single 5 HP (3.68 kW) 3-phase electric motor.
 - b. 4 inch coupler to truck lavatory waste connection.
 - c. Grinder Cutters: 12 inch cutting stack with 11 tooth cam cutters. Heat treated alloy steel, surface ground for uniformity and through-hardened.
 - d. Seal Faces: Tungsten carbide / tungsten carbide
 - e. Plumbing Includes: Schedule 40 steel piping and flanged fittings, and inspection flush port.
3. Manufacturers:
 - a. JWC Environmental LLC.
 - b. Substitutions: None. This is a sole source provider of an item compatible with existing equipment and systems, and that performs the intended function or meets the specialized needs of the Authority as permitted by Authority Policy 5.02 sections (8) and (9).

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install plumbing equipment in accordance with manufacturer's instructions, as required by code, and complying with conditions of certification, if any.

PART 4 - METHOD OF MEASUREMENT AND BASIS OF PAYMENT

Section 22 30 00 Plumbing Equipment will not be paid for separately. Full compensation shall be considered as included in the contract price for the applicable bid items and no additional compensation will be allowed therefor.

END OF SECTION

SECTION 26 05 00.20

ELECTRICAL EQUIPMENT TESTING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Selection and Payment.
- B. Submittals.
- C. Contractor Responsibilities.
- D. Schedule of Inspection and Testing Work.
- E. Thermographic Survey.

1.2 REFERENCES

- A. NETA STD ATS – Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems, the most current edition applies.

1.3 INDEPENDENT TESTING AGENCY

- A. Employ and pay for services of an independent testing agency to perform specified inspection, and testing.

1.4 SUBMITTALS

- A. Testing Agency Qualifications: Submit certification of testing agency qualifications.
- B. Test Reports: Submit test report to Authority Representative. Include:
 - 1. Summary of project.
 - 2. Description of equipment tested.
 - 3. Test results.
 - 4. Conclusions and recommendations.
 - 5. Appendix, including appropriate test forms.
 - 6. Identification of test equipment used.
 - 7. Signature of responsible testing agency authority.
 - 8. Date and time of test.
 - 9. Provide interpretation of test results.

1.5 QUALITY ASSURANCE

- A. Qualifications of Testing Agency: NETA STD ATS.
- B. Test Instrument Calibration: NETA STD ATS.
- C. Inspection and Test Procedures: NETA STD ATS.

1.6 SCHEDULE OF INSPECTION AND TESTING WORK

- A. As specified in technical sections including, but not limited to:
 - 1. Branch Circuit Panelboards.
 - 2. Cables: Low Voltage (600V Maximum).
 - 3. Grounding Systems.
 - 4. Modifications to existing distribution equipment of the types listed above.

1.7 SYSTEM TESTING

- A. Submit system testing procedure/script for approval. Coordinate with Authority Representative.

1.8 THERMOGRAPHIC SURVEY

- A. Provide a complete thermographic survey in accordance with NETA ATS.
- B. Provide load banks as needed to test equipment where building load is not available or where the Authority Representative requires testing prior to connection of building load.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

PART 4 - METHOD OF MEASUREMENT AND BASIS OF PAYMENT

- 4.1** Full compensation for Section 260500.20 Electrical Equipment Testing shall be considered as included in the contract lump sum price paid for Bid Schedule A, and no additional compensation will be allowed therefor.

END OF 26 05 00.20

SECTION 26 05 05

SELECTIVE DEMOLITION FOR ELECTRICAL

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Electrical demolition.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- A. Materials and equipment for patching and extending work: As specified in individual sections.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that abandoned wiring and equipment serve only abandoned facilities.
- B. Report discrepancies to Authority Representative before disturbing existing installation.

3.2 PREPARATION

- A. Coordinate utility service outages with Authority Representative, in accordance with the General Conditions.
- B. Provide temporary wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits, use personnel experienced in such operations.
- C. Existing Electrical Service: Maintain existing system in service until new system is complete and ready for service. Disable system only to make switchovers and connections. Minimize outage duration.
 - 1. Obtain permission from Authority Representative at least 72 hours before partially or completely disabling system.
 - 2. Make temporary connections to maintain service in areas adjacent to Work area.

3.3 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

- A. Remove, relocate, and extend existing installations to accommodate new construction.
- B. Remove abandoned wiring to source of supply.

- C. Disconnect and remove abandoned panelboards and distribution equipment.
- D. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.
- E. Disconnect and remove abandoned luminaires.
- F. Repair adjacent construction and finishes damaged during demolition and extension work, in accordance with the Contract Documents.
- G. Maintain access to existing electrical installations that remain active. Modify installation or provide access panel as appropriate.
- H. Extend existing installations using materials and methods compatible with existing electrical installations, or as specified.

3.4 CLEANING AND REPAIR

- A. Clean and repair existing materials and equipment that remain or that are to be reused.

PART 4 - METHOD OF MEASUREMENT AND BASIS OF PAYMENT

- 4.1** Full compensation for Section 260500.20 Electrical Equipment Testing shall be considered as included in the contract lump sum price paid for Bid Schedule A, and no additional compensation will be allowed therefor.

END OF 26 05 05

SECTION 26 05 19

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Single conductor building wire.
- B. Wiring connectors.
- C. Electrical tape.
- D. Heat shrink tubing.
- E. Wire pulling lubricant.
- F. Cable ties.

1.2 RELATED REQUIREMENTS

- A. Section 26 05 05 - Selective Demolition for Electrical: Disconnection, removal, and/or extension of existing electrical conductors and cables.
- B. Section 26 05 26 - Grounding and Bonding for Electrical Systems: Additional requirements for grounding conductors and grounding connectors.
- C. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.

1.3 REFERENCE STANDARDS

- A. ASTM B3 - Standard Specification for Soft or Annealed Copper Wire 2013 (Reapproved 2018).
- B. ASTM B8 - Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft 2011 (Reapproved 2017).
- C. ASTM B33 - Standard Specification for Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes 2010, with Editorial Revision (2020).
- D. ASTM B787/B787M - Standard Specification for 19 Wire Combination Unilay-Stranded Copper Conductors for Subsequent Insulation 2004 (Reapproved 2020).
- E. ASTM D3005 - Standard Specification for Low-Temperature Resistant Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape 2017.
- F. ASTM D4388 - Standard Specification for Nonmetallic Semi-Conducting and Electrically Insulating Rubber Tapes 2013.
- G. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.
- H. NEMA WC 70 - Power Cables Rated 2000 Volts or Less for the Distribution

of Electrical Energy 2009.

- I. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems 2017.
- J. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- K. UL 44 - Thermoset-Insulated Wires and Cables Current Edition, Including All Revisions.
- L. UL 83 - Thermoplastic-Insulated Wires and Cables Current Edition, Including All Revisions.
- M. UL 486A-486B - Wire Connectors Current Edition, Including All Revisions.
- N. UL 486C - Splicing Wire Connectors Current Edition, Including All Revisions.
- O. UL 486D - Sealed Wire Connector Systems Current Edition, Including All Revisions.
- P. UL 510 - Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape Current Edition, Including All Revisions.

1.4 SUBMITTALS

- A. Product Data: Provide manufacturer's standard catalog pages and data sheets for conductors and cables, including detailed information on materials, construction, ratings, listings, and available sizes, configurations, and stranding.
- B. Project Record Documents: Record actual installed circuiting arrangements. Record actual routing for underground circuits.

1.5 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store conductors and cables in accordance with manufacturer's instructions.

1.7 FIELD CONDITIONS

- A. Do not install or otherwise handle thermoplastic-insulated conductors at temperatures lower than 14 degrees F, unless otherwise permitted by manufacturer's instructions. When installation below this temperature is unavoidable, notify Authority Representative and obtain direction before proceeding with work.

PART 2 - PRODUCTS

2.1 CONDUCTOR AND CABLE APPLICATIONS

- A. Do not use conductors and cables for applications other than as permitted by NFPA 70 and product listing.
- B. Provide single conductor building wire installed in suitable raceway unless otherwise indicated, permitted, or required.
- C. Nonmetallic-sheathed cable is not permitted.
- D. Manufactured wiring systems are not permitted.

