

SECTION 03 30 10 – CAST-IN-PLACE CONCRETE - FOUNDATIONS

PART 1 – GENERAL

1.00 RELATED DOCUMENTS

Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1-Specification sections, apply to work of this section.

~~A. Related Sustainable Design Sections:~~

~~1. 018113 Sustainable Design Requirements~~

~~2. 017419 Construction Waste Management~~

~~3. 018119 Construction Indoor Air Quality Management~~

~~4. 018121 Erosion and Sedimentation Control~~

1.01 DESCRIPTION

A. Perform the work of this Section in accordance with the requirements of the Contract Documents, City of New Rochelle Building Department, and 2020 New York State Building Code.

B. Work Included: Work consists of furnishing all labor, material, and equipment necessary for completion of all concrete work including, but not necessarily limited to the following:

1. Formwork, complete with required shoring, reshoring, bracing and anchorage.
2. Reinforcing, complete with required supports, spacers, and related accessories.
3. Vapor barrier under interior slabs on grade.
4. Accessories including water stops and bentonite rope.
5. Cast-in-place concrete including footings, grade beams, tie beams, walls, buttresses, beams, structural floor, and slabs-on-grade, toppings, caisson caps, pile caps.
6. Finish and cure for floor slabs.

7. Miscellaneous concrete work such as equipment bases and pads.
8. Masonry Reinforcing Bars: Dowels installed under Section **04 22 00 Concrete Unit Masonry**.
9. Reinforcing bars drilled and epoxied into existing work.

C. Work Installed But Furnished by Others:

1. Anchor Bolts, Weld Plates, Bearing Plates, Embed Plates, and Angles Cast Into Concrete: Furnished under **05 50 00 Metal Fabrications**.
2. Railing Sleeves: Furnished under Section **05 52 13 Pipe and Tube Railings**.
3. Dovetail Slots for Masonry: Furnished under Section **04 22 00 Concrete Unit Masonry**.

1.02 QUALITY CONTROL

- A. Requirements of Regulatory Agencies: The Work under this section shall be subject to all applicable provisions of the **2020 New York State Building Code and the City of New Rochelle Building Department**.
- B. Reference Standards: Comply with following standards except where more stringent requirements are shown or specified:
 1. American Concrete Institute (ACI):
 - a. ACI 214, "Recommended Practice for Evaluation of Strength Test Results of Concrete."
 - b. ACI 301, "Specifications for Structural Concrete for Buildings,"
 - c. ACI 302, "Guide for Concrete Floor and Slab Construction."
 - d. ACI 305R, "Hot Weather Concreting."
 - e. ACI 306R, "Cold Weather Concreting."
 - f. ACI 318, "Building Code Requirements for Reinforced Concrete."
 - g. ACI 347, "Recommended Practice for Concrete Formwork."
 - h. ACI SP-66, "ACI Detailing Manual."
 - i. ACI SP-15, "ACI Field Reference Manual."

2. American Society for Testing and Materials (ASTM):
- a. ASTM C31, "Method of Making and Curing Concrete Test Specimen in the Field."
 - b. ASTM C33, "Specifications for Concrete Aggregates."
 - c. ASTM C39, "Test Method of Compressive Strength of Cylindrical Concrete Specimen."
 - d. ASTM C94, "Specifications for Ready-Mixed Concrete."
 - e. ASTM C109, "Test Method for Compressive Strength for Hydraulic Cement Mortars Using (2-in or 55-mm Cube Specimens)."
 - f. ASTM C138, "Test Method for Unit Weight, Yield, and Air Content (Gravimetric) of Concrete."
 - g. ASTM C143, "Test Method for Slump of Portland Cement Concrete."
 - h. ASTM C 150, "Specification for Portland Cement."
 - i. ASTM C172, "Method of Sampling Freshly Mixed Concrete."
 - j. ASTM C173, "Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method."
 - k. ASTM C231, "Test Method of Air Content of Freshly Mixed Concrete by the Pressure Method."
 - l. ASTM C260, "Specifications for Air-Entraining Admixtures for Concrete."
 - m. ASTM C311, "Methods of Sampling and Testing Fly Ash or Natural Pozzolans for Use as an Mineral Admixture in Portland Cement Concrete."
 - n. ASTM C457, "Practice for Microscopical Determination of Air-Void Content and Parameter of the Air-Void System in Hardened Concrete."
 - o. ASTM C494, "Specifications for Chemical Admixtures for Concrete."
 - p. ASTM C567, "Test Method for Unit Weight of Structural Lightweight Concrete."

- q. ASTM C618, "Specification for Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete."
 - r. ASTM C666, "Test Method for Resistance of Concrete to Rapid Freezing and Thawing."
 - s. ASTM C672, "Test for Method for Scaling Resistance of Concrete Surfaces Exposed to Deicing Chemicals."
 - t. ASTM C685, "Standard Specification for Concrete made by Volumetric Batching and Continuous Mixing."
 - u. ASTM C1077, "Standard Practice for Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluations."
3. Other:
- a. Concrete Reinforcing Steel Institute CRSI MSP-2, "Manual of Standard Practice."
 - b. AASHTO T318: "Standard Method of Test for Water Content of Freshly Concrete Using the Microwave Oven".
4. Contractor shall have following ACI publications at Project construction site:
- a. ACI SP-15, "Specifications for Structural Concrete for Buildings C1301-84 (Revised 1989) with selected ACI and ASTM References.
 - b. ACI 302.1R, "Guide for Concrete Floor and Slab Construction.
 - c. ACI 305R, "Hot Weather Concreting."
 - d. ACI 306R, "Cold Weather Concreting."
 - e. ACI 306.1, "Standard Specification for Cold Weather Concreting."
- C. Design Criteria:
- 1. Concrete: See General Notes on Structural Drawings and ACI 301, Chapter 3.
 - 2. Formwork Design: The Contractor shall assume all responsibility for the safety of the formwork and shall provide all necessary design, construction, materials, and maintenance to produce the required concrete work safely. Design all formwork to have sufficient camber to maintain the tolerances

specified, Strength shall be sufficient to compensate for the weight of the fresh concrete and construction live load of 50 psf minimum.

3. Shoring and Reshoring Design: The Contractor shall assume all responsibility for the safety of shoring and reshoring and shall provide all necessary design, construction, materials, and maintenance to produce the required concrete safely. Design all shoring to take the full load of the concrete, place directly above any reshoring occurring below. Removal strength shall be determined in accordance with ACI 301 2.3.4. Shoring and reshore calculations shall be available at the request of the Structural Engineer.
- D. The Contractor is responsible for quality control, including workmanship and materials furnished by his subcontractors and suppliers.
1. Inspection or testing by the **City** does not relieve the Contractor of his responsibility to perform the Work in accordance with the Contract Documents.
 2. Workmanship: The Contractor is responsible for and shall bear the cost of correcting concrete work which does not conform to the specified requirements including, but not limited to, strength, tolerances, finishes and flatness/levelness. Correct deficient concrete by means acceptable to the Architect and Structural Engineer. The cost of extra work incurred by the Architect and Structural Engineer to approve corrective work shall be borne by the Contractor.
- E. Record of Work: A record shall be kept by the **Construction Manager** listing the time and date of placement of all concrete for the structure. Such record shall be kept until the completion of the project and shall be available to the Architect and Structural Engineer for examination at anytime. All concrete batch trip tickets will be collected and retained by the Contractor. Concrete batch trip tickets shall contain information specified in ASTM C94, Paragraph entitled, "Batch Ticket Information," including items 15.2 through 15.2.8 Batch trip ticket shall also show the total amount of water in the mix as batched (including water present in the aggregate before batching) and the amount of water required by the design mix proportions.

1.03 QUALITY ASSURANCE

- A. Contractor's Quality Control System:
1. General: The Contractor shall establish a quality control system and shall perform sufficient inspection and tests of all items of work, including that of his subcontractors, to ensure conformance to the Contract Documents for materials, workmanship, construction, finish, functional performance and identification. Contractor's quality control system is the means by which he

assures himself that his construction complies with the requirements of the Contract Documents. Controls shall be adequate to cover all construction operations.

2. Records: Contractor shall maintain correct records on an appropriate form for all inspections and tests performed, instructions received from the Architect, Structural Engineer or Testing Agency, and actions taken as a result of those instructions. These records shall include evidence that the required inspections or tests have been performed (including type and number of inspections or tests, nature of defects, causes for rejection, etc.) proposed or directed remedial action, and corrective action taken. Contractor shall document inspections and tests as required by this section.
- B. The **City** will employ and Independent Testing Laboratory acceptable to the Architect and Structural Engineer to provide testing services specified in paragraph 1.04 Testing Inspection.
 - C. The Architect, Structural Engineer, and Independent Testing Laboratory shall be offered uninterrupted access to the ready-mix batching plant at all times that the work is in progress.
 - D. Provide the Testing Agency with the following:
 1. Incidental labor required to facilitate testing.
 2. Minimum one day's advance notice when concrete is to be placed.
 3. Storage facilities for concrete test cylinders meeting ACI requirements.
 4. Materials, samples, and access to materials as required for testing.
 5. Reimbursement of costs for testing and inspection resulting as a consequence of the following:
 - a. Work not in compliance with the Contract Documents,
 - b. Testing requested by Contractor or Subcontractor such as additional cylinders for early breaks, etc.
 - c. Testing to verify the adequacy of work done, without prior notice, without proper supervision, or contrary to standard construction practice.
 - E. All concrete flat work finishers on project shall hold current ACI concrete flat work finisher certification.

1.04 TESTING AND INSPECTION

- A. Concrete inspection and testing will be made in accordance with building code requirements, and Contract Documents, and will include the following:
 - 1. Testing concrete for strength, slump, air content, temperature, and unit weight.
 - 2. Marking and testing concrete cylinders, including furnishing cylinder containers for specimens.
 - 3. Transporting and storing of all specimens involved in testing and inspection. Test cylinders are to be transported to laboratory no later than 24 hours after casting, no earlier than 16 hours after casting.
 - 4. Inspection of mixing and placing of concrete at the site, including recording of: amount and location of concrete placement, method of placing concrete, and any other pertinent information. Verification of compliance with requirements of this specification for concrete placement and curing (including Section 1.07.).
- B. Test Specimens: The Testing laboratory will take specimens of each class of concrete from different locations on the job as follows: At least one set of four 6x12 cylinders (five cylinders if 4x8) for each 150 cubic yards or fraction thereof, or each 5000 square feet of floor or wall area (whichever is less) of each class of concrete with compressive strength $f'c$ less than 6,000psi, but not less than one set for any one day's operation. At least one set of five 6x12 cylinders (six cylinders if 4x8) for each 150 cubic yards or fraction thereof, or each 5000 square feet of floor or wall area (whichever is less) of each class of concrete with compressive strength $f'c$ of 6,000psi or higher, but not less than one set for any one day's operation
 - 1. For concrete placed by pumping, test specimens and concrete used for determination of slump, air content, and weight are to be taken at the point of placement of concrete.
 - 2. Samples will be obtained in accordance with ASTM C172.
 - 3. Marking, curing and subsequent handling of test cylinders, except as modified herein, shall be in accordance with ASTM C31. Testing shall be in accordance with ASTM C39.
 - 4. Cure test specimens for ASTM C31 as follows:
 - a. To verify 28-day compressive strength unless otherwise noted:

- (1) The cylinders shall be placed in laboratory storage under moist curing conditions at approximately 70°F within 24 hours after molding, and maintained therein until tested.
 - b. To verify compressive strength for form removal or for additional test cylinders required due to cold weather concreting conditions.
 - (1) Store test specimens on structure as near to point of sampling as possible and protect from elements in same manner as that given to portion of structure as specimen represents.
 - (2) Transport to test laboratory no more than 4 hours before testing. Remove molds from specimen immediately before testing.
5. One cylinder shall be tested at 7 days for information.
6. Two 6x12 cylinders (Three 4x8 cylinders) shall be tested at 28 days for acceptance. The acceptance test results shall be the average strength of these two (three) cylinders.
7. For 56 day tests:
 - a. For concrete $f'c < 6,000$ psi, one cylinder shall be kept for eventual testing at 56 days to verify any marginal results of 28-day tests. If not required to be tested, cylinder will be discarded after 28 days.
 - b. For concrete with $f'c = 6,000$ psi or greater, two cylinders shall be tested at 56 days for acceptance. The acceptance test results shall be the average strength of these two cylinders.
- C. Test Reports: Reports of cylinder tests shall be submitted as specified herein within five days of laboratory testing. Test reports shall, as a minimum, include:
 1. Project data including project name and address, concrete supplies, supplier's delivery ticket number and mix identification number, Testing Agency's test or cylinder identification number, and location of pour.
 2. Results of field testing at time of sampling including date and time of sampling, , ambient air temperature and concrete temperature, concrete slump and air content, and concrete wet unit weight.
 3. Results or laboratory testing including date test specimens were transported to laboratory, date and age of concrete at time of testing, compressive strength of each cylinder tested, average compressive strength of tested cylinders, and specified design strength of concrete represented by the test.

- D. Additional Testing: Contractor shall bear the cost of testing and inspection resulting as a consequence of the following:
 - 1. Work not in compliance with the Contract Documents.
 - 2. Testing requested by the Contractor or Subcontractor such as additional cylinders for early breaks, etc.
 - 3. Testing to verify the adequacy of work done without prior notice, without proper supervision, or contrary to standard construction practice.
- E. Reinforcing Steel Inspection: Concrete reinforcing shall be inspected prior to closing of concrete form work or placing of concrete by the Special Inspector. Refer to Section 3.03 for placing requirements. Inspect all reinforcing for conformance with contract requirements. Submit written reports of all Special Inspections in accordance with Test reports herein. Such reports shall include a description of each area inspected and deficiencies noted. Deficiencies observed shall immediately be brought to the attention of the contractor's field superintendent. Corrections made by contractor to resolve such deficiencies must be addressed and listed in the report.
- F. Weldable Reinforcing Steel: Review materials report of 1.05I if submitted. Verify reinforcing to be welded meets ASTM A706 prior to welding. Provide 100% U.T. inspection of all full penetrations welds at reinforcing bars
- G. Mix Designs: Review of concrete mix designs for compliance with approved project TR3 forms.

1.05 SUBMITTALS

- A. All submittals to be in accordance with Section 013300.
 - 1. For all materials in this section, provide documentation from manufacturer indicating percentages of post-consumer and pre-consumer recycled content. Submit with Sustainable Materials Reporting Form (SMRF) indicating the costs for material, delivery, and tax, excluding labor.
 - 2. For all materials in this section, provide documentation from manufacturer indicating the location of manufacture, extraction and harvest of all materials provided under this section. Submit with Sustainable Materials Reporting Form (SMRF) indicating the costs for material, delivery, and tax, excluding labor.

3. For products described in Specification 018113 Section 1.O, provide Material Safety Data Sheet (MSDS) or letter from manufacturer certifying the VOC content for each adhesive, sealant, paint and coating, flooring, and composite wood product does not exceed the maximum VOC threshold based on application.
4. Where new wood products are used and will be permanently installed inside the building, provide vendor invoices for each new wood product that has been harvested in accordance with the FSC standards. Invoices shall include chain-of-custody, certificate numbers, and itemized costs for all certified products.

B. Mix Designs:

1. Submit substantiating Technical Report Design Mix data for each concrete mix design contemplated for use to the Structural Engineer not less than three weeks prior to first concrete placement. Data for each mix shall, as a minimum, include the following:
 - a. Mix identification designation (unique for each mix submitted).
 - b. Statement of intended use for mix.
 - c. Mix proportions, including all admixtures used.
 - d. Manufacturer's data and/or certifications verifying conformance of all mix materials, including admixtures, with specified requirements.
 - e. Wet and dry unit weight, ASTM C138.
 - f. Entrained air content, ASTM C173
 - g. Design slump, ASTM C143
 - h. Required average strength qualification data per ACI 301 4.2. Submit separate qualification data for each production facility, which will supply concrete to the project.
 - i. Average strength qualification data (trial mix data or field test data per ACI 301 4.2). When field test data is used to qualify average strength, submit separate qualification data for each production facility, which will supply concrete to the project.

- j. Field test data submitted for qualification of average strength under ACI 301 4.2 shall include copies of the Concrete Testing Agency's reports from which the data was compiled.
- 2. Separate design mixes are required for each strength and class of concrete, each change in type and/or quantity of mix materials including admixtures, each change in slump limits, and each change in entrained air content beyond the tolerances specified in the TR3 mix design data.
- C. Submit shop drawings for fabrication, bending and placement of concrete reinforcement. Comply with ACI Detailing Manual (SP 66), Provide scale elevations of all walls with reinforcing shown. Include special reinforcement required at openings through concrete structure. Include all accessories specified and required to support reinforcement. Show location of proposed construction joints on the shop drawings.
- D. Formwork Layout Drawings:

Contractor shall submit formwork layout drawings including design calculations signed and sealed by an engineer employed by the contractor and licensed in the State of New York to the Engineer for record.
- E. Product Data:
 - 1. Submit product data with application and installation instructions for proprietary materials and items including reinforcement and forming accessories, admixtures, patching compounds, epoxies, grouts, sealer, water stops, joint systems, and others as required.
 - 2. Submit curing compound product data and verification of its compatibility with other finish materials by the Architect.
- F. Substitutions: Any request for product substitution must be submitted for acceptance, with all necessary documentation.
- G. Weldable Reinforcing Steel: All reinforcing bars to be welded that do not meet ASTM A706 require submission of a report of material properties stating conformance with the welding procedures specified in AWS D 1.4.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Delivery of Materials: Deliver materials in manufacturer's unopened containers fully identified with manufacturer's name, trade name, type, class, grade, size and color.

- B. Storage of Materials: Store materials in unopened containers. Store off ground and under cover, protected from damage.
- C. Reinforcing: Unload and store reinforcing bars so they will be kept free of mud and damage.
- D. Concrete: No water is to be added after the addition of superplasticizers.
 - 1. Non-Silica Fume Concrete
 - a. Hauling Time: Start of discharge of all concrete transmitted in a truck mixer, agitator, or other transportation device not later than 1 hour after mixing water has been added, and complete placement within 90 minutes.
 - b. Extra Water: Deliver concrete to the job in exact quantities required by the design mix. Should extra water be required before depositing the concrete, the Contractor's Superintendent shall have sole authority to authorize the addition of water. Any additional water added to the mix after leaving the batch plant shall be indicated on the top ticket and signed by the person responsible. Where extra water is added to the concrete, it shall be mixed thoroughly for 30 revolutions of the drum at mixing speed. Water may be added at the site only once to each batch.

1.07 JOB CONDITIONS

- A. Cold Weather Concreting (ACI 306R)
 - 1. When concrete is placed after the first frost or under conditions of cold weather concreting (defined as period when mean daily temperature drops below 40°F for more than three successive days), take additional precautions as specified in this Section and in ACI 306R, when placing, curing, monitoring, and protecting fresh concrete.
 - 2. Warm mix water, sand, and aggregated so that no frozen lumps or ice, snow or aggregate will survive mixing but do not overheat ingredients to cause flash setting of concrete or loss of entrained air.
 - 3. Place and maintain internal concrete temperature at or above the minimums given in the following table:

Least Dimension of the Member	Minimum Internal Concrete Temperature as Placed and Maintained

Less than 12"	55° F
12 to 36"	50° F
36-72"	45° F
Greater than 72"	40° F

Do not exceed given minimum placement temperature by more than 20° F.

- a. Cure slabs on grade, foundations, and substructures other than grade beams not subject to early loading, at placement temperature for 2 days minimum.
 - b. Temporary heaters used to maintain temperature of air surrounding exposed, uncured concrete during curing operations shall be vented type, vented to outside of protection envelope.
 - c. Before placing concrete topping, structure upon which toppings is to be placed shall be preheated to placement temperature of topping.
 - d. Cure and protect concrete for supported slabs, beams, columns at temperature specified above until attainment of 75% design strength.
 - e. Determine strength of curing concrete by either of following methods:
 - (1) Calculate maturity factor based upon curing time and measure internal concrete temperature as described in ACI 306R, Chapter 7.
 - (2) Cast and field cure at least six test specimens from the last 100 cubic yards of concrete but no fewer than three specimens for each two hours of entire placing time or for each 100 cubic yards, whichever yields greatest number of specimens. Make specimens in accordance with ASTM C31. Cover specimens properly, immediately after finishing. Protect outside surfaces of cardboard molds, if used, from contact with sources of water for first 24 hours after molding. Field cure test specimen on structure as near to point of sampling as possible and protect from elements in same manner as that given to portion of structure specimen represents. Test cylinders in accordance with ASTM C31 and C39.
4. Cast expandable thermistors or thermocouples in concrete at a rate of at least one per 100 cubic yards of concrete placed for supported structure.

Monitor internal temperature of concrete at twelve-hour-maximum intervals throughout curing process.

5. During operation, maintain temperature of placed concrete as constant as possible, and protect from rapid atmospheric temperature changes.
 6. Maintain concrete in continually moist condition during curing process by leaving forms in place as long as possible and by use of steam or moisture retaining covers on unformed surfaces.
 7. Following curing operation, avoid rapid changes in concrete temperature. Do not allow internal temperature of concrete to change at a rate exceeding 50°F in any 24-hour period of 5°F in any one hour.
 8. Do not place concrete without approval of the Structural Engineer on days when temperature at 9:00 a.m. is below 30°F and wind velocity exceeds 10 MPH.
 9. The non-chloride accelerator specified in Section **2.04** or high-early strength type III cement may be used when accepted by the Structural Engineer.
- B. Freeze Resistant Concrete: ASTM C1622, "Standard Specification for Cold Weather Admixture Systems and Chapter 9 of ACI 212.3R-10". The contractor shall prepare a plan for placing, finishing and curing procedures that assure the specified hardened properties are achieved.
- C. Hot Weather Concreting (ACI 305R)

Hot weather is defined as a condition of high temperature; low humidity and high wind velocity which causes rate of evaporation in excess of 0.2 pounds per square ft. per hour as determined by ACI 305R, figure 2.1.5 When concrete is placed under conditions of hot weather concreting, Contractor shall provide extra protection of concrete against excessive placement temperatures and excessive drying throughout placing and curing operations and follow Items 1-5 below:

1. Forms, reinforcement, and air shall be cooled by water for spraying immediately before placing concrete. Placement temperature of concrete shall not exceed 90°F.
2. Protect concrete during finishing operations by one of the following:
 - a. Continuous fog spray between finishing operations,

- b. Immediately following screening, applying evaporation retarding agent in accordance with recommendations of manufacturer.
 3. Immediately following screening, apply specific evaporation retarding agent in accordance with recommendations of manufacturer. Plastic cracking conditions may require application of compound several times during concrete finishing sequence.
 4. During curing operation cover concrete with wet burlap or cotton mats. Keep mats constantly wet for 7 days minimum. Leave mats in place for 3 additional days after discontinuing wetting process.
 5. When the air temperature is forecast to exceed 92°F at any time during the duration of a concrete pour, the Contractor shall obtain acceptance from the Structural Engineer of the procedures to be used in protecting, depositing, finishing, and curing the concrete.
- D. Mass Concrete
 1. Concrete for the mat foundation shall not reach a temperature greater than 165°F at any location.
 2. Temperature gradient between the center of the mat foundation and its surface shall not exceed 50°F.
 3. Contractor shall take appropriate measures in accordance with ACI 207.1R-05 to ensure in-place concrete reaches the specified compressive strength.
- E. Protection: Protect newly finished slabs from rain damage. Cover masonry walls, glazing, and other finish materials with polyethylene or otherwise protect from damage due to pouring of concrete.