2.2 CONDUCTOR AND CABLE GENERAL REQUIREMENTS

- A. Provide products that comply with requirements of NFPA 70.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. Provide new conductors and cables manufactured not more than one year prior to installation.
- D. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, etc. as required for a complete operating system.
- E. Comply with NEMA WC 70.
- F. Thermoplastic-Insulated Conductors and Cables: Listed and labeled as complying with UL 83.
- G. Thermoset-Insulated Conductors and Cables: Listed and labeled as complying with UL 44.
- H. Conductors for Grounding and Bonding: Also comply with Section 26 05 26.
- I. Conductor Material:
 - 1. Provide copper conductors only. Aluminum conductors are not acceptable for this project. Conductor sizes indicated are based on copper.
 - 2. Copper Conductors: Soft drawn annealed, 98 percent conductivity, uncoated copper conductors complying with ASTM B3, ASTM B8, or ASTM B787/B787M unless otherwise indicated.
 - 3. Tinned Copper Conductors: Comply with ASTM B33.
- J. Minimum Conductor Size:
 - 1. Branch Circuits: 12 AWG.
 - 2. Control Circuits: 14 AWG.
- K. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

L. Conductor Color Coding:

1. Color code conductors as indicated unless otherwise required by the authority having jurisdiction. Maintain consistent color coding throughout project.
2. Color Coding Method: Integrally colored insulation.
3. Color Code:
 - a. 480Y/277 V, 3 Phase, 4 Wire System:
 - (1) Phase A: Brown.
 - (2) Phase B: Orange.
 - (3) Phase C: Yellow.
 - (4) Neutral/Grounded: Gray.
 - b. 208Y/120 V, 3 Phase, 4 Wire System:
 - (1) Phase A: Black.
 - (2) Phase B: Red.
 - (3) Phase C: Blue.
 - (4) Neutral/Grounded: White.
 - c. 240/120 V, 1 Phase, 3 Wire System:
 - (1) Phase A: Black.
 - (2) Phase B: Red.
 - (3) Neutral/Grounded: White.
 - d. Equipment Ground, All Systems: Green.
 - e. For control circuits, comply with manufacturer's recommended color code.

2.3 SINGLE CONDUCTOR BUILDING WIRE

- A. Description: Single conductor insulated wire.
- B. Conductor Stranding:
 1. Feeders and Branch Circuits:
 - a. Size 12 AWG and Smaller: Solid.
 - b. Size 10 AWG and Larger: Stranded.
 2. Control Circuits: Stranded.
- C. Insulation Voltage Rating: 600 V.
- D. Insulation:
 1. Copper Building Wire: Type THHN/THWN or THHN/THWN-2, except as indicated below, rated 90 degree C.
 - a. Size 1 AWG and Larger: Type XHHW-2, 90 degree C.
 - b. Installed Underground: Type XHHW-2, 90 degree C.

2.4 WIRING CONNECTORS

- A. Description: Wiring connectors appropriate for the application, suitable for use with the conductors to be connected, and listed as complying with UL 486A-486B or UL 486C as applicable.
- B. Connectors for Grounding and Bonding: Comply with Section 26 05 26.
- C. Wiring Connectors for Splices and Taps:
 - 1. Copper Conductors Size 8 AWG and Smaller: Use twist-on insulated spring connectors or push-in wire connectors.
 - 2. Copper Conductors Size 6 AWG and Larger: Use mechanical connectors or compression connectors.
- D. Wiring Connectors for Terminations:
 - 1. Provide terminal lugs for connecting conductors to equipment furnished with terminations designed for terminal lugs.
 - 2. Provide compression adapters for connecting conductors to equipment furnished with mechanical lugs when only compression connectors are specified.
 - 3. Where over-sized conductors are larger than the equipment terminations can accommodate, provide connectors suitable for reducing to appropriate size, but not less than required for the rating of the overcurrent protective device.
 - 4. Provide motor pigtail connectors for connecting motor leads in order to facilitate disconnection.
 - 5. Copper Conductors Size 8 AWG and Larger: Use mechanical connectors or compression connectors where connectors are required.
 - a. Provide compression type, long barrel, double-hole, copper-type lugs (2 crimp minimum) for all power and grounding connections landed on bus.
 - 6. Conductors for Control Circuits: Use crimped terminals for all connections.
- E. Twist-on Insulated Spring Connectors: Rated 600 V, 221 degrees F for standard applications and 302 degrees F for high temperature applications; pre-filled with sealant and listed as complying with UL 486D for damp and wet locations.
- F. Push-in Wire Connectors: Rated 600 V, 221 degrees F.
- G. Mechanical Connectors: Provide bolted type or set-screw type.
- H. Compression Connectors: Provide circumferential type or hex type crimp configuration with inspection port.

- I. Crimped Terminals: Nylon-insulated, with insulation grip and terminal configuration suitable for connection to be made.

2.5 ACCESSORIES

A. Electrical Tape:

1. Vinyl Insulating Electrical Tape: Complying with ASTM D3005 and listed as complying with UL 510; minimum thickness of 7 mil; resistant to abrasion, corrosion, and sunlight; conformable for application down to 0 degrees F and suitable for continuous temperature environment up to 221 degrees F.
2. Rubber Splicing Electrical Tape: Ethylene Propylene Rubber (EPR) tape, complying with ASTM D4388; minimum thickness of 30 mil; suitable for continuous temperature environment up to 194 degrees F and short-term 266 degrees F overload service.
3. Electrical Filler Tape: Rubber-based insulating moldable putty, minimum thickness of 125 mil; suitable for continuous temperature environment up to 176 degrees F.
4. Varnished Cambric Electrical Tape: Cotton cambric fabric tape, with or without adhesive, oil-primed and coated with high-grade insulating varnish; minimum thickness of 7 mil; suitable for continuous temperature environment up to 221 degrees F.
5. Moisture Sealing Electrical Tape: Insulating mastic compound laminated to flexible, all-weather vinyl backing; minimum thickness of 90 mil.

B. Heat Shrink Tubing: Heavy-wall, split-resistant, with factory-applied adhesive; rated 600 V; suitable for direct burial applications; listed as complying with UL 486D.

C. Wire Pulling Lubricant: Listed; suitable for use with the conductors or cables to be installed and suitable for use at the installation temperature. Yellow 77 is not permitted.

D. Cable Ties: Material and tensile strength rating suitable for application. Any cable ties exposed to the elements, weather, sunlight, or located within a manhole must be black and UV resistant.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that interior of building has been protected from weather.
- B. Verify that work likely to damage wire and cable has been completed.
- C. Verify that raceways, boxes, and equipment enclosures are installed and are properly sized to accommodate conductors and cables in accordance with NFPA 70.
- D. Verify that field measurements are as indicated.
- E. Verify that conditions are satisfactory for installation prior to starting work.

3.2 PREPARATION

- A. Clean raceways thoroughly to remove foreign materials before installing conductors and cables.

3.3 INSTALLATION

- A. Circuiting Requirements:
 - 1. Unless dimensioned, circuit routing indicated is diagrammatic.
 - 2. When circuit destination is indicated without specific routing, determine exact routing required.
 - 3. Arrange circuiting to minimize splices.
 - 4. Circuiting Adjustments: Unless otherwise indicated, when branch circuits are shown as separate, combining them together in a single raceway is permitted, under the following conditions:
 - a. Provide no more than 9 current-carrying conductors in a single raceway. Dedicated neutral conductors are considered current-carrying conductors.
 - b. Increase size of conductors as required to account for ampacity derating.
 - c. Size raceways, boxes, etc. to accommodate conductors.
 - 5. Common Neutrals: Unless otherwise indicated, sharing of neutral/grounded conductors among up to three single phase branch circuits of different phases installed in the same raceway is permitted where not otherwise prohibited, except for the following:
 - a. Branch circuits fed from ground fault circuit interrupter (GFCI) circuit breakers.
 - b. Branch circuits with dimming controls.
 - 6. Provide oversized neutral/grounded conductors where indicated.
- B. Install products in accordance with manufacturer's instructions.

- C. Perform work in accordance with NECA 1 (general workmanship).
- D. Installation in Raceway:
 - 1. Tape ends of conductors and cables to prevent infiltration of moisture and other contaminants.
 - 2. Pull all conductors and cables together into raceway at same time.
 - 3. Do not damage conductors and cables or exceed manufacturer's recommended maximum pulling tension and sidewall pressure.
 - 4. Use suitable wire pulling lubricant where necessary, except when lubricant is not recommended by the manufacturer.
- E. Paralleled Conductors: Install conductors of the same length and terminate in the same manner.
- F. Secure and support conductors and cables in accordance with NFPA 70 using suitable supports and methods approved by the authority having jurisdiction. Provide independent support from building structure. Do not provide support from raceways, piping, ductwork, or other systems.
 - 1. Installation in Vertical Raceways: Provide supports where vertical rise exceeds permissible limits.
- G. Install conductors with a minimum of 6 inches of slack at each outlet.
- H. Where conductors are installed in enclosures for future termination by others, provide a minimum of 5 feet of slack.
- I. Neatly train and bundle conductors inside boxes, wireways, panelboards and other equipment enclosures.
- J. Group or otherwise identify neutral/grounded conductors with associated ungrounded conductors inside enclosures in accordance with NFPA 70.
- K. Make wiring connections using specified wiring connectors.
 - 1. Make splices and taps only in accessible boxes. Do not pull splices into raceways or make splices in conduit bodies.
 - 2. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors.
 - 3. Do not remove conductor strands to facilitate insertion into connector.
 - 4. Clean contact surfaces on conductors and connectors to suitable remove corrosion, oxides, and other contaminants. Do not use wire brush on plated connector surfaces.
 - 5. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
 - 6. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.

- L. Insulate splices and taps that are made with uninsulated connectors using methods suitable for the application, with insulation and mechanical strength at least equivalent to unspliced conductors.
 - 1. Dry Locations: Use insulating covers specifically designed for the connectors, electrical tape, or heat shrink tubing.
 - a. For taped connections, first apply adequate amount of rubber splicing electrical tape or electrical filler tape, followed by outer covering of vinyl insulating electrical tape.
 - b. For taped connections likely to require re-entering, including motor leads, first apply varnished cambric electrical tape, followed by adequate amount of rubber splicing electrical tape, followed by outer covering of vinyl insulating electrical tape.
 - 2. Damp Locations: Use insulating covers specifically designed for the connectors, electrical tape, or heat shrink tubing.
 - a. For connections with insulating covers, apply outer covering of moisture sealing electrical tape.
 - b. For taped connections, follow same procedure as for dry locations but apply outer covering of moisture sealing electrical tape.
 - 3. Wet Locations: Use heat shrink tubing.
- M. Insulate ends of spare conductors using vinyl insulating electrical tape.
- N. Identify conductors and cables in accordance with Section 26 05 53, Identification for Electrical Systems.
- O. Unless specifically indicated to be excluded, provide final connections to all equipment and devices, including those furnished by others, as required for a complete operating system.

3.4 FIELD QUALITY CONTROL

- A. Inspect and test in accordance with NETA ATS, except Section 4.
- B. Perform inspections and tests listed in NETA ATS, Section 7.3.2. The insulation resistance test is required for all conductors. The resistance test for parallel conductors listed as optional is not required.
 - 1. Disconnect surge protective devices (SPDs) prior to performing any high potential testing. Replace SPDs damaged by performing high potential testing with SPDs connected.
- C. Correct deficiencies and replace damaged or defective conductors and cables.

PART 4 - METHOD OF MEASUREMENT AND BASIS OF PAYMENT

- 4.1** Full compensation for Section 260505 Selective Demolition for Electrical shall be considered as included in the contract lump sum price paid for Bid Schedule A, and no additional compensation will be allowed therefor.

END OF 26 05 19

SECTION 26 05 26

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Grounding and bonding requirements.
- B. Conductors for grounding and bonding.
- C. Connectors for grounding and bonding.

1.2 RELATED REQUIREMENTS

- A. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables: Additional requirements for conductors for grounding and bonding, including conductor color coding.
- B. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.

1.3 REFERENCE STANDARDS

- A. IEEE 81 - IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Grounding System 2012.
- B. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.
- C. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems 2017.
- D. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- E. UL 467 - Grounding and Bonding Equipment Current Edition, Including All Revisions.

1.4 SUBMITTALS

- A. Product Data: Provide manufacturer's standard catalog pages and data sheets for grounding and bonding system components.

1.5 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 - PRODUCTS

2.1 GROUNDING AND BONDING REQUIREMENTS

- A. Do not use products for applications other than as permitted by NFPA 70 and product listing.
- B. Unless specifically indicated to be excluded, provide all required components, conductors, connectors, conduit, boxes, fittings, supports, accessories, etc. as necessary for a complete grounding and bonding system.
- C. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
- D. Bonding and Equipment Grounding:
 - 1. Provide bonding for equipment grounding conductors, equipment ground busses, metallic equipment enclosures, metallic raceways and boxes, device grounding terminals, and other normally non-current-carrying conductive materials enclosing electrical conductors/equipment or likely to become energized as indicated and in accordance with NFPA 70.
 - 2. Provide insulated equipment grounding conductor in each feeder and branch circuit raceway. Do not use raceways as sole equipment grounding conductor.
 - 3. Where circuit conductor sizes are increased for voltage drop, increase size of equipment grounding conductor proportionally in accordance with NFPA 70.
 - 4. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
 - 5. Terminate branch circuit equipment grounding conductors on solidly bonded equipment ground bus only. Do not terminate on neutral (grounded) or isolated/insulated ground bus.
 - 6. Provide bonding jumper across expansion or expansion/deflection fittings provided to accommodate conduit movement.
 - 7. Provide bonding for metal building frame.
 - 8. Provide bonding for metal siding not effectively bonded through attachment to metal building frame.

2.2 GROUNDING AND BONDING COMPONENTS

- A. General Requirements:
 - 1. Provide products listed, classified, and labeled as suitable for the purpose intended.

2. Provide products listed and labeled as complying with UL 467 where applicable.
- B. Conductors for Grounding and Bonding, in Addition to Requirements of Section 26 05 26:
 1. Use insulated copper conductors unless otherwise indicated.
- C. Connectors for Grounding and Bonding:
 1. Description: Connectors appropriate for the application and suitable for the conductors and items to be connected; listed and labeled as complying with UL 467.
 2. Unless otherwise indicated, use exothermic welded connections for underground, concealed and other inaccessible connections.
 3. Unless otherwise indicated, use mechanical connectors, compression connectors, or exothermic welded connections for accessible connections.
 - a. Exceptions: Use exothermic welded connections for connections to metal building frame.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that work likely to damage grounding and bonding system components has been completed.
- B. Verify that field measurements are as indicated.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 SEQUENCING

- A. Do not install ground rod electrodes until final backfill and compaction is complete.

3.3 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Perform work in accordance with NECA 1 (general workmanship).
- C. Make grounding and bonding connections using specified connectors.
 - 1. Remove appropriate amount of conductor insulation for making connections without cutting, nicking, or damaging conductors. Do not remove conductor strands to facilitate insertion into connector.
 - 2. Remove nonconductive paint, enamel, or similar coating at threads, contact points, and contact surfaces.
 - 3. Exothermic Welds: Make connections using molds and weld material suitable for the items to be connected in accordance with manufacturer's recommendations.
 - 4. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
 - 5. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.
- D. Identify grounding and bonding system components in accordance with Section 26 05 53.

3.4 FIELD QUALITY CONTROL

- A. Inspect and test in accordance with NETA ATS except Section 4.
- B. Perform inspections and tests listed in NETA ATS, Section 7.13.
- C. Perform ground electrode resistance tests under normally dry conditions. Precipitation within the previous 48 hours does not constitute normally dry conditions.
- D. Investigate and correct deficiencies where measured ground resistances do not comply with specified requirements.

PART 4 - METHOD OF MEASUREMENT AND BASIS OF PAYMENT

- 4.1** Full compensation for Section 260519 Low-Voltage Electrical Power Conductors and Cables shall be considered as included in the contract lump sum price paid for Bid Schedule A, and no additional compensation will be allowed therefor.

END OF 26 05 26

SECTION 26 05 29

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Support and attachment requirements and components for equipment, conduit, cable, boxes, and other electrical work.

1.2 RELATED REQUIREMENTS

- A. Section 26 05 33.13 - Conduit for Electrical Systems: Additional support and attachment requirements for conduits.
- B. Section 26 05 33.16 - Boxes for Electrical Systems: Additional support and attachment requirements for boxes.

1.3 REFERENCE STANDARDS

- A. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel 2019.
- B. MFMA-4 - Metal Framing Standards Publication 2004.
- C. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.
- D. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- E. NFPA 101 - Life Safety Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- F. UL 5B - Strut-Type Channel Raceways and Fittings Current Edition, Including All Revisions.

1.4 SUBMITTALS

- A. Product Data: Provide manufacturer's standard catalog pages and data sheets for channel (strut) framing systems, non-penetrating rooftop supports, and post-installed concrete and masonry anchors.

1.5 QUALITY ASSURANCE

- A. Comply with NFPA 70.
- B. Comply with applicable building code.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 - PRODUCTS

2.1 SUPPORT AND ATTACHMENT COMPONENTS

A. General Requirements:

1. Provide all required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for the complete installation of electrical work.
2. Provide products listed, classified, and labeled as suitable for the purpose intended, where applicable.
3. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported. Include consideration for vibration, equipment operation, and shock loads where applicable.
4. Do not use products for applications other than as permitted by NFPA 70 and product listing.
5. Do not use wire, chain, perforated pipe strap, or wood for permanent supports unless specifically indicated or permitted. The use of aircraft cable is acceptable.
6. Steel Components: Use corrosion resistant materials suitable for the environment where installed.
 - a. Indoor Dry Locations: Use zinc-plated steel unless otherwise indicated.
 - b. Outdoor and Damp or Wet Indoor Locations: Use stainless steel unless otherwise indicated.
 - c. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.

B. Conduit and Cable Supports: Straps, clamps, etc. suitable for the conduit or cable to be supported.

1. Conduit Straps: One-hole or two-hole type; steel or malleable iron.
2. Conduit Clamps: Bolted type or unistrut strap type, unless otherwise indicated.

C. Outlet Box Supports: Hangers, brackets, etc. suitable for the boxes to be supported.

D. Metal Channel (Strut) Framing Systems: Factory-fabricated continuous-slot metal channel (strut) and associated fittings, accessories, and hardware required for field-assembly of supports.