PART 2 – PRODUCTS

2.00 GENERAL

All materials shall be in accordance with ACI 301 unless amended or superseded by requirements of following articles of General Notes on the structural drawings.

2.01 SUSTAINABLE PERFORMANCE REQUIREMENTS

- A. Minimum Recycled Content, as defined in Section 018113, for the following materials:
 1. Concrete: 15-40% total recycled content by weight- as specified and approved by the structural engineer. Documented using an assembly material calculator.

2. Steel: A minimum of 80% recycled content for all products manufactured by arc furnace, and 40% for all other products.

~~B. Minimum Regional Content, as defined in Section 018113, for the following materials:~~

~~1. Concrete: 90% or more total regional content by weight. Documented using an assembly material calculator.~~

~~2. Steel: 50% or more total regional content by weight~~

~~C. VOC content limitations, as defined in Section 018113~~

2.02 FORM MATERIALS AND SYSTEMS

- A. Formwork and formwork systems shall be designed by a Professional Engineer employed by the Contractor. The Professional Engineer shall be registered in the state of New York. The Contractor shall submit written certification indicating conformance with this requirement.
- B. Forms of Exposed Finish Concrete: Unless otherwise indicated, construct formwork for exposed concrete surfaces with plywood, metal, metal-framed plywood faced or other acceptable panel-type materials, to provide continuous, straight, smooth, exposed surfaces. Furnish in largest practicable sizes to minimize number of joints and to conform to join system shown on drawings. Provide form material with sufficient thickness to withstand pressure of newly placed concrete without bow or deflection.
- C. Forms for Unexposed Finish Concrete: Form concrete surfaces, which will be unexposed in finished structure with plywood, lumber, metal, or other acceptable material. Provide lumber dressed on at least two edges and one side for tight fit.
- D. Cylindrical Columns and Supports: Form round section members with metal, fiberglass reinforced plastic, or paper or fiber tubes. Construct paper or fiber tubes of laminated plies using water-resistant adhesive with wax-impregnated exterior for weather and moisture protection. Provide units with sufficient wall thickness to resist loads imposed by wet concrete without deformation.
- E. Void Forms: Moisture resistant treated paper faces, biodegradable. Structurally sufficient to support weight of wet concrete until initial set. Sizes as required to provide void spaces as shown on the drawings.

- F. Slab Construction Joint Forms: Galvanized steel with continuous tongue and groove.
 - 1. Subject to compliance with requirements, provide one of the following:
"Keyed Kold" – Burke Co.
"Super Screed" – Vulcan Metal Products.
- G. Slab Control Joint Forms: Molded plastic material for insertion into slab surface during finishing. Configuration to provide joint depth of not less than $\frac{1}{4}$ th of the slab thickness.
 - 1. Subject to compliance with requirements, provide one of the following:
 - a. "Zipcap" – Greenstreak Plastic Products Co.
 - b. "Crack Inducer" – Progress Unlimited, Inc.
 - c. "Kold-Seal Zipper Strip" – Vinlyex Corp.
- H. Chamfer Strips: $\frac{3}{4}$ ", 45° job-cut wood.
- I. Rustication Strips: Job-cut wood, size and shape as indicated on the drawings.
- J. Form Coatings: Provide commercial formulation form-coating compounds that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces. Provide the following or equal: "Nox-Crete form Coating," manufactured by Nox-Crete Inc., Omaha, NE
Tele: 800-669-2738

2.03 REINFORCING MATERIALS

- A. General: Sizes, types, grade or yield strengths as indicated on the drawings. Use 60,000 psi yield strength if not otherwise indicated. Use reinforcing conforming to ASTM A706 where welding of reinforcing is required unless otherwise indicated. Provide uncoated finish unless otherwise indicated.
- B. Deformed Bars: ASTM A615 plus supplementary requirement (S1), Deformed Billet Steel Bars or ASTM A706, Low-Alloy Steel Deformed Bars unless otherwise indicated.
- C. Smooth Bars for Masonry Joint Reinforcement: Conform to requirements of ASTM A615 plus supplementary requirements (S1) or ASTM A706.
- D. Smooth Wire for Spiral Reinforcement: ASTM A82, Cold-Drawn Steel Wire for Concrete Reinforcement having a yield strength, measure at a strain of 0.35%, of 70,000 psi.

- E. Welded Wire Fabric: Mesh size and gage as indicted on the drawings. Conform to ASTM A185, plain in all flat sheets.
- F. Coatings:
 - 1. Epoxy Coated: ASTM A775. Film thickness of coating after curing to be 8-12 mils when measure in accordance with Method G12. See 3.03A.6 for field touch up.
- G. Tie Wire: Tie wire shall be No. 16 American Wire Gage or heavier black annealed.
- H. Supports for Reinforcement: Provide supports for reinforcement including bolsters, chair, spaces and other devices for spacing, supporting and fastening reinforcing bars and welded wire fabric in place within specified tolerances. Use wire bar-typed supports complying with CRSI, Class 1 or 2, unless otherwise acceptable.
 - 1. Use supports with sand plates or horizontal runners for slab-on-grade where base material will not support chair legs.
 - 2. All materials that come in direct contact with epoxy coated or galvanized bars, such as slab bolsters, high chairs, tie wires, etc., shall be plastic coated.
 - 3. Provide accessories and supports for welded wire fabric and reinforcement in slabs as required to maintain position as shown on the drawings.
- I. Reinforcing Splices: Mechanical Splices for reinforcing shall develop 125% of the specified yield strength F_y of the bar. Subject to compliance with the requirements use one of the following:
 - a. DB Grout sleeve system by Richmond Screw Anchor Co.
 - b. NMB splice sleeve type O-X by Sleeve Splice North America, Inc.
 - c. Or approval equal

2.04 CONCRETE MATERIALS

- A. Cementitious Materials:
 - 1. General: Provide materials of the same brand or source throughout the project unless otherwise specified.
 - 2. Portland Cement: ASTM C150 Type I or II. Type II only for Mat concrete.
 - 3. Fly Ash:

- a. ASTM C618, Class C or F, except maximum loss on ignition: 3.0%
Maximum percent retained on #325 sieve: 28% Maximum water
requirement, stated as percentage of control: 100%.
 - b. Testing: ASTM C311
 - c. Percentage of fly ash in mix design shall be weight, not by volume.
Water/cement ratio will be calculated as water/cementitious (total
cement and fly ash) ratio.
 - d. Fly Ash Substitution:
 - (1) Class C fly ash may be substituted for up to 25% of minimum
cement or cementitious at one for one (by weight) substitution
rate, providing required strength at all specified ages is attained.
 - (2) Class F fly ash may be substituted for up to 20% minimum cement
or cementitious at one for one (by weight) substitution rate
sufficient to provide required strength at all specified ages.
 - (3) Ground granulated blast-furnace slag: ASTM C-989
 - a. Subject to compliance with the requirements provide the
following:
 - i. NEW CEM – Blue Circle Cement, Inc.
 - ii. Approved equal.
 - b. May be substituted for up to 50% of minimum cement or
cementitious at one for one (by weight) substitution rate,
providing required strength at all specified ages is attained.
 - e. No fly ash shall be permitted in concrete used to encase electric
conduit.
- B. Aggregates:
- 1. General: Provide aggregates from the same source throughout the project
unless otherwise specified.
 - 2. Maximum nominal aggregate size to be $\frac{3}{4}$ " unless otherwise approved by
the structural engineer.
 - 3. Normal Weight Aggregate: ASTM C33 containing no deleterious substances,
which cause surface spalling. Pea gravel shall be graded for 90% passing the

$\frac{3}{8}$ " screen and 90% retained on the $\frac{1}{4}$ " screen. Use pea gravel only when acceptable to the Structural Engineer.

- C. Water: Potable.
- D. Admixtures:
 - 1. General: Unless specified, no admixtures may be used without specific approval of the Structural Engineer.
 - 2. Prohibited Products: Calcium chloride or admixtures containing more than 0.05% chloride ions or thiocyanates are not permitted.
 - 3. Air-Entraining Admixture: ASTM C260
 - a. Subject compliance with requirements, provide one of the following:
 - (1) "Air Mix" or "AEA 92" – Euclid Chemical Co.
 - (2) Daravair" – W.R Grace
 - (3) "MB-VR" or "MB-AE" – Master Builders
 - 4. Water Reducing Admixture: ASTM C494, Type A
 - a. Subject to compliance with requirements, provide one of the following:
 - (1) "Econ WR-91" – Euclid Chemical Co.
 - (2) "Pozzolith 200N" – BASF
 - (3) "Plastocrete 161" – Sika Chemical Co.
 - (4) "WRDA" – W.R Grace & Co.
 - 5. High Range Water Reducing Admixture (Superplasticizer): ASTM C494, Type F or G
 - a. Subject to compliance with requirements, provide one of the following:
 - (1) "Eucon 37" or "Plastol Series" – Euclid Chemical Co.
 - (2) "Glenium" or "Pozzolith 400N" – BASF
 - (3) "Sikament" – Sika Chemical Co.
 - (4) "Daracem" – W.R Grace & Co.

6. Non-Corrosive, Non-Chloride Accelerator: ASTM C494, Type C or E. The admixture manufacturer must have long-term, non-corrosive test data (of at least a year's duration) using an acceptable accelerated corrosion test method such as electrical potential measurements.
 - a. Subject to compliance with requirements, provide one of the following:
 - (1) "Accelguard 80, 90 or NCA" – Euclid Chemical Co.
 - (2) "Daraset Accelerator" – W.R Grace & Co.
 - (3) "Pozzolith - 40" - BASF
7. Retarding Admixture: ASTM C494, Type D
 - a. Subject to compliance with requirements, use one of the following:
 - (1) "Eucon Retarder 75" or "Eucon WO" – Euclid Chemical Co.
 - (2) "Daratard 17" – W.R Grace & Co.
 - (3) "Pozzolith 300-R" – BASF
8. Micro-silica admixture shall be:
 - a. Eucon MSA by The Euclid Chemical Company "FORCE" 10,00" by W.R Grace Co., Cambridge, MA.
 - b. Use of dry silica fume product is not acceptable unless approved in writing by Engineer.
9. Certification: Written certification of conformance to the above requirements will be required from all admixture manufacturers prior to mix design review by the Structural Engineer.