1. Comply with MFMA-4.
2. Channel Material:

- a. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel.
- 3. Minimum Channel Thickness: Steel sheet, 12 gage, 0.1046 inch.
- 4. Minimum Channel Dimensions: 1-1/2 inch width by 7/8 inch height.
- E. Anchors and Fasteners:
 - 1. Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.
 - 2. Concrete: Use expansion anchors.
 - 3. Solid or Grout-Filled Masonry: Use expansion anchors.
 - 4. Steel: Use beam clamps, machine bolts, or welded threaded studs. Provide seismic straps for I-Beams.
 - 5. Sheet Metal: Use sheet metal screws.
 - 6. Wood: Use wood screws.
 - 7. Plastic and lead anchors are not permitted.
 - 8. Post-Installed Concrete and Masonry Anchors: Evaluated and recognized by ICC Evaluation Service, LLC (ICC-ES) for compliance with applicable building code.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that mounting surfaces are ready to receive support and attachment components.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Perform work in accordance with NECA 1 (general workmanship).
- C. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.
- D. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
- E. Unless specifically indicated or approved by Authority Representative, do not provide support from suspended ceiling support system or ceiling grid.
- F. Unless specifically indicated or approved by Authority Representative, do not provide support from roof deck.

- G. Do not penetrate or otherwise notch or cut structural members without approval of the Authority Representative.
- H. Equipment Support and Attachment:
 - 1. Use metal fabricated supports or supports assembled from metal channel (strut) to support equipment as required.
 - 2. Use metal channel (strut) secured to studs to support equipment surface-mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.
 - 3. Use metal channel (strut) to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
 - 4. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.
- I. Conduit Support and Attachment: Also comply with Section 26 05 33.13, Conduit for Electrical Systems.
- J. Box Support and Attachment: Also comply with Section 26 05 33.16, Boxes for Electrical Systems.
- K. Secure fasteners according to manufacturer's recommended torque settings.
- L. Remove temporary supports.

3.3 FIELD QUALITY CONTROL

- A. Inspect support and attachment components for damage and defects.
- B. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.
- C. Correct deficiencies and replace damaged or defective support and attachment components.

PART 4 - METHOD OF MEASUREMENT AND BASIS OF PAYMENT

- 4.1** Full compensation for Section 260529 Hangers and Supports for Electrical Systems shall be considered as included in the contract lump sum price paid for Bid Schedule A, and no additional compensation will be allowed therefor.

END OF 26 05 29

SECTION 26 05 33.13

CONDUIT FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Galvanized steel rigid metal conduit (RMC).
- B. Aluminum rigid metal conduit (RMC).
- C. Intermediate metal conduit (IMC).
- D. PVC-coated galvanized steel rigid metal conduit (RMC).
- E. Liquidtight flexible metal conduit (LFMC).
- F. Rigid polyvinyl chloride (PVC) conduit.
- G. Conduit fittings.
- H. Accessories.

1.2 RELATED REQUIREMENTS

- A. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables.
- B. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
 - 1. Includes additional requirements for fittings for grounding and bonding.
- C. Section 26 05 29 - Hangers and Supports for Electrical Systems.
- D. Section 26 05 33.16 - Boxes for Electrical Systems.
- E. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.

1.3 REFERENCE STANDARDS

- A. ANSI C80.1 - American National Standard for Electrical Rigid Steel Conduit (ERSC) 2015.
- B. ANSI C80.5 - American National Standard for Electrical Rigid Metal Conduit -- Aluminum (ERMC-A) 2015.
- C. ANSI C80.6 - American National Standard for Electrical Intermediate Metal Conduit (EIMC) 2018.
- D. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.
- E. NECA 101 - Standard for Installing Steel Conduits (Rigid, IMC, EMT) 2013.
- F. NECA 102 - Standard for Installing Aluminum Rigid Metal Conduit 2004.
- G. NECA 111 - Standard for Installing Nonmetallic Raceways (RNC, ENT, LFNC) 2017.

- H. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable 2014.
- I. NEMA RN 1 - Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit 2018.
- J. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Conduit 2020.
- K. NEMA TC 3 - Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing 2016.
- L. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- M. UL 6 - Electrical Rigid Metal Conduit-Steel Current Edition, Including All Revisions.
- N. UL 6A - Electrical Rigid Metal Conduit-Aluminum, Red Brass, and Stainless Steel Current Edition, Including All Revisions.
- O. UL 360 - Liquid-Tight Flexible Steel Conduit Current Edition, Including All Revisions.
- P. UL 514B - Conduit, Tubing, and Cable Fittings Current Edition, Including All Revisions.
- Q. UL 651 - Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings Current Edition, Including All Revisions.
- R. UL 1242 - Electrical Intermediate Metal Conduit-Steel Current Edition, Including All Revisions.

1.4 SUBMITTALS

- A. Product Data: Provide manufacturer's standard catalog pages and data sheets for conduits and fittings.
- B. Project Record Drawings: Record actual routing for conduits installed underground, conduits embedded within concrete slabs, and conduits 2-inch size and larger.

1.5 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store conduit and fittings in accordance with manufacturer's instructions.

PART 2 - PRODUCTS

2.1 CONDUIT APPLICATIONS

- A. Do not use conduit and associated fittings for applications other than as permitted by NFPA 70 and product listing.
- B. Unless otherwise indicated and where not otherwise restricted, use the conduit types indicated for the specified applications. Where more than one listed application applies, comply with the most restrictive requirements. Where conduit type for a particular application is not specified, use galvanized steel rigid metal conduit.
- C. Embedded Within Concrete:
 - 1. Where rigid polyvinyl (PVC) conduit is provided, transition to galvanized steel rigid metal conduit where emerging from concrete.
 - 2. Where electrical metallic tubing (EMT) emerges from concrete into salt air, use corrosion protection tape to provide supplementary corrosion protection for a minimum of 4 inches on either side of where conduit emerges or use PVC-coated galvanized steel rigid metal conduit.
- D. Exposed, Exterior: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), or PVC-coated galvanized steel rigid metal conduit.
- E. Concealed, Exterior, Not Embedded in Concrete or in Contact With Earth: Use galvanized steel rigid metal conduit or intermediate metal conduit (IMC).
- F. Corrosive Locations Above Ground: Use PVC-coated galvanized steel rigid metal conduit or aluminum rigid metal conduit.
- G. Connections to Vibrating Equipment:
 - 1. Damp, Wet, or Corrosive Locations: Use liquidtight flexible metal conduit.
 - 2. Maximum Length: 6 feet unless otherwise indicated.
 - 3. Vibrating equipment includes, but is not limited to:
 - a. Transformers.
 - b. Motors.

2.2 CONDUIT REQUIREMENTS

- A. Fittings for Grounding and Bonding: Also comply with Section 26 05 26, Grounding and Bonding for Electrical Systems.
- B. Provide all conduit, fittings, supports, and accessories required for a complete raceway system.
- C. Provide products listed, classified, and labeled as suitable for the purpose intended.

- D. Minimum Conduit Size, Unless Otherwise Indicated:
 - 1. Branch Circuits: 3/4-inch trade size.
 - 2. Branch Circuit Homeruns: 3/4-inch trade size.
 - 3. Control Circuits: 3/4-inch trade size.
- E. Where conduit size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

2.3 GALVANIZED STEEL RIGID METAL CONDUIT (RMC)

- A. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit complying with ANSI C80.1 and listed and labeled as complying with UL 6.
- B. Fittings:
 - 1. Non-Hazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
 - 2. Material: Use steel or malleable iron.
 - a. Do not use die cast zinc fittings.
 - 3. Connectors and Couplings: Use threadless steel compression fittings permitted.

2.4 ALUMINUM RIGID METAL CONDUIT (RMC)

- A. Description: NFPA 70, Type RMC aluminum rigid metal conduit complying with ANSI C80.5 and listed and labeled as complying with UL 6A.
- B. Fittings:
 - 1. Non-Hazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
 - 2. Material: Use aluminum.
 - 3. Connectors and Couplings: Use threaded type fittings only. Threadless set screw and compression (gland) type fittings are not permitted.

2.5 INTERMEDIATE METAL CONDUIT (IMC)

- A. Description: NFPA 70, Type IMC galvanized steel intermediate metal conduit complying with ANSI C80.6 and listed and labeled as complying with UL 1242.
- B. Fittings:
 - 1. Non-Hazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
 - 2. Material: Use steel or malleable iron.
 - a. Do not use die cast zinc fittings.

3. Connectors and Couplings: Use threaded type fittings only. Threadless set screw and compression (gland) type fittings are not permitted.

2.6 PVC-COATED GALVANIZED STEEL RIGID METAL CONDUIT (RMC)

- A. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit with external polyvinyl chloride (PVC) coating complying with NEMA RN 1 and listed and labeled as complying with UL 6.
- B. Exterior Coating: Polyvinyl chloride (PVC), nominal thickness of 40 mil.
- C. Interior Coating: Urethane, minimum thickness of 2 mil.
- D. PVC-Coated Fittings:
 1. Non-Hazardous Locations: Use fittings listed and labeled as complying with UL 514B.
 2. Material: Use steel or malleable iron.
 3. Exterior Coating: Polyvinyl chloride (PVC), minimum thickness of 40 mil.
 4. Interior Coating: Urethane, minimum thickness of 2 mil.
- E. PVC-Coated Supports: Furnish with exterior coating of polyvinyl chloride (PVC), minimum thickness of 15 mil.

2.7 LIQUIDTIGHT FLEXIBLE METAL CONDUIT (LFMC)

- A. Description: NFPA 70, Type LFMC polyvinyl chloride (PVC) jacketed steel flexible metal conduit listed and labeled as complying with UL 360.
- B. Fittings:
 1. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
 2. Material: Use steel or malleable iron.
 - a. Do not use die cast zinc fittings.

2.8 RIGID POLYVINYL CHLORIDE (PVC) CONDUIT

- A. Description: NFPA 70, Type PVC rigid polyvinyl chloride conduit complying with NEMA TC 2 and listed and labeled as complying with UL 651; Schedule 40 unless otherwise indicated; rated for use with conductors rated 90 degrees C.
- B. Fittings:
 1. Description: Fittings complying with NEMA TC 3 and listed and labeled as complying with UL 651; material to match conduit.

2.9 ACCESSORIES

- A. Corrosion Protection Tape: PVC-based, minimum thickness of 20 mil.

- B. Conduit Joint Compound: Corrosion-resistant, electrically conductive; suitable for use with the conduit to be installed.
- C. Solvent Cement for PVC Conduit and Fittings: As recommended by manufacturer of conduit and fittings to be installed.
- D. Pull Strings: Use nylon cord with average breaking strength of not less than 200 pound-force.
- E. Modular Seals for Conduit Penetrations: Rated for minimum of 40 psig; Suitable for the conduits to be installed.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that mounting surfaces are ready to receive conduits.
- B. Verify that conditions are satisfactory for installation prior to starting work.

3.2 SEQUENCING

- A. Do not begin installation of conductors and cables until installation of conduit is complete between outlet, junction, and splicing points.

3.3 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Perform work in accordance with NECA 1 (general workmanship).
- C. Install galvanized steel rigid metal conduit (RMC) in accordance with NECA 101.
- D. Install aluminum rigid metal conduit (RMC) in accordance with NECA 102.
- E. Install intermediate metal conduit (IMC) in accordance with NECA 101.
- F. Install PVC-coated galvanized steel rigid metal conduit (RMC) using only tools approved by the manufacturer.
- G. Install rigid polyvinyl chloride (PVC) conduit in accordance with NECA 111.
- H. Conduit Routing:
 - 1. Unless dimensioned, conduit routing indicated is diagrammatic.
 - 2. When conduit destination is indicated without specific routing, determine exact routing required.
 - 3. Conceal all conduits unless specifically indicated to be exposed.
 - 4. Unless otherwise approved, do not route conduits exposed:
 - a. Across building exterior surfaces.
 - 5. Conduits installed underground or embedded in concrete may be routed in the shortest possible manner unless otherwise indicated.

Route all other conduits parallel or perpendicular to building structure and surfaces, following surface contours where practical.

6. Arrange conduit to maintain adequate headroom, clearances, and access.
7. Arrange conduit to provide no more than the equivalent of three 90-degree bends between pull points for power.
8. Arrange conduit to provide no more than the equivalent of two 90-degree bends between pull points for communication.
9. Arrange conduit to provide no more than 150 feet between pull points.
10. Route conduits above water and drain piping where possible.
11. Arrange conduit to prevent moisture traps. Provide drain fittings at low points and at sealing fittings where moisture may collect.
12. Maintain minimum clearance of 6 inches between conduits and piping for other systems.
13. Maintain minimum clearance of 12 inches between conduits and hot surfaces.
14. Group parallel conduits in the same area together on a common rack.
15. In exterior locations, conduit shall terminate in bottom or sides of boxes (not the top).
16. Arrange all conduits entering panelboards or switchboards, either from the top or the bottom, to enter without the use of gutters. Auxiliary Gutters may only be used with approval from the Authority Representative and cannot be used as a "fix" for conduits that are in the incorrect positions.

I. Conduit Support:

1. Secure and support conduits in accordance with NFPA 70 and Section 26 05 29, Hangers and Supports for Electrical Systems using suitable supports and methods approved by the authority having jurisdiction.
2. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
3. Installation Above Suspended Ceilings: Do not provide support from ceiling support system. Do not provide support from ceiling grid or allow conduits to lay on ceiling tiles.
4. Use conduit strap to support single surface-mounted conduit.
 - a. Use clamp back spacer with conduit strap for damp and wet locations to provide space between conduit and mounting surface.

5. Use metal channel (strut) with accessory conduit clamps to support multiple parallel surface-mounted conduits.
6. Use conduit clamp to support single conduit from beam clamp or threaded rod.
7. Use trapeze hangers assembled from threaded rods and metal channel (strut) with accessory conduit clamps to support multiple parallel suspended conduits.
8. Use non-penetrating rooftop supports to support conduits routed across rooftops (only where approved).
9. Use of wire for support of conduits is not permitted.
10. Where conduit support intervals specified in NFPA 70 and NECA standards differ, comply with the most stringent requirements.

J. Connections and Terminations:

1. Use approved zinc-rich paint or conduit joint compound on field-cut threads of galvanized steel conduits prior to making connections.
2. Where two threaded conduits must be joined and neither can be rotated, use three-piece couplings or split couplings. Do not use running threads.
3. Use suitable adapters where required to transition from one type of conduit to another.
4. Provide drip loops for liquidtight flexible conduit connections to prevent drainage of liquid into connectors.
5. Terminate threaded conduits in boxes and enclosures using threaded hubs or double lock rings with ground bushings for dry locations and raintight hubs for wet locations.
6. Where spare conduits stub up through concrete floors and are not terminated in a box or enclosure, provide threaded couplings equipped with threaded plugs set flush with finished floor.
7. Provide insulating bushings or insulated throats for EMT conduits utilizing conductor size #4 AWG and larger to protect conductors.
8. Secure joints and connections to provide maximum mechanical strength and electrical continuity.

K. Penetrations:

1. Do not penetrate or otherwise notch or cut structural members, including footings and grade beams, without approval of the Authority Representative.
2. Make penetrations perpendicular to surfaces unless otherwise indicated.

3. Provide sleeves for penetrations as indicated or as required to facilitate installation. Set sleeves flush with exposed surfaces unless otherwise indicated or required.
 4. Conceal bends for conduit risers emerging above ground.
 5. Provide metal escutcheon plates for conduit penetrations exposed to public view.
- L. Embedment Within Structural Concrete Slabs (only where approved by Authority Representative):
1. Include proposed conduit arrangement with submittals.
 2. Secure conduits to prevent floating or movement during pouring of concrete.
- M. Conduit Movement Provisions: Where conduits are subject to movement, provide expansion and expansion/deflection fittings to prevent damage to enclosed conductors or connected equipment. This includes, but is not limited to:
1. Where conduits cross structural joints intended for expansion, contraction, or deflection.
 2. Where calculated in accordance with NFPA 70 for rigid polyvinyl chloride (PVC) conduit installed above ground to compensate for thermal expansion and contraction.
 3. Where conduits are subject to earth movement by settlement or frost.
- N. Condensation Prevention: Where conduits cross barriers between areas of potential substantial temperature differential, provide sealing fitting or approved sealing compound at an accessible point near the penetration to prevent condensation. This includes, but is not limited to:
1. Where conduits pass from outdoors into conditioned interior spaces.
 2. Where conduits pass from unconditioned interior spaces into conditioned interior spaces.
- O. Provide pull string in all empty conduits and in conduits where conductors and cables are to be installed by Contractor. Leave minimum slack of 12 inches at each end.
- P. Provide grounding and bonding in accordance with Section 26 05 26, Grounding and Bonding for Electrical Systems.
- Q. Identify conduits in accordance with Section 26 05 53, Identification for Electrical Systems.

3.4 FIELD QUALITY CONTROL

- A. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.

- B. Where coating of PVC-coated galvanized steel rigid metal conduit (RMC) contains cuts or abrasions, repair in accordance with manufacturer's instructions.
- C. Correct deficiencies and replace damaged or defective conduits.

3.5 CLEANING

- A. Clean interior of conduits to remove moisture and foreign matter.

3.6 PROTECTION

- A. Immediately after installation of conduit, use suitable manufactured plugs to provide protection from entry of moisture and foreign material and do not remove until ready for installation of conductors.
- B. All spare underground conduits shall have compression type plugs installed.

PART 4 - METHOD OF MEASUREMENT AND BASIS OF PAYMENT

- 4.1 Full compensation for Section 260533.13 Conduit for Electrical Systems shall be considered as included in the contract lump sum price paid for Bid Schedule A, and no additional compensation will be allowed therefor.