2.05 RELATED MATERIALS

- A. Moisture Barrier: Provide moisture/vapor barrier cover where indicated. Use only materials, which are resistant to decay when tested in accordance with ASTM E154, as follows: Polyethylene sheet, not less than 12 mils thickness.
- B. Water stops: Provide flat, dumbbell type or center bulb type water stops at construction joints and other joints as indicated. Size to suit joints, but no less than 6 inches.
 1. Rubber Water stops: Corps of Engineers CRD-C513

- a. Subject to compliance with requirements, provide products of one of the following manufacturers:
 - (1) Burke Company
 - (2) Edoco Technical Products
 - (3) Williams Products
2. Polyvinyl Chloride Water stops: Corps of Engineers CRD-C572
 - a. Subject to compliance with requirements, provide products of one of the following manufacturers:
 - (1) Burke Company
 - (2) Edoco Technical Products
 - (3) Progress Unlimited
- C. Curing Compounds: Unless otherwise indicated on architectural or structural plans referenced to curing compound refers to a dissipating resin compound.
 1. Curing and Sealing Compound: (VOC Compliant) Federal Specification TT-C-800A, 30% solids content minimum, and have test data from an independent laboratory indicating a maximum moisture loss of 0.030 sq.ft. per gallon. Manufacturer's certification required.
 - a. Subject to compliance with requirements, provide one of the following"
 - (1) "KurezVox" – Euclid Chemical Company
 - (2) "Super-Rez Seal" or "Super Pliocure" – Euclid Chemical Co.
 - (3) "Master Kure 30" – Master Buildings
 2. Dissipating Resin Compound: ASTM C309, Type I. The film must chemical break down in a two four week period allowable moisture loss shall not exceed 0.030g/sq.cm
 - a. Subject to compliance with requirements, provide one of the following:
 - (1) CureCrete 309- by CureCrete Distribution
 - (2) "W.B Resin Cure = 30%" – Conspec Marketing & Manufacturing Co., Inc.

- (3) "Kurez DR VOX" Euclid Chemical Co.
 - (4) "Masterseal" –BASF
- 3. Curing and Hardening Dust proofing Compound: Sodium silicate compound. Use for remedial curing and hardening subject to acceptance by Architect and Structural Engineer. Manufacture shall supply 20 year warranty.
 - a. Subject to compliance with requirements, provide one of the following:
 - (1) Ashford Formula – by CureCrete
 - (2) CT Densifier – by Cheprobe
- D. Absorptive Cover: Burlap cloth made from jute or kenaf, weighing approximately 9 oz. per sq. yd., complying with AASHTO M 182, Class 2.
- E. Moisture-Retaining Cover: One of the following, complying with ASTM C171:
 - 1. Waterproof paper
 - 2. Polyethylene film
 - 3. Polyethylene-coated burlap
- F. Clear Penetrating Sealer: Material suitable for application on horizontal surfaces containing not less than 20% siloxane or 40% silane in mineral spirits or alcohol-based carrier. Provide certification of 90% chloride screen effectiveness when tested in accordance with the procedure of NCHRP Report No. 244, "Southern Climate Exposure" at manufacturer's recommended rate of application.
 - 1. Subject to compliance with requirements, provide one of the following:
 - a. Deck A Pell H₂O – by Tnemec/Chemprode
 - b. "Chem-Treat BSM40" – Dynamit Nobel of America, Inc.
 - c. "Consolideck SX" – ProSoCo, Inc.
 - d. "ENViro Seal 40" – Harris Specialty Chemicals, Inc.
- G. Non-Slip Aggregate Finish: Provide fused aluminum oxide grits, or crushed emery, as abrasive aggregate for non-slip finish with emery aggregate containing not less than 40% aluminum oxide and not less than 25% ferric oxide. Use material that is factory-graded, packaged, rustproof and non-glazing, and is unaffected by freezing, moisture, and cleaning materials. Apply where indicated on architectural drawings.

- H. Colored Wear Resistant Finish: Packaged, dry, combination of materials, consisting of Portland Cement, graded quartz aggregate, coloring pigments, and dispersing agents. Use coloring pigments that are finely ground, non-fading mineral oxides, inner-ground with cement. Color, as selected by Architect, unless otherwise indicated.
 - 1. Subject to compliance requirements, provide one of the following:
 - a. "Surflex" – Euclid Chemical Co.
 - b. "Colorchron" – BASF
- I. Epoxy Products: Two component materials suitable for use on dry or damp surface, complying with ASTM C881, for use in all structural concrete repairs. Obtain prior approval of Structural Engineer as to methods and procedures.
 - 1. Injection Epoxy: Subject to compliance with requirements, provide one of the following:
 - a. "Dural 452 Series" – Euclid Chemical Company
 - b. "Sikadur 35, Hi Mod LV" – Sika Chemical Corp.
 - 2. Epoxy Mortar: Subject to compliance with requirements, provide one of the following:
 - a. "Concresice 1210"" – Adhesive Engineering Co.
 - b. "Dural 452 Series" – Euclid Chemical Co.
 - c. "Sikatoe 121and 122" – Sika Chemical Corp.
 - 3. Epoxy Adhesive: Subject to compliance with requirements, provide one of the following:
 - a. "Dural 452 Series" – Euclid Chemical Co.
 - b. "Sikadur 32 Hi-Mod" – Sika Chemical Corp.
 - 4. Watertight Joint Compound: Subject to compliance with requirements, provide one of the following:
 - a. "Euco Epoxy #452" – Euclid Chemical Co.
 - b. "Sikadur Hi-Mod" – Sika Chemical Corp.

- J. Epoxy Joint Filler: Three components, 100% solids epoxy compound, with a minimum shore D hardness of 50.
 - 1. Subject to compliance with requirements, provide one of the following:
 - a. "Euco QWIK joint UVR or Euco 700" – Euclid Chemical Co.
 - b. "Sikadur Lo-Mod" – Sika Chemical Corp.
- K. Polymer Repair Mortar: These patching mortars may be used when color match of the adjacent concrete is not required. Prior approval by the Engineer is required.
 - 1. Vertical and Overhead Repairs
 - a. EucoRepair V100, Verticoat or Verticoat Supreme by Euclid Chemical Company
 - b. Sikatop 123 by Sika Corp.
 - 2. Horizontal Repairs
 - a. Thin Top Supreme, Tammspatch II or Concrete Top Supreme by Euclid Chemical Company
 - b. Sikatop 121 or Sikatop 122 by Sika Corp.
- L. Bonding Compound: Polyvinyl acetate, re-wettable type. Interior use only.
 - 1. Subject to compliance with requirements, provide one of the following:
 - a. "Euco Weld" – Euclid Chemical Co.
 - b. "Weldcrete" – Larson Co.
 - c. "Sikabond" – Sika Chemical Corp.
- M. Bonding Admixture: Acrylic latex, non-rewettable type. Interior use only.
 - 1. Subject to compliance with requirements, provide one of the following:
 - a. "SBR Latex" or "Flex-Con" – Euclid Chemical Co.
 - b. "Daraweld C" – W.R. Grace Co.

c. "Acryl 60" – Standard Dry Wall

N. Underlayment Compound: Free flowing, self-leveling, pumpable cementitious base compound. 7 day minimum strength = 400 psi.

1. Subject to compliance with requirements, provide one of the following:

a. "SilFlo 300" – Silpro Corp.

b. "Flo Top" – Euclid Chemical Co.

c. "Pourcrete" – BASF

O. Non-Shrink Grout shall be non-metallic and non-shrink or expansive type. Compressive strength shall be equal to or greater than the concrete material to which it is contact unless otherwise noted on plan.

2.06 PROPORTIONING AND DESIGN OF MIXES

A. Strength: Proportions mixes to attain compressive strengths as indicated on the drawings in 28 days unless higher strengths are specified herein.

B. Durability: Conform to ACI 301 as modified herein.

1. Concrete Exposed to Weather or Freeze-Thaw Cycles such as paving, site work, loading docks, and exterior slabs: Meet requirements of ACI 303 3.4.1.

2. Concrete Exposed to Deicers or Other Aggressive Chemicals: Meet requirements of ACI 301 3.4.3 except that normal weight concrete shall have a water-cement ratio not exceeding 0.40 and lightweight concrete shall be proportioned for a minimum compressive strength of 5000 psi.

C. Slump Limits: Slump of concrete, measure at point of placement, shall fall within the following limits:

1. Concrete Containing HRWR (Superplasticized): 9" maximum unless otherwise directed by the Structural Engineer.

2. Pumped Lightweight Concrete: 5-1/2" maximum.

3. All Other Structural Concrete: 4" maximum or 9" if the specified high range water reducing admixture is used.

D. Selection of Proportions: Use method of ACI 301 4.2.3.. Proportioning based on method of ACI 301 4.2.3.6a is not permitted.

1. Field test records used for documentation of the average strength produced by a proposed mix in accordance with ACI 301 4.2.3.4a shall, in addition to the requirements there listed, comply with the following:
 - a. The test record shall represent production concrete from a single design mix, produced during the past year, and may be composed of 30 or more consecutive tests.
 - b. The test record shall represent concrete made with identical materials and proportions (including admixtures) to the proposed mix.
 - c. The test record shall represent concrete proportioned to produce the maximum slump allowed by these specifications, and for air-entrained concrete, within $\pm 0.5\%$ of the maximum air content allowable.
2. Mixes proportioned on the basis of trial mixtures shall meet the provisions of ACI 301 4.2.3.4b.

E. Air Entrainment:

1. See 2.05 H.4.
2. For nominal maximum aggregate size of $\frac{3}{4}$, total air content to be 4 $\frac{1}{2}\%$ - 7 $\frac{1}{2}\%$ at concrete exposed to freezing and thawing
3. Interior slabs of normal weight concrete not exposed to freezing and thawing to have 3% maximum air content.

F. Corrosion Inhibitor:

1. Provide (3) gallons / CY of concrete.
2. Provide compatible hydration stabilizer and/or retarder as required to prevent early setting of concrete prior to placement.

2.07 PRE-CONCRETE CONFERENCE

- A. At least 60 days prior to the start of the concrete construction schedule, the contractor shall conduct a meeting to review the proposed mix designs and to discuss the required methods and procedures to achieve the required concrete construction. The contractor shall send a pre-concrete conference agenda to all attendees 20 days prior to the scheduled date of the conference. The contractor shall require responsible representatives of every party who is concerned with the concrete work to attend the conference, including but not limited to the following:

- Ready Mix Concrete Manufacturer
 - Admixture Manufacturer
 - Concrete Subcontractor / Finishing Foreman
 - Concrete Pumping Equipment Manufacturer
 - Laboratory responsible for field quality control
 - Independent testing agency responsible for concrete design mixtures
- B. Minutes of the meeting shall be recorded, typed and printed by the contractor and distributed by him to all parties concerned within 5 days of the meeting. One copy of the minutes shall also be transmitted to the following for information purposes: **City's** Representative, Special Inspection Agency and Engineer of Record.
- C. The concrete contractor shall state that the proposed mix designs will enable him to properly place, pump, finish and achieve the required concrete quality specified required by the specifications.