END OF 26 05 33.13

SECTION 26 05 33.16

BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Outlet and device boxes up to 100 cubic inches, including those used as junction and pull boxes.
- B. Cabinets and enclosures, including junction and pull boxes larger than 100 cubic inches.

1.2 RELATED REQUIREMENTS

- A. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- B. Section 26 05 29 - Hangers and Supports for Electrical Systems.
- C. Section 26 05 33.13 - Conduit for Electrical Systems:
 - 1. Conduit bodies and other fittings.
 - 2. Additional requirements for locating boxes to limit conduit length and/or number of bends between pulling points.
- D. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.

1.3 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.
- B. NECA 130 - Standard for Installing and Maintaining Wiring Devices 2010.
- C. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable 2014.
- D. NEMA OS 1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports 2013.
- E. NEMA OS 2 - Nonmetallic Outlet Boxes, Device Boxes, Covers and Box Supports 2013.
- F. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum) 2018.
- G. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- H. SCTE 77 - Specification for Underground Enclosure Integrity 2017.
- I. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations Current Edition, Including All Revisions.

- J. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations Current Edition, Including All Revisions.
- K. UL 508A - UL Standard for Safety Industrial Control Panels 2018.
- L. UL 514A - Metallic Outlet Boxes Current Edition, Including All Revisions.
- M. UL 514C - Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers Current Edition, Including All Revisions.

1.4 SUBMITTALS

- A. Product Data: Provide manufacturer's standard catalog pages and data sheets for outlet and device boxes, junction and pull boxes, cabinets and enclosures, and underground boxes/enclosures.
- B. Project Record Documents: Record actual locations for pull boxes, cabinets and enclosures, and underground boxes/enclosures.
- C. Maintenance Materials: Furnish the following for the Authority Representative's use in maintenance of project.
 - 1. Keys for Lockable Enclosures: Two of each different key.

1.5 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 - PRODUCTS

2.1 BOXES

- A. General Requirements:
 - 1. Do not use boxes and associated accessories for applications other than as permitted by NFPA 70 and product listing.
 - 2. Provide all boxes, fittings, supports, and accessories required for a complete raceway system and to accommodate devices and equipment to be installed.
 - 3. Provide products listed, classified, and labeled as suitable for the purpose intended.
 - 4. Where box size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
 - 5. Provide grounding terminals within boxes where equipment grounding conductors terminate.
 - 6. For sheet-steel boxes extensions must match. (Welded box needs welded extension; Stamped box needs stamped extension)

B. Outlet and Device Boxes Up to 100 cubic inches, Including Those Used as Junction and Pull Boxes:

1. Use cast iron boxes or cast aluminum boxes for damp or wet locations unless otherwise indicated or required; furnish with compatible weatherproof gasketed covers.
2. Use cast iron boxes or cast aluminum boxes where exposed galvanized steel rigid metal conduit or exposed intermediate metal conduit (IMC) is used.
3. Use cast iron boxes in locations subject to damage.
4. Use cast aluminum boxes in locations not subject to damage.
5. Use cast aluminum boxes where aluminum rigid metal conduit is used.
6. Use nonmetallic boxes where exposed rigid PVC conduit is used.
7. Use suitable concrete type boxes where flush-mounted in concrete.
8. Use suitable masonry type boxes where flush-mounted in masonry walls.
9. Do not use "through-wall" boxes designed for access from both sides of wall.
10. Cast Metal Boxes: Comply with NEMA FB 1, and list and label as complying with UL 514A; furnish with threaded hubs.
11. Nonmetallic Boxes: Comply with NEMA OS 2, and list and label as complying with UL 514C.
12. Boxes for Ganged Devices: Use multigang boxes of single-piece construction. Do not use field-connected gangable boxes unless specifically indicated or permitted.
13. Minimum Box Size, Unless Otherwise Indicated:
 - a. Wiring Devices (Other Than Communications Systems Outlets): 4 inch square by 1-1/2 inch deep (100 by 38 mm) trade size.

- C. Cabinets and Enclosures, Including Junction and Pull Boxes Larger Than 100 cubic inches:
 - 1. Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E, or UL 508A.
 - 2. NEMA 250 Environment Type, Unless Otherwise Indicated:
 - a. Outdoor Locations: Type 4X, painted steel.
 - 3. Junction and Pull Boxes Larger Than 100 cubic inches:
 - a. Provide screw-cover or hinged-cover enclosures unless otherwise indicated.
 - b. Boxes 6 square feet and Larger: Provide sectionalized screw-cover or hinged-cover enclosures.
 - 4. Cabinets and Hinged-Cover Enclosures, Other Than Junction and Pull Boxes:
 - a. Provide lockable hinged covers, all locks keyed alike unless otherwise indicated.
 - b. Back Panels: Painted steel, removable.
 - 5. Finish for Painted Steel Enclosures: Manufacturer's standard grey unless otherwise indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that mounting surfaces are ready to receive boxes.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install boxes in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards where mounting heights are not indicated.
- C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- D. Provide separate boxes for emergency power and normal power systems.
- E. Unless otherwise indicated, provide separate boxes for line voltage and low voltage systems.
- F. Flush-mount boxes in finished areas unless specifically indicated to be surface-mounted.

- G. Unless otherwise indicated, boxes may be surface-mounted where exposed conduits are indicated or permitted.
- H. Box Locations:
 - 1. Unless dimensioned, box locations indicated are approximate.
 - 2. Locate boxes as required for devices installed under other sections or by others.
 - 3. Locate boxes so that wall plates do not span different building finishes.
 - 4. Locate boxes so that wall plates do not cross masonry joints.
 - 5. Unless otherwise indicated, where multiple outlet boxes are installed at the same location at different mounting heights, install along a common vertical center line. Align outlet boxes with adjacent switches, thermostats and similar devices.
 - 6. Locate junction and pull boxes as indicated, as required to facilitate installation of conductors, and to limit conduit length and/or number of bends between pulling points in accordance with Section 26 05 33.13, Conduit for Electrical Systems.
- I. Box Supports:
 - 1. Secure and support boxes in accordance with NFPA 70 and Section 26 05 29, Hangers and Supports for Electrical Systems using suitable supports and methods approved by the authority having jurisdiction.
 - 2. Provide independent support from building structure except for cast metal boxes (other than boxes used for fixture support) supported by threaded conduit connections in accordance with NFPA 70. Do not provide support from piping, ductwork, or other systems.
- J. Install boxes plumb and level.
- K. Install boxes as required to preserve insulation integrity.
- L. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.
- M. Close unused box openings.
- N. Install blank wall plates on junction boxes and on outlet boxes with no devices or equipment installed or designated for future use.
- O. Provide grounding and bonding in accordance with Section 26 05 26, Grounding and Bonding for Electrical Systems.
- P. Identify boxes in accordance with Section 26 05 53, Identification for Electrical Systems.
- Q. Auxiliary gutters may only be used with approval from Authority Representative. If approved, the cover must advise all different sources of power within.

3.3 CLEANING

- A. Clean interior of boxes to remove dirt, debris, plaster, and other foreign material.

3.4 PROTECTION

- A. Immediately after installation, protect boxes from entry of moisture and foreign material until ready for installation of conductors.

PART 4 - METHOD OF MEASUREMENT AND BASIS OF PAYMENT

- 4.1** Full compensation for Section 260533.16 Boxes for Electrical Systems shall be considered as included in the contract lump sum price paid for Bid Schedule A, and no additional compensation will be allowed therefor.

END OF 26 05 33.16

SECTION 26 05 53

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Electrical identification requirements.
- B. Identification nameplates and labels.
- C. Wire and cable markers.
- D. Underground warning tape.
- E. Warning signs and labels.

1.2 RELATED REQUIREMENTS

- A. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables: Color coding for power conductors and cables 600 V and less; vinyl color coding electrical tape.

1.3 REFERENCE STANDARDS

- A. ANSI Z535.2 - American National Standard for Environmental and Facility Safety Signs 2011.
- B. ANSI Z535.4 - American National Standard for Product Safety Signs and Labels 2011.
- C. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- D. NFPA 70E - Standard for Electrical Safety in the Workplace 2018.
- E. UL 969 - Marking and Labeling Systems Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Verify final designations for equipment, systems, and components to be identified prior to fabrication of identification products.
- B. Sequencing:
 - 1. Do not conceal items to be identified, in locations such as above suspended ceilings, until identification products have been installed.
 - 2. Do not install identification products until final surface finishes and painting are complete.

1.5 SUBMITTALS

- A. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product.
- B. Shop Drawings: Provide schedule of items to be identified indicating proposed designations, materials, legends, and formats.

1.6 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.

1.7 FIELD CONDITIONS

- A. Do not install adhesive products when ambient temperature is lower than recommended by manufacturer.