PART 3 – EXECUTION

3.00 GENERAL

- A. Perform concrete work in accordance with ACI 301 except as specified herein and on the drawings.
- B. Use ready-mixed concrete conforming to ASTM C94

3.01 CONCRETE CAST ON EARTH

- A. Preparation:
1. Foundation Bearing Surfaces: Excavate to smooth, level surface in undisturbed, natural soil unless otherwise indicated or accepted by the Geotechnical Engineer.
 2. Slab Subgrade: Underslab surfaces shall be fine graded to smooth, level surface prior to installation of slab forms.
 3. Rock Subgrade: In addition to requirements of geotechnical specifications, provide mud slab as required under bearing elements (walls, footings, piers, columns) to allow for installation of waterproofing or rebar cages in conformance with requirements on Architectural and Structural requirements.

- B. Inspection: All foundation bearing surfaces shall be inspected and accepted by the Geotechnical Engineer / Special Inspector prior to the start of formwork.

3.02 FORMWORK

- A. General:

1. Design, construct, brace, and maintain formwork in accordance with ACI 301 and ACI 347 as modified herein.
2. Fabricate forms for easy removal. Provide crush plates or wrecking plates where stripping may damage concrete surfaces. Kerf wood inserts for forming keyways, reglets, recesses, and the like, to facilitate removal.
3. Provide temporary openings where interior area of formwork is inaccessible for cleanout, for inspection before concrete placement, or for placement of concrete. Securely brace temporary openings and seal to forms to prevent loss of concrete mortar.

- B. Preparation of Form Surfaces:

1. Clean reused forms of concrete matrix residue, repair and patch as required to return forms to acceptable surface condition.
2. Coat contact surfaces of forms with specified form coating compound before reinforcement is placed in conformance with manufacturer's instructions.
3. Thin form-coating compounds only in conformance with manufacturer's instructions. Do not allow excess form-coating material to accumulate in forms or to come into contact with concrete surfaces against which fresh concrete will be placed.

- C. Void Spaces: Contractor shall be solely responsible for providing void spaces of full size and extent shown on the drawings. Specified void forms may be used at the Contractor's option. Where used, such forms shall be placed in the largest pieces practical and shall be adequately secured in place with joints sealed to prevent leakage of concrete into the void space. Contractor shall provide evidence satisfactory to the Structural Engineer that proper void spaces have been provided.

- D. Chamfer Strips: Install 45° chamfer strips at exposed outside corners. Install chamfer strips at internal corners and edges of formed joints as detailed.

- E. Rustication Strips: Install as shown in the drawings. Securely nail within the forms using finish nails.

3.03 PLACING REINFORCEMENT

A. General:

1. Comply with Concrete Reinforcing Steel Institute's "Recommended Practice for Placing Reinforcing Bars," and as herein specified.
2. Clean reinforcement of loose rust and mill scale, earth, ice, and other materials, which reduce or destroy bond with concrete.
3. Accurately position, support, and secure reinforcement against displacement by construction or concrete placement operations with metal chairs, runners bolsters, spacers, hangers, or other means acceptable to the Structural Engineer. On vertical formwork, use approved bar chairs or spacers as required to maintain proper concrete cover and bar position.
4. Install reinforcement to tolerances given in ACI 117.
5. Install welded wire fabric in the longest lengths practical. Lap adjoining pieces at least one full mesh and wire together. Offset end laps in adjacent widths to prevent continuous laps.
6. Handling of Epoxy-Coated Bars: All systems for handling coated bars shall have padded contact areas. All bundling bands shall be padded. Touch up all damaged or missing epoxy coating on reinforcement prior to pouring concrete.

B. Welding Reinforcement: Welding-reinforcing bars not permitted except where specifically indicated. Protect exposed bars intended for bonding with future construction from corrosion by providing adequate covering.

C. Inspection of Reinforcement: Completed installation of concrete reinforcement must be accepted by the Special Inspector before depositing concrete.

D. Drilled-in dowels: Provide drilled-in dowels to existing work where called for on the drawings. Drill holes in existing concrete, insert steel dowels and pack solidly with non-shrink grout or epoxy as specified. Do not core holes. Do not penetrate existing reinforcing without prior written approval of Structural Engineer. Dowels may be re-spaced to avoid existing reinforcing. Tolerance on drilled-in dowels to be \pm spacing/2.

3.04 INSTALLATION OF EMBEDDED ITEMS

A. General

1. Coordinate work with requirements of other trades and notify Architect and Structural Engineer of all conflicts and nonconforming conditions.
 2. Coordinate the requirements for installation of embedded items specified and furnished in other sections of the specifications. Obtain templates and instructions for setting embedded items.
 3. Do not install sleeves in concrete slabs, beams, walls, or columns except where shown on the structural drawings or approved by the Structural Engineer.
- B. Embedded Pipes and Conduits: Conform to requirements of ACI 318 6.3.
- C. Anchor Bolts, Inserts, Form Blockouts, and other items built into the concrete shall be securely fastened to formwork or held in place with templates. Insertion into concrete after casting is not allowed.
- D. Dovetail Slots: Install in formwork whenever masonry abuts concrete such as brick ledges, or surfaces to receive masonry veneer, intersections of masonry walls with concrete walls or columns. At wall intersections, install one vertical slot for each 8" of masonry wall width. At brick ledges, or concrete backup, install vertical slots at 16' o.c.

3.05 JOINTS

- A. Construction Joints in Formed Elements:
1. General: Locate and install construction joints as indicated on the drawings or, if not shown on drawings, locate so as not to impair strength or appearance of the structure. Submit construction joint locations not shown on drawings to Architect and Structural Engineer for acceptance.
 2. Keyways: Provide keyways as detailed on the drawings. Where not detailed, provide 1 – ½" minimum depth continuous keyways in all construction joints in walls and slabs and between walls and footings.
 3. Place construction joints as required at third points of spans of beams and girders unless indicated otherwise. Continue reinforcement across construction joints. Submit construction joint locations not shown on the drawings for Structural Engineer's acceptance.
 4. Water stops: Provide water stops in construction joints Continuously at all construction joints below grade. Install water stops to form continuous diaphragm in each joint. Make provisions to support and protect exposed water stops during progress of work. Fabricate field joints in water stops in accordance with manufacturer's instructions.

B. Joints in Slabs on Ground:

1. Control (Contraction) Joints: Construct joint by saw cutting. Make saw cuts as soon as possible after placing concrete without dislodging aggregate and to a depth of $\frac{1}{4}$ of the slab thickness.
2. Isolation Joints: Do not separate slabs from vertical surfaces with specified expansion joint material unless otherwise shown on the drawings.

3.06 CONCRETE PLACEMENT

A. Preplacement Inspection: Formwork installation, reinforcing steel placement, and installation of all items to be embedded or cast-in to be verified by the Contractor prior to placement.

B. General: Comply with ACI 301, ACI 304, and as herein specified.

1. Do not place concrete in freestanding water, over ice, or on frozen subgrade.
2. Concrete shall not be placed within 20 feet of pile driving. Concrete shall have cured a minimum of 24 hours before pile driving commences within a distance of 20 feet.
3. Refer to geotechnical report for additional limitations related to foundation installation.

C. Conveying: Convey concrete from the mixer to point of deposit without segregation.

D. Placing:

1. Deposit concrete continuously or in layers of such thickness that no concrete will be placed on concrete which has hardened sufficiently to cause the formation of seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as herein specified. Deposit concrete as nearly as practicable to its final location to avoid segregation.
2. Placing Concrete in Forms: Deposit concrete in forms in horizontal layers not deeper than 24" and in a manner to avoid inclined joints. Where placement consists of several layers, place each layer while preceding layer is still plastic to avoid cold joints. Guide the flow of concrete in walls and columns for vertical drop between the reinforcing. Free fall, except in walls

and columns, shall not exceed five feet. Free fall in walls and columns shall not exceed 10 feet without prior acceptance by Structural Engineer.

3. Placing Concrete Slabs: Deposit and consolidate concrete slabs in a continuous operation, within limits of construction joints, until the placing of a panel or section is completed. Continuous intermediate screed stops at intervals not greater than 15 feet set prior to concrete placement are required. For slabs cast over metal deck, place screeds along beam lines. Set screeds and adjust as necessary to achieve proper slab elevation and minimum thickness, allowing for beam camber and deflection of deck and framing members.

E. Consolidation:

1. Maintain one standby vibrator for every three vibrators used.
2. Consolidate placed concrete by internal vibrating equipment with a minimum frequency of 7000 rpm, supplemented by hand spading, rodding, or tamping. Use equipment and procedures for consolidation of concrete in accordance with ACI 309.
3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations not farther than visible effectiveness of machine. Place vibrators to rapidly penetrate placed layer and at least 6" into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to set. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing segregation of mix.
4. Consolidate concrete during placing operations so that concrete is thoroughly worked around reinforcement and other embedded items and into corners.

3.07 FINISH OF FORMED SURFACES

- A. Definitions: Refer to ACI 301 5.3.3, for formed surfaced finish definitions.
- B. Provide formed surfaced finishes as defined on the Architectural drawings.

3.08 SLAB SURFACE FINISHES

- A. Definitions: Refer to ACI 301 5.3.4 for definition of slab surface finishes.
- B. Provide slab surface finishes as defined on the Architectural drawings.

3.09 CONCRETE CURING, PROTECTION AND SURFACE TREATMENT

A. General:

1. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Maintain concrete with minimal moisture loss at a relatively constant temperature for the period necessary for hydration of the cement and hardening of concrete.
2. Curing shall commence as soon as free water has disappeared from the concrete surface after placing and finishing. The curing period shall be seven days for all concrete except high-early strength concrete, which shall be cured for three days minimum, unless test cylinders, made and kept adjacent to the structure and cured by the same methods, are tested with the average compressive strength equal to 70% of the specified 28-day strength.
3. Curing shall be in accordance with ACI 301 procedures. Avoid rapid drying at the end of the curing period. During hot and cold weather, cure concrete in accordance with ACI 305 and ACI 306.

B. Curing Methods: Perform concrete curing by using moisture curing, moisture-retaining cover curing, curing compound, or by a combination of these methods, as specified herein. The Contractor shall choose a curing method based on compatibility with the requirement's for subsequent material usage (finishes etc.) on the concrete surface and/or as specifically called for on the drawings. The curing period shall be seven days minimum for all concrete except high early strength concrete, which shall be cured for three days minimum, unless test cylinders, made and kept adjacent to the structure and cured by the same methods are tested with the average compressive strength equal to 70% of the specified 28-day strength.

1. Provide moisture curing when specified by one of the following methods:
 - a. Keep concrete surface continuously wet covering with water.
 - b. Continuous water-fog spray.
 - c. Covering concrete surface with specified absorptive cover, thoroughly saturating cover with water and keeping it continuously wet. Place absorptive cover to provide coverage of concrete surfaces and edges, with 4" lap over adjacent absorptive covers.
2. Provide moisture-cover curing as follows:

- a. Cover concrete surfaces with moisture retaining cover for curing concrete, placed in widest practical width with sides and ends lapped at least 3" and sealed by water proof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
- 3. Provide dissipating curing compound to interior slabs with resilient flooring, carpet over cushion, or left exposed, and to exterior slabs, walks and curbs as follows:
 - a. Apply specified curing compound to concrete slabs as soon as final finishing operations are complete (within 30 minutes). Apply uniformly in continuous operation by power-spray or roller in accordance with manufacturer's directions.
 - b. Maintain continuity of coating and repair damage during curing period.
 - c. Use moisture curing as specified above in lieu of membrane curing compounds on surfaces which are to be covered with coating material applied directly to concrete such as liquid floor hardener, water proofing, damp proofing, membrane roofing, flooring (such as ceramic or quarry tile, glue-down carpet), painting, and other coatings and finish materials.
- C. Curing Formed Surfaces: Where wooden forms are used, cure formed concrete surfaces, including undersides of beams, supported slabs and other similar surfaces by moist curing with forms in place for full curing period or until forms are removed. When forms are removed, continue curing by methods of specified above for specified curing time.
- D. Curing Unformed Surfaces: Cure unformed surfaces, such as slabs, floor topping, and other flat surfaces by application of appropriate curing method. Final cure concrete surfaces to receive liquid floor hardener or finish flooring by use of moisture-retaining cover, unless otherwise directed.
- E. Environmental conditions: See Section 1.07 for cold and hot weather concreting requirements.
- F. Exposed surfaces: In addition to requirements of 3.11 herein all surfaces to be painted/stained or left permanently exposed are to have additional surface rubbing or otherwise as required either by the manufacturer or architects.

3.10 FORM REMOVAL AND RESHORING

- A. Removal of Forms: Supplement and Modify ACI 301 as follows:

1. ACI 301 4.5.4: Formwork not supporting weight of concrete such as sides of beams, walls, columns and similar parts of the work, may be removed after cumulatively curing at not less than 50°F for 24 hours after placing the concrete, provided that concrete sufficiently cured to be undamaged by form removal operations. Provided that supplementary curing and protection is provided for the exposed concrete, and provided that the concrete strength required by the general notes for form removal has been met.

3.11 REPAIR OF SURFACES DEFECTS

A. Formed Surfaces:

1. Allow Architect and Structural Engineer to observe concrete surfaces immediately upon removal of forms.
2. Modify or replace concrete not conforming to required lines, details, and elevations.
3. Repair or replace concrete not properly placed resulting in excessive honeycombing and other defects. Patch, repair, or replace exposed architectural finished concrete as directed by the Architect,
4. Patching of tie holes is required.
5. Repair defects in structural concrete elements as follows:
 - a. Deep Defects Exposing Reinforcing: Chip to sound concrete and clean thoroughly to remove all loose concrete and dust. Apply thin coat of specified epoxy adhesive. Form and pour, or dry pack with specified non-metallic, non-shrink grout with compressive strength equal to the concrete, prior to development of tack-free condition of epoxy adhesive. Strip forms after grout has hardened and provide specified finish. Moist cure or apply specified clear curing and sealing compound immediately after finishing.
 - b. Defects Greater Than ½" Depth Not Exposing Reinforcing: Chip, clean, and apply specified epoxy adhesive. Dry pack using specified non-metallic, non-shrink grout prior to development of tack-free condition of epoxy adhesive. Provide specified finish and cure as specified above.
 - c. Defects Less Than ½" Depth and Tie Holes:
 - (1) For concrete having a specified compressive strength of 5,000 psi or less: Chip and clean as specified above. Dry pack, finish, and cure as specified above.

- (2) For concrete having a specified compressive strength greater than 5,000 psi: Chip and clean as specified above. At Contractor's option, dampen surface and apply specified epoxy mortar, followed by specified finish (no curing required); or apply thin coat of the specified bonding compound followed by dry pack, finish and cure as specified above.

- d. Other equivalent repair procedures may be used subject to review and acceptance by the Architect and Structural Engineer.

B. Unformed Surfaces:

1. Test unformed surfaces, such as monolithic slabs, for smoothness and verify surface plane to tolerances specified for each surface and finish. Correct low and high areas as herein specified. Test unformed surfaces sloped to drain for trueness of slope, in addition to smoothness using a template having required slope.
2. Correct high areas in unformed surfaces by grinding or other methods acceptable to the Architect after concrete has cured a minimum of 14 days.
3. Low surfaces of unformed concrete shall be brought to the attention of the Structural Engineer for review and remedial solution.

3.12 TOLERANCES

A. Formed Surfaces and Building Lines: Conform to ACI 117, as modified and amended herein.

1. Sleeves and Blockouts:

- a. Size: $+1/2"$, $-0"$

- b. Location:

- (1) Minimum dimension 6" or larger" $\pm 1/2"$

- (2) Minimum dimension less than 6": Locate in nearest open space between reinforcing, not less than 1" clear from nearest reinforcing bar.

2. Permissible variations from plumb and designated building lines for portions of buildings more than 100 ft. above ground shall be as specified in ACI 117.

B. Slab Finishing Tolerance:

1. Trowel Finish:

- a. Formed slabs Class A – $\frac{1}{8}$ " in 10'
 - b. Slabs on metal deck Class B – $\frac{1}{4}$ " in 10'
 - 2. Floated Finish: Class B – $\frac{1}{4}$ " in 10'
 - 3. Scratched Finish: Class C- $\frac{1}{4}$ " in 2'
 - 4. Topping Slab: Class A – $\frac{1}{8}$ " in 10'
 - C. Embedded Items: Unless noted otherwise on drawings, tolerances shall be as follows:
 - 1. Anchor Bolts
 - a. Adjacent anchor bolts in a group receiving a single fabricated setting piece: $\pm\frac{1}{8}$ "
 - b. Location and alignment of anchor bolt groups from designated location and alignment: $\pm\frac{1}{4}$ "
 - 2. Embedded Plates and Weldments:
 - a. Location: ± 1 " vertical, ± 1 " horizontal
 - b. Plumb and alignment: $\frac{1}{4}$ " in 12"
- 3.13 MISCELLANEOUS CONCRETE REQUIREMENTS All other concrete work indicated on the drawings shall be provided and installed even though not specifically mentioned herein, to complete the work, which may include the following: Refer also to architectural drawings.
- B. Anchors: Install anchors furnished under other sections in accordance with shop approved drawings and/or setting instructions.
 - C. Equipment Bases: Install concrete bases for all pumps, boilers, tanks, fans, transformers, floor mounted electrical equipment, etc., including anchor bolts and inserts in accordance with setting instructions furnished by the Contractor responsible for installing the equipment. Finish all bases in a workmanlike manner with a troweled finish. The bases shall be located and sizes determined by the Contractor furnishing the equipment.

END OF SECTION 033010

SECTION 033055

CAST-IN-PLACE CONCRETE (SITE)

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

- A. This Section specifies requirements for concrete cast-in-place on the site
- B. The work includes cast-in-place concrete pavement, walkways bases, foundations, structures, and thrust blocks

1.2 RELATED SECTIONS

- A. Sections which directly relate to the work of this section include:
 - 1. Geotechnical Report by Carlin Simpson and Associates.
 - 2. Section 321100 – BASE COURSES (PAVEMENT).
 - 3. Section 321610 - CURBING.

1.3 REFERENCE STANDARDS

- A. A. References herein are made in accordance with the following abbreviations and all work under this Section shall conform to the latest editions as applicable
 - 1. American Concrete Institute (ACI):
 - 301 Specifications for Structural Concrete
 - 305R Hot Weather Concreting
 - 306R Cold Weather Concreting
 - 325.9R Guide for Construction of Concrete Pavements and Concrete Bases
 - 2. ASTM International (ASTM):
 - A82 Standard Specification for Steel Wire, Plain, for Concrete Reinforcement
 - A1064 Standard Specification for Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
 - A615 Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
 - C31 Standard Practice for Making and Curing Concrete Test Specimens in the Field
 - C33 Standard Specification for Concrete Aggregates
 - C94 Standard Specification for Ready-Mixed Concrete

- C143 Standard Test Method for Slump of Hydraulic-Cement Concrete
 - C150 Standard Specification for Portland Cement
 - C171 Standard Specification for Sheet Materials for Curing Concrete
 - C231 Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
 - C260 Standard Specification for Air-Entraining Admixtures for Concrete
 - C309 Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
 - C494 Standard Specification for Chemical Admixtures for Concrete
 - C1116 Standard Specification for Fiber-Reinforced Concrete
3. Concrete Reinforcing Steel Institute (CRSI):
- Manual Manual of Standard Practice.
4. United States Department of Justice - Americans with Disabilities Act (ADA):
- ADA ADA Accessibility Guidelines for Buildings and Facilities; 28 CFR Part 36.
5. State Regulations regarding Accessibility.

1.4 QUALITY ASSURANCE

- A. Work and materials for construction of the cement concrete walks shall conform to ACI 316R. Other cast-in-place concrete shall conform to ACI 301.
- B. Work, materials, and color of the wheelchair ramp paving shall conform to applicable sections of Americans with Disabilities Act (ADA) and state Standards, whichever is more stringent.
- C. Dimensions, locations, and details of equipment pads, anchors, supports, and similar features shown on the Drawings are approximate. Manufacturer's approved shop drawings of equipment to be supported, anchored, or contained thereby shall be consulted for exact location, size, and details.

1.5 SUBMITTALS

- A. Submit description of methods and sequence of placement for each type of specially-finished concrete, including description of methods and sequence of placement.
- B. Submit manufacturer's product data for the following:
 - 1. Form release agent.
 - 2. Concrete coloring additive.
 - 3. Preformed joint filler.

4. Concrete reinforcement specification data from manufacturer.
5. Stamp and imprinting tools, manufacturer's literature.
6. Manufacturer's literature for protective coating for sidewalks.
7. Detectable Warning including manufacturer's certification that product complies with ADA

1.6 TESTING

- A. The Owner may employ an independent testing laboratory to inspect and test concrete paving and other cast-in-place concrete work.
- B. When requested, Contractor shall prepare test specimens in accordance with ASTM C31, standard cylinder size 4-inch x 8 inch.
- C. Testing of materials and installed work may occur at any time during progress of the work. Rejected materials and installed work shall be removed and replaced.

PART 2 -

2.1 STEEL REINFORCEMENT

- A. Steel reinforcing bars shall conform to ASTM A615, Grade 60, deformed.
 1. Bars employed as dowels shall be hot-rolled plain rounds.
- B. Steel Wire: ASTM A82, plain cold drawn steel.
- C. Welded Wire Reinforcement: Welded wire reinforcement shall conform to the applicable requirements of ASTM A1064. Fabric reinforcement shall be furnished in flat sheets. Fabric reinforcement in rolls will not be permitted.
- D. Supports for Reinforcement: Bolsters, chairs, and other devices for spacing, supporting, and fastening reinforcing bars, and welded wire fabric in place shall be wire bar-type supports complying with CRSI Manual.
 1. For slabs-on-grade, use supports with sand plates or horizontal runners where base material will not support chair legs.
 2. For exposed-to-view concrete surfaces where legs of supports are in contact with forms, provide supports with legs that are protected by plastic (CRSI Class 1).