PART 2 - PRODUCTS

2.1 IDENTIFICATION REQUIREMENTS

- A. Identification for Equipment:
 - 1. Use identification nameplate to identify each piece of electrical distribution and control equipment and associated sections, compartments, and components. In addition to the equipment tag/name, include information as follows:
 - a. Switchboards:
 - (1) Identify ampere rating.
 - (2) Identify voltage and phase.
 - (3) Identify power source and circuit number. Include location when not within sight of equipment.
 - (4) Use identification nameplate to identify main overcurrent protective device.
 - (5) Use identification nameplate to identify load(s) served for each branch device. Do not identify spares and spaces.
 - b. Panelboards:
 - (1) Identify ampere rating.
 - (2) Identify voltage and phase.
 - (3) Identify power source and circuit number. Include location when not within sight of equipment.
 - (4) Identify main overcurrent protective device. Use identification label for panelboards with a door. For power distribution panelboards without a door, use identification nameplate.

- (5) Use typewritten circuit directory to identify load(s) served for panelboards with a door. Identify spares and spaces using pencil.
 - c. Enclosed switches:
 - (1) Identify voltage and phase.
 - (2) Identify power source and circuit number. Include location when not within sight of equipment.
 - (3) Identify load(s) served. Include location when not within sight of equipment.
 - d. Time Switches:
 - (1) Identify load(s) served and associated circuits controlled. Include location.
 - e. Electricity Meters:
 - (1) Identify load(s) metered.
- 2. Service Equipment:
 - a. Use identification nameplate to identify each service disconnecting means.
 - b. For buildings or structures supplied by more than one service, or any combination of branch circuits, feeders, and services, use identification nameplate or means of identification acceptable to authority having jurisdiction at each service disconnecting means to identify all other services, feeders, and branch circuits supplying that building or structure. Verify format and descriptions with authority having jurisdiction.
- 3. Use identification label to identify highest voltage present for each piece of electrical equipment.
- 4. Use identification nameplate to identify disconnect location for equipment with remote disconnecting means.
- 5. Use identification label at each fused switch to identify required NEMA fuse class and size.
- 6. Use identification label at each motor controller to identify nameplate horsepower, full load amperes, code letter, service factor, voltage, and phase of motor(s) controlled.
- 7. Use warning signs to identify electrical hazards for entrances to all rooms and other guarded locations that contain exposed live parts operating at 600 V nominal or less with the word message "DANGER; Electrical hazard; Authorized personnel only" or approved equivalent.
- 8. Use warning signs to identify electrical hazards for entrances to all buildings, vaults, rooms, or enclosures containing exposed live parts or exposed conductors operating at over 600 V nominal with the word message "DANGER; HIGH VOLTAGE; KEEP OUT".

9. Use warning labels to identify electrical hazards for equipment, compartments, and enclosures containing exposed live parts or exposed conductors operating at over 600 V nominal with the word message "DANGER; HIGH VOLTAGE; KEEP OUT".
 10. Use warning labels, identification nameplates, or identification labels to identify electrical hazards for equipment where multiple power sources are present with the word message "DANGER; Hazardous voltage; Multiple power sources may be present; Disconnect all electric power including remote disconnects before servicing" or approved equivalent.
- B. Identification for Conductors and Cables:
1. Color Coding for Power Conductors 600 V and Less: Comply with Section 26 05 19 Low-Voltage Electrical Power Conductors and Cables.
 2. Use identification nameplate or identification label to identify color code for ungrounded and grounded power conductors inside door or enclosure at each piece of feeder or branch-circuit distribution equipment when premises has feeders or branch circuits served by more than one nominal voltage system.
 3. Use wire and cable markers to identify circuit number or other designation indicated for power, control, and instrumentation conductors and cables at the following locations:
 - a. At each source and load connection.
 - b. Within boxes when more than one circuit is present.
 - c. Within equipment enclosures when conductors and cables enter or leave the enclosure.
 4. Use wire and cable markers to identify connected grounding electrode system components for grounding electrode conductors.
 5. Use underground warning tape to identify direct buried cables.
- C. Identification for Raceways:
1. Use color-coded bands to identify specified systems for accessible conduits at maximum intervals of 10 feet.
 - a. Color-Coded Bands: Use field-painting to mark bands 3 inches wide.
 2. Color Code:
 - a. Emergency Power / UPS System: Orange .
 - b. Fire Alarm System: Red.
 - c. Ground: Green.
 - d. HVAC: Brown.
 - e. Loading Bridge System: Purple.
 - f. Paging / Public Address / Intercom Systems: Black.

- g. Security / ACS System: Pink.
 - h. Telephone / Data System: White.
 - i. Visual Display Systems (RIDS/BIDS, etc.): Gray.
 - j. 12 kV System: Yellow / Black.
 - k. 208/120V System: Blue.
 - l. 480/277V System: Yellow.
 - m. Yellow with White stripes: Lighting control
 - n. Orange with Blue stripes: Emergency 208/120V
 - o. Orange with Yellow stripes: Emergency 480/277V
 - p. Raceways over 600 volts shall have black letters in an orange field.
- 3. Use identification labels to identify circuits enclosed for accessible conduits 10 feet on center.
 - 4. Use underground warning tape to identify underground raceways.
 - 5. All underground conduits that terminate in vaults or manholes shall have identification tags installed above every conduit.
- D. Identification for Boxes:
- 1. Use color coded boxes to identify specified systems.
 - a. Color-Coded Boxes: Field-painted per the same color code used for raceways.
 - b. For exposed boxes flush mounted in walls, ceilings, or floors, shall be painted on box interior.
 - 2. Use identification labels to identify circuits enclosed.
 - 3. All boxes shall be labeled inside the box and on the box exterior.

2.2 IDENTIFICATION NAMEPLATES AND LABELS

- A. Identification Nameplates:
- 1. Materials:
 - a. Outdoor Locations: Use plastic, stainless steel, or aluminum nameplates suitable for exterior use.
 - 2. Plastic Nameplates: Two-layer or three-layer laminated acrylic or electrically non-conductive phenolic with beveled edges; minimum thickness of 1/16 inch; engraved text.
 - a. Exception: Provide minimum thickness of 1/8 inch when any dimension is greater than 4 inches.
 - 3. Stainless Steel Nameplates: Minimum thickness of 1/32 inch; engraved or laser-etched text.
 - 4. Aluminum Nameplates: Anodized; minimum thickness of 1/32 inch; engraved or laser-etched text.
 - 5. Mounting Holes for Mechanical Fasteners: Two, centered on sides

for sizes up to 1 inch high; Four, located at corners for larger sizes.

B. Identification Labels:

1. Materials: Use self-adhesive laminated plastic labels; UV, chemical, water, heat, and abrasion resistant.
 - a. Use only for indoor locations.
2. Text: Use factory pre-printed or machine-printed text. Do not use handwritten text unless otherwise indicated.

C. Format for Equipment Identification:

1. Minimum Size: 1 inch by 2.5 inches.
2. Legend:
 - a. Equipment designation or other approved description.
 - b. Other information as indicated.
3. Text: All capitalized unless otherwise indicated.
4. Minimum Text Height:
 - a. System Designation: 1/2 inch.
 - b. Equipment Designation: 1/4 inch.
 - c. Other Information: 1/8 inch.
 - d. Exception: Provide minimum text height of 1 inch for equipment located more than 10 feet above floor or working platform.
5. Color:
 - a. Normal Power System: White text on black background.

D. Format for General Information and Operating Instructions:

1. Minimum Size: 1 inch by 2.5 inches.
2. Legend: Include information or instructions indicated or as required for proper and safe operation and maintenance.
3. Text: All capitalized unless otherwise indicated.
4. Minimum Text Height: 1/4 inch.
5. Color: Black text on white background unless otherwise indicated.
 - a. Exceptions:
 - (1) Provide white text on red background for general information or operational instructions for emergency systems.
 - (2) Provide white text on red background for general information or operational instructions for fire alarm systems.

E. Format for Caution and Warning Messages:

1. Minimum Size: 2 inches by 4 inches.
 2. Legend: Include information or instructions indicated or as required for proper and safe operation and maintenance.
 3. Text: All capitalized unless otherwise indicated.
 4. Minimum Text Height: 1/2 inch.
 5. Color: Black text on yellow background unless otherwise indicated.
- F. Format for Receptacle Identification:
1. Minimum Size: 3/8 inch by 1.5 inches.
 2. Legend: Power source and circuit number or other designation indicated.
 - a. Include voltage and phase for other than 120 V, single phase circuits.
 3. Text: All capitalized unless otherwise indicated.
 4. Minimum Text Height: 3/16 inch.
 5. Color: Black text on clear background.
- G. Format for Control Device Identification:
1. Minimum Size: 3/8 inch by 1.5 inches.
 2. Legend: Load controlled or other designation indicated.
 3. Text: All capitalized unless otherwise indicated.
 4. Minimum Text Height: 3/16 inch.
 5. Color: Black text on clear background.