2.2 PORTLAND CEMENT CONCRETE

- A. Portland cement concrete shall conform to the following:
 1. Maximum water-cement ratio shall be 0.45 conforming to ACI 316R.
 2. Concrete shall be air-entrained type conforming to ASTM C94. Air content by volume shall be 6 percent + 1.5 percent, tested in accordance with ASTM C260.
 3. Slump of concrete shall not be less than 3 inches nor greater than 4 inches, determined in accordance with ASTM C143.

4. Cement for concrete shall be a Portland cement conforming to ASTM C150, Type I or II. Only one color of cement, all of the same manufacturer, shall be used for the work. Type III cement shall be used only with the prior approval of the Engineer.
5. Fine and coarse aggregates for concrete shall conform to ASTM C33.
6. Concrete shall contain a water reducing agent to minimize cement and water content of the concrete mix at the specified slump. Water reducing agent shall conform to ASTM C494, Type A.
7. Concrete shall contain no calcium chloride or admixtures containing calcium chloride. No admixtures other than those specified shall be used in the concrete without the specific written permission of the Engineer.

2.3 CONCRETE AGGREGATES

- A. Fine Aggregates: Fine aggregates shall conform to ASTM C33, part 6.
- B. Coarse aggregates shall conform to ASTM C33, Parts 9 through 11 and Tables 2 and 3, with the following Class designations:
 1. Class 1S: For footings and foundations not exposed to the weather.
 2. Class 4S: For pavements, driveways, curbs, walkways, sidewalks, and retaining walls that are exposed to the weather.
 3. Class 1N: For pavements, driveways, curbs, walkways, sidewalks, and retaining walls that are not exposed to the weather.
- C. Exposed Aggregate: Exposed aggregate for ADA curb ramps shall be selected, hard, durable, washed rounded stones free of deleterious reactivity to cement with graded sizes between 1/2 to 3/4 inch diameter nominal sieves.

2.4 COLORED CONCRETE

- A. Color hardener and curing compound shall be manufactured and supplied by the Bomanite Corporation, 81 Encina Avenue, Palo Alto, CA 94301; tel. 800-854-2094, or approved equivalent.
 1. Color for concrete shall have visual contrast with surrounding paving.
 2. Curing compound shall be liquid applied.
- B. Surface sealer shall be non-yellowing type which breathes water vapor, as manufactured by ProSoCo, Sika Chemical Corporation, Dural-International Corporation, or approved equivalent.

2.5 CURING MATERIALS FOR UNCOLORED CONCRETE

- A. Curing shall be accomplished by the following methods:
 1. Moist curing with burlap covering.

2. Curing paper, nonstaining, fiber reinforced laminated Kraft bituminous product conforming to ASTM C171. Four mil polyethylene sheeting may be substituted for curing paper.
3. Curing compound, a resin-base, white pigmented compound conforming to ASTM C309, Type 2.

2.6 EXPANSION JOINTS

- A. Expansion joint filler shall be preformed, nonbituminous type conforming to ASTM D1752, Type II, similar to Sealtight Cork Expansion Joint Filler, manufactured by W.R. Meadows, Inc., Elgin, IL 60120, or approved equivalent.
 1. Premolded filler shall be one piece for the full depth and width of the joint.
- B. Smooth dowel shall be hot rolled plain steel dowel bonded at one end and operating in smooth close fitting sleeve (of same material) at the other end.

2.7 CONTROL JOINTS

- A. Joint filler to be polyethylene foam with manufacturer's recommended sealant

2.8 FORMS

- A. Cylindrical Forms: Sonotube Fibre Forms, wax-impregnated strippable forms manufactured by Sonoco Products Company, General Products Division, ABS or PVC plastic reusable forms, or approved equivalent.
- B. Forms for Exposed Finish: Plywood, metal, metal-framed plywood faced, or other acceptable panel materials. Plywood shall conform to U.S. Product Standard PS-1 and APA Graded B-B (Concrete Form) Class I Exterior Grade plywood or B-B or A-C Class I high density overlay concrete form plywood. Formwork materials shall produce smooth, continuous, straight and level surfaces.
- C. Forms for Unexposed Finish: Plywood, lumber, or metal, with lumber dressed on at least two edges and one side.
- D. Form Ties: prefabricated, adjustable length galvanized steel snap-off ties, with brackets, cones, cornerlocks, and other accessories as necessary.
- E. Form Release Agent: Commercial formulation compounds that will not bond with, stain or adversely affect concrete.
- F. Imprinting Tools: Mats and tools used to stamp projecting texture and patterns onto plastic concrete surfaces and which shall be specifically designed with rigid back supports to enable a clean, sharp, stamping image. Stamps for curb ramps shall be designed to meet ADA detectable warning requirements.

2.9 FIBROUS REINFORCING

- A. Material shall meet ASTM C1116 and shall be as manufactured by NyCon Incorporated, or approved equal.
- B. Mix fibrous reinforcement in accordance with manufacturer's instructions including product data and technical bulletins.

1. Add fibrous reinforcement to concrete mix at the concrete batch facility.
 2. Adding and mixing fibrous reinforcement at the job site will not be allowed.
- C. Provide job mix design data to show concrete mix will attain specified strength requirements.
- 2.10 EXPOSED CONCRETE PROTECTIVE COATING
- A. Protective Coating shall be silane-siloxane product
- 2.11 DETECTABLE WARNING
- A. Detectable warnings shall meet ADA and State Standards, whichever is more stringent, and shall be ADA Solutions Cast-in-Place Replaceable Tactile Warning Surface Tiles Federal Yellow (or approved equal).

PART 3 - EXECUTION

3.1 PREPARATION OF SUBGRADE

- A. The subgrade of areas to be paved shall be graded and compacted as specified in Section 321100, BASE COURSES (PAVEMENTS).
- B. Excavation required in pavement subgrade shall be completed before fine grading and final compaction of subgrade are performed. Where excavation must be performed in completed subgrade, subbase, base, or pavement, subsequent backfill and compaction shall be performed as required by the Engineer and as specified in the Geotechnical Report.
- C. Materials shall not be stored or stockpiled on subgrade.
- D. Prepared subgrade will be inspected by the Engineer. Subgrade shall be approved for installation of the gravel base course. Disturbance to subgrade caused by inspection procedures shall be repaired.

3.2 BASE COURSE

- A. Base course for concrete paving shall be pavement subbase course or gravel base materials specified in Section 321100, BASE COURSES (PAVEMENTS) as shown on the drawings.
- B. Width of base course shall extend beyond edge of the proposed pavement as shown on the drawings.
- C. Material shall be placed in lifts no more than 6 inches thick, compacted measure. Each lift shall be separately compacted to specified density.
1. Material shall be placed adjacent to wall, manhole, catch basin, and other structures only after they have been set to required grade.
 2. Rolling shall begin at sides and progress to center of crowned areas, and shall begin on low side and progress toward high side of sloped areas. Rolling shall continue until material does not creep or wave ahead of roller wheels.
 3. Surface irregularities which exceed 1/2 inch as measured by means of a 10 foot long straightedge shall be regraded and recompacted.

- D. Base course shall be compacted at optimum moisture content to not less than 95 percent of maximum density as determined by ASTM D1557.
- E. The base course shall be kept clean and uncontaminated. Less select materials shall not be permitted to become mixed with the base course material.

3.3 STEEL REINFORCEMENT

- A. Before being placed in position, reinforcing steel shall be thoroughly cleaned of loose mill and rust scale, dirt, ice, and other foreign material which may reduce the bond between the concrete and reinforcing. Where there is delay in placing concrete after reinforcement is in place, bars shall be re-inspected and cleaned when required.
- B. Any bar showing cracks after bending shall be discarded.
- C. Unless otherwise shown on the Drawings, reinforcing shall extend within 2 inches of formwork and expansion joints. Reinforcing shall continue through control joints. Adjacent sheets of fabric reinforcing shall lap 6 inches.
- D. After forms have been coated with form release agent, but before concrete is placed, reinforcing steel shall be securely wired in the required position and shall be maintained in that position until concrete is placed and compacted. Chair bars and supports shall be installed in a number and arrangement approved by the Engineer.

3.4 FORMS

- A. General: Design, erect, support, brace, and maintain formwork to support vertical, lateral, static, and dynamic loads that might be applied until concrete structure can support such loads. Construct formwork so concrete members and structures are of correct size, shape, alignment, elevation, and position. Maintain formwork construction tolerances and surface irregularities complying with the following ACI 347 limits.
 - 1. Provide Class A tolerances for concrete surfaces exposed to view.
 - 2. Provide Class C tolerances for other concrete surfaces.
- B. Construct forms to provide for openings, offsets, sinkages, keyways, recesses, moldings, chamfers, blocking, screeds, bulkheads, anchorages, and inserts, and other features required for the work. Use selected materials to obtain required finishes. Solidly butt joints and provide back-up at joints to prevent cement paste from leaking.
- C. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Kerf wood inserts for forming keyways, reglets, recesses, and other features for easy removal.
- D. Chamfer exposed corners and edges, using wood, metal, PVC, or rubber chamfer strips fabricated to produce uniform smooth lines and tight edge joints.
- E. Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, or other debris just before placing concrete. Re-tighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

3.5 INSTALLING EMBEDDED ITEMS

- A. General: Set and build into formwork the anchorage devices and other embedded items required for work that is attached to, or supported by, cast-in-place concrete. Use setting drawings, diagrams, instructions, and directions provided by suppliers of items to be attached.
- B. Forms for Slabs: Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and contours in finished surfaces. Provide and secure units to support screed strips using strike-off templates or compacting-type screeds.

3.6 PREPARING FORM SURFACES

- A. Coat contact surfaces of forms with an approved, nonresidual, low-VOC form-coating compound before placing reinforcement.

3.7 CONCRETE PLACING

- A. Equipment, methods of mixing and placing, and precautions to be observed as to weather, and condition of base shall meet the requirements of ACI 316R.
- B. The Engineer shall be notified of scheduled concrete placement sufficiently in advance of start of operation to allow preliminary inspection of the work, including subgrade, forms, and reinforcing steel.
- C. Work shall not be performed during rainy weather or when temperature is less than 40°F. (4.4°C.).
- D. Adjacent work shall be protected from stain and damage. Damaged and stained areas shall be replaced or repaired to equal their original conditions.
- E. Existing concrete, earth, and other water-permeable material against which new concrete is to be placed shall be thoroughly damp when concrete is placed. There shall be no free water on surface.
- F. Concrete which has set or partially set, before placing shall not be used. Retempering of concrete will not be permitted.
- G. Concrete shall be thoroughly vibrated, or otherwise consolidated to secure a solid and homogeneous mass, thoroughly worked around reinforcement and into corners of forms.
- H. When joining fresh concrete to concrete which has attained full set, latter shall be cleaned of foreign matter, and mortar laitance shall be removed by chipping and washing. Clean, roughened base surface shall be saturated with water, but shall have no free water on surface. A coat of 1:1 cement-sand grout, approximately 1/8 inch thick, shall be well scrubbed into the thoroughly dampened concrete base. New concrete shall be placed immediately, before grout has dried or set.

3.8 FINISHING

- A. Concrete surfaces shall be screened and finished true to line and grade, and free of hollows and bumps. Surface shall be dense and smooth.
 - 1. Finished concrete surface for concrete subbases shall be wood floated to a slightly rough surface. Surface shall not deviate more than 1/4 inch in 10 feet.