2.3 WIRE AND CABLE MARKERS

- A. Markers for Conductors and Cables: Use wrap-around self-adhesive vinyl cloth, wrap-around self-adhesive vinyl self-laminating, heat-shrink sleeve, plastic sleeve, plastic clip-on, or vinyl split sleeve type markers suitable for the conductor or cable to be identified.
- B. Markers for Conductor and Cable Bundles: Use plastic marker tags secured by nylon cable ties.
- C. Legend: Power source and circuit number or other designation indicated.
- D. Text: Use factory pre-printed or machine-printed text, all capitalized unless otherwise indicated.
1. Do not use handwritten text.
- E. Minimum Text Height: 1/8 inch.
- F. Color: Black text on white background unless otherwise indicated.

2.4 WARNING SIGNS AND LABELS

- A. Comply with ANSI Z535.2 or ANSI Z535.4 as applicable.
- B. Warning Signs:
 - 1. Materials:
 - a. Outdoor Locations: Use factory pre-printed rigid aluminum signs.
 - 2. Rigid Signs: Provide four mounting holes at corners for mechanical fasteners.
 - 3. Minimum Size: 7 by 10 inches unless otherwise indicated.
- C. Warning Labels:
 - 1. Materials: Use factory pre-printed or machine-printed self-adhesive polyester or self-adhesive vinyl labels; UV, chemical, water, heat, and abrasion resistant; produced using materials recognized to UL 969.
 - a. Do not use labels designed to be completed using handwritten text.
 - 2. Machine-Printed Labels: Use thermal transfer process printing machines and accessories recommended by label manufacturer.
 - 3. Minimum Size: 2 by 4 inches unless otherwise indicated.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean surfaces to receive adhesive products according to manufacturer's instructions.

3.2 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install identification products to be plainly visible for examination, adjustment, servicing, and maintenance. Unless otherwise indicated, locate products as follows:
 - 1. Surface-Mounted Equipment: Enclosure front.
 - 2. Flush-Mounted Equipment: Enclosure front.
 - 3. Free-Standing Equipment: Enclosure front; also enclosure rear for equipment with rear access.
 - 4. Elevated Equipment: Legible from the floor or working platform.
 - 5. Branch Devices: Adjacent to device.
 - 6. Interior Components: Legible from the point of access.
 - 7. Conduits: Legible from the floor.

8. Boxes: Inside and Outside face of cover.
 9. Conductors and Cables: Legible from the point of access.
 10. Devices: Outside face of cover.
- C. Install identification products centered, level, and parallel with lines of item being identified.
 - D. Secure nameplates to exterior surfaces of enclosures using stainless steel screws and to interior surfaces using self-adhesive backing or epoxy cement.
 1. Do not use adhesives on exterior surfaces except where substrate cannot be penetrated.
 - E. Install self-adhesive labels and markers to achieve maximum adhesion, with no bubbles or wrinkles and edges properly sealed.
 - F. Install underground warning tape above buried lines with one tape per trench at 3 inches below finished grade.
 - G. Secure rigid signs using stainless steel screws.
 - H. Mark all handwritten text, where permitted, to be neat and legible.

3.3 FIELD QUALITY CONTROL

- A. Replace self-adhesive labels and markers that exhibit bubbles, wrinkles, curling or other signs of improper adhesion.

PART 4 - METHOD OF MEASUREMENT AND BASIS OF PAYMENT

- 4.1 Full compensation for Section 260553 identification for Electrical Systems shall be considered as included in the contract lump sum price paid for Bid Schedule A, and no additional compensation will be allowed therefor.

END OF 26 05 53

SECTION 26 28 16.16

ENCLOSED SWITCHES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Enclosed safety switches.

1.2 RELATED REQUIREMENTS

- A. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- B. Section 26 05 29 - Hangers and Supports for Electrical Systems.
- C. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.

1.3 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.
- B. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum) 2018.
- C. NEMA KS 1 - Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum) 2013.
- D. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems 2017.
- E. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- F. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations Current Edition, Including All Revisions.
- G. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations Current Edition, Including All Revisions.
- H. UL 98 - Enclosed and Dead-Front Switches Current Edition, Including All Revisions.
- I. UL 869A - Reference Standard for Service Equipment Current Edition, Including All Revisions.

1.4 SUBMITTALS

- A. Product Data: Provide manufacturer's standard catalog pages and data sheets for enclosed switches and other installed components and accessories.
- B. Project Record Documents: Record actual locations of enclosed switches.

1.5 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- B. Handle carefully in accordance with manufacturer's written instructions to avoid damage to enclosed switch internal components, enclosure, and finish.

1.7 FIELD CONDITIONS

- A. Maintain ambient temperature between -22 degrees F and 104 degrees F during and after installation of enclosed switches.

PART 2 - PRODUCTS

3.4 MANUFACTURERS

- A. Source Limitations: Furnish enclosed switches and associated components produced by the same manufacturer as the other electrical distribution equipment used for this project and obtained from a single supplier.

2.2 ENCLOSED SAFETY SWITCHES

- A. Description: Quick-make, quick-break enclosed safety switches listed and labeled as complying with UL 98; heavy duty; ratings, configurations, and features as indicated on the Drawings.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:
 - 1. Altitude: Less than 6,600 feet.
 - 2. Ambient Temperature: Between -22 degrees F and 104 degrees F.
- D. Horsepower Rating: Suitable for connected load.
- E. Voltage Rating: Suitable for circuit voltage.
- F. Short Circuit Current Rating:
 - 1. Provide enclosed safety switches, when protected by the fuses or supply side overcurrent protective devices to be installed, with listed short circuit current rating not less than the available fault current at

the installed location as determined by short circuit study performed in accordance with Section 26 05 73, Electrical Power System Study.

2. Minimum Ratings:
 - a. Switches Protected by Class H Fuses: 10,000 rms symmetrical amperes.
 - b. Heavy Duty Single Throw Switches Protected by Class R, Class J, Class L, or Class T Fuses: 200,000 rms symmetrical amperes.
 - c. Double Throw Switches Protected by Class R, Class J, or Class T Fuses: 100,000 rms symmetrical amperes.
- G. Enclosed Safety Switches Used for Service Entrance: Listed and labeled as suitable for use as service equipment according to UL 869A.
- H. Provide with switch blade contact position that is visible when the cover is open.
- I. Fuse Clips for Fusible Switches: As required to accept fuses indicated.
 1. Where NEMA Class R fuses are installed, provide rejection feature to prevent installation of fuses other than Class R.
- J. Conductor Terminations: Suitable for use with the conductors to be installed.
- K. Provide insulated, groundable fully rated solid neutral assembly where a neutral connection is required, with a suitable lug for terminating each neutral conductor.
- L. Provide solidly bonded equipment ground bus in each enclosed safety switch, with a suitable lug for terminating each equipment grounding conductor.
- M. Enclosures: Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E.
 1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
 - a. Outdoor Locations: Type 4X, Stainless Steel.
 2. Finish for Painted Steel Enclosures: Manufacturer's standard, factory applied grey unless otherwise indicated.
- N. Provide safety interlock to prevent opening the cover with the switch in the ON position with capability of overriding interlock for testing purposes.
- O. Heavy Duty Switches:
 1. Comply with NEMA KS 1.
 2. Conductor Terminations:
 - a. Provide mechanical lugs unless otherwise indicated.

- b. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
 - 3. Provide externally operable handle with means for locking in the OFF position, capable of accepting three padlocks.
 - a. Provide means for locking handle in the ON position where indicated.
- P. Provide the following features and accessories where indicated or where required to complete installation:
 - 1. Hubs: As required for environment type; sized to accept conduits to be installed.
 - 2. Integral fuse pullers.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that the ratings of the enclosed switches are consistent with the indicated requirements.
- C. Verify that mounting surfaces are ready to receive enclosed safety switches.
- D. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Perform work in accordance with NECA 1 (general workmanship).
- C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- D. Provide required support and attachment in accordance with Section 26 05 29, Hangers and Supports for Electrical Systems.
- E. Install enclosed switches plumb.
- F. Except where indicated to be mounted adjacent to the equipment they supply, mount enclosed switches such that the highest position of the operating handle does not exceed 79 inches above the floor or working platform.
- G. Provide grounding and bonding in accordance with Section 26 05 26, Grounding and Bonding for Electrical Systems.
- H. Where accessories are not self-powered, provide control power source as indicated or as required to complete installation.
- I. Identify enclosed switches in accordance with Section 26 05 53, Identification for Electrical Systems.

3.3 FIELD QUALITY CONTROL

- A. Inspect and test in accordance with NETA ATS, except Section 4.
- B. Perform inspections and tests listed in NETA ATS, Section 7.5.1.1.
- C. Correct deficiencies and replace damaged or defective enclosed safety switches or associated components.

3.4 ADJUSTING

- A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

3.5 CLEANING

- A. Clean dirt and debris from switch enclosures and components according to manufacturer's instructions.
- B. Repair scratched or marred exterior surfaces to match original factory finish.

PART 4 - METHOD OF MEASUREMENT AND BASIS OF PAYMENT

- 4.1** Full compensation for Section 262816.16 Enclosed Switches shall be considered as included in the contract lump sum price paid for Bid Schedule A, and no additional compensation will be allowed therefor.

END OF 26 28 16.16