2. Finished concrete surfaces shall be wood floated and steel troweled, or broom finished, to a uniform surface. Surface shall not deviate more than 1/8 inch in 10 feet.
- B. Horizontal surfaces of concrete surfaces which will be exposed shall be given a light broomed finish, with direction of grooves in concrete surface perpendicular to length of concrete band, slab, or pad. After concrete has set sufficiently to prevent coarse aggregate from being torn from surface, but before it has completely set, brooms shall be drawn across the surface to produce a pattern of small parallel grooves. Broomed surface shall be uniform, with no smooth, unduly rough or porous spots, or other irregularities. Coarse aggregate shall not be dislodged by brooming operation.
- C. Immediately following finishing operations, arises at edges and both sides of expansion joints shall be rounded to a 1/4- inch radius. Control joints to be tooled shall be scored into slab surface with scoring tool. Adjacent edges of control joint shall at same time be finished to a 1/4- inch radius.
- D. Where finishing is performed before end of curing period, concrete shall not be permitted to dry out, and shall be kept continuously moist from time of placing until end of curing period, or until curing membrane is applied.
- E. Sidewalks, walkways, accessible routes, and ramps shall be constructed and finished in accordance with the Americans with Disabilities Act (ADA) and state and local requirements. Provide protective coating in accordance with manufacturer's recommendations.
- F. Exposed Aggregate Finish: Expose coarse aggregate in pavement surfaces as follows:
 1. Immediately after float finishing, spray-apply chemical surface retarder to pavement according to manufacturer's written instructions.
 2. Cover pavement surface with plastic sheeting, sealing laps with tape, and remove when ready to continue finishing operations.
 3. Without dislodging aggregate, remove excess mortar by lightly brushing surface with a stiff, nylon-bristle broom.
 4. Fine-spray surface with water and brush. Repeat water flushing and brushing cycle until cement film is removed from aggregate surfaces to depth required.

3.9 STAMPING

- A. Mat Stamping: While initially finished concrete is plastic accurately align and place stamp mats in sequence. Uniformly load mats and press into concrete to produce requirement imprint pattern and depth of imprint on concrete surface. Remove stamp mats immediately. Hand stamp edges and surfaces unable to be imprinted using stamp mats.
- B. Tool Stamping: While initially finished concrete is plastic, cover surface with polyethylene film, stretch taut to remove wrinkles, lap sides and ends 3 inches (75 mm), and secure to edge forms. Lightly broom surface to remove air bubbles. Accurately align and place stamp tools in sequence and tamp into concrete to produce required imprint pattern and depth of imprint on concrete surface. Remove stamp tools immediately. Hand stamp edges and surfaces unable to be imprinted by stamp tools. Unroll and remove polyethylene film immediately after tool stamping.

3.10 CURING

- A. Concrete shall be kept continuously damp from time of placement until end of specified curing period or cured by other methods. Water shall not be added to surface during floating and troweling operations, and not earlier than 24 hours after concrete placement. Between finishing operations, surface shall be protected from rapid drying by a covering of waterproofing paper. Surface shall be damp when the covering is placed over it, and shall be kept damp by means of a fog spray of water, applied as often as necessary to prevent drying, but not sooner than 24 hours after placing concrete. None of the water so applied shall be troweled or floated into surface.
- B. Concrete surfaces shall be cured by completely covering with curing paper or application of a curing compound.
 - 1. Concrete cured using waterproof paper shall be completely covered with paper with seams lapped and sealed with tape. Concrete surface shall not be allowed to become moistened between 24 and 36 hours after placing concrete. During curing period, concrete surface shall be checked frequently, and sprayed with water as often as necessary to prevent drying, but not earlier than 24 hours after placing concrete.
 - 2. Concrete cured with a curing compound shall have the compound applied at a rate of 200 square feet per gallon, in two applications perpendicular to each other.
 - 3. Curing period shall be seven (7) days minimum.
- C. Only if additional protection is absolutely required, the surface should remain uncovered after the seven (7) day period for at least four (4) days, after which time new and unwrinkled non-staining reinforced waterproof Kraft curing paper may be used.

3.11 EXPANSION JOINTS

- A. Expansion joints shall be 1/2 inch wide and located to provide a maximum spacing of 50 feet between joints or where shown on the drawings. Expansion joints shall be troweled in the concrete to required width with preformed joint filler in place. Joint filler shall extend the full depth of the slab and full length of the expansion joint.
 - 1. For concrete walks, pavements, and pads, depth of joint filler shall be placed to form a 1-1/4 inch deep recess for sealant and backer rod below finished concrete surface.
 - 2. Use of multiple pieces to make up required depth and width of joint will not be permitted.

3.12 CONSTRUCTION JOINTS

- A. Construction joints shall be placed whenever placing of concrete is suspended for more than 30 minutes.
 - 1. Butt joint with dowels or use a thickened edge joint if construction joints occur at control joint locations.
 - 2. Keyed joints with tie-bars shall be used if the joint occurs at any other location.

3.13 CONTROL JOINTS

- A. Control joints shall be tooled into the concrete slab, with 3-inch wide border and troweled edges, in pattern as shown on the Drawings. If no pattern is shown, then pattern shall result in square shape with a maximum area of 36 square feet. Joints shall be made after concrete is finished and when the surface is stiff enough to support the weight of workmen without damage to the slab, but before slab has achieved its final set.
- B. Scoring shall cut into slab surface at least 1 inch, but in no case not less than 25 percent of slab depth.

3.14 COLD WEATHER CONCRETING

- A. Materials for concrete shall be heated when concrete is mixed, placed, or cured when the mean daily temperature is below 40°F. or is expected to fall to below 40°F. within 72 hours. the concrete, after placing, shall be protected by covering, heat, or both.
- B. Details of handling and protecting of concrete during freezing weather shall be subject to the approval and direction of the Engineer. Procedures shall be in accordance with provisions of ACI 306R.

3.15 HOT WEATHER CONCRETING

- A. Concrete just placed shall be protected from the direct rays of the sun and the forms and reinforcement just prior to placing shall be sprinkled with cold water. Every effort shall be made to minimize delays which will result in excessive mixing of the concrete after its arrival on-site.
- B. During periods of excessively hot weather (95°F., or above), ingredients in the concrete shall be cooled with cold mixing water to maintain the temperature of the concrete at permissible levels in accordance with the provisions of ACI 305R. Any concrete with a temperature above 95°F., when ready for placement, will be rejected.
- C. Temperature records shall be maintained throughout the period of hot weather giving air temperature, general weather conditions (calm, windy, clear, cloudy, etc.) and relative humidity. Records shall include checks on temperature of concrete when delivered to Project site and after placing in forms. Data should be correlated with the progress of the work so that conditions surrounding the construction of any part of the structure can be ascertained.

3.16 PROTECTION OF CONCRETE SURFACES

- A. Concrete surfaces shall be protected from traffic or damage until surfaces have hardened sufficiently.

3.17 DETECTABLE WARNINGS

- A. Detectable warnings shall be install at locations as shown on plans and per manufacture's recommendations.

END OF SECTION

SECTION 03 41 00 – PRECAST CONCRETE

PART 1 – GENERAL

1.1 GENERAL PROVISIONS

- A. Perform the work of this Section in accordance with the requirements of the Contract Documents, **City of New Rochelle Building Department, and 2020 New York State Building Code.**

1.2 SUMMARY

- A. Work Included:

- 1. Furnish, fabricate, deliver, supervise and install all materials, labor and equipment associated with precast concrete which may include but is not limited to: inserts, embedded plates, clamps, nuts, bolts, bearing pads, base plates, storage and handling protection, product design, and engineering and other work including connections shown on Drawings required to complete Work, including:

- a. Double-T units
- b. Inverted-T beams
- c. Spandrel beams
- d. Columns
- e. Wall units
- f. Connection and supporting hardware
- g. Erection and grouting of all structural precast framing members

- 2. All other work normally related to the above or specified under this section.

- B. Related Sections: The following Sections contain requirements related to this Section.
Refer to Section 00 01 10 Table of Contents for specification sections that are “For Reference Only”.

- 1. All Sections in Division 01 – General Requirements.
- 2. Cast-in-Place Concrete and Accessories: Section 03 30 10 Cast-in-Place Concrete - **Foundations**
- 3. Testing and Inspection of Field Welds and Connections: Section 1.4.I herein.
- 4. Anchors and Adjacent Structural Frame: Section **05 50 00 Metal Fabrications.**

5. Waterproofing Systems: **Division 7**
 6. Caulking and Sealants: **Section 07 92 33 and 07 92 36**
 7. Fire Protection: **Division 21**
 8. Concrete Unit Masonry: Section 04 22 00
- C. Work Furnished but not installed:
1. Anchor bolts and other embedments with placement drawings for embedment in cast-in-place concrete to provide for attachment of precast pieces.
 2. As-built anchor bolt and embedments location survey: Provide with sufficient time for Engineer to review and corrective action. Notify **Construction Manager** and Engineer of any discrepancies prior to piece erection. Submit proposed needed corrections to Engineer for review with survey.
 3. Alignment Survey: Furnish to **Construction Manager** after all precast members in final position, but before architectural precast panels are erected. Refer to 3.2.G of this Section for erection tolerances.
- D. The following work may be performed by others:
1. Setting of all embedments and anchor bolts into cast-in-place concrete.
 2. Installation of all joint sealant systems. See Section 07 92 00.
 3. Provision for site access and storage for precast delivery and installation.

1.3 INTERPRETATION OF DRAWINGS AND SPECIFICATIONS

- A. Direct questions relating to the intent of the Specifications or Drawings, quality of work required thereby, to the Architect. In the event of disagreement, the Architect's interpretations becomes final, conclusive and binding on all parties.

1.4 QUALITY ASSURANCE

- A. Definition: "Engineer" in this Section shall mean Structural Engineer of Record.
- B. Work shall conform to requirements of ACI 318, CRSI MSP-, PCI MNL 116, and PCI MNL 120, except where more stringent requirements are shown on Drawings or specified in this Section.

- C. Welders and welding procedures shall conform to requirements of AWS D1.1 and AWS D1.4. Welding is prohibited except where shown on Drawings, unless approved in writing by Engineer.
- D. Manufacturer Qualifications:
 - 1. All precast concrete Work shall be done by a firm, which has at least 5 years of demonstrated capability, subject to the Architect's, **City's** and Engineer's approval, to produce and install type of precast work specified. Precast concrete supplier shall have sufficient production capacity to produce, transport, and deliver and erect required pieces without causing delay in the project.
 - 2. Precast concrete supplier shall have on staff or retain qualified Professional Engineer, registered in New York and the state in which precast concrete is to be fabricated, to certify precast concrete as fabricated conforms to requirements of ACI 318.
 - 3. Precast concrete supplier and plant shall hold current and in good standing, certification by Prestressed Concrete Institute before start of production.
- E. Source Quality Control: Quality control of precast concrete products shall be the responsibility of the manufacturer. The Architect, Engineer and **City's** Testing Agency or their representative shall have access to the manufacturing plant at all times during the manufacture of precast concrete products. The manufacturer shall cooperate with the Architect, Engineer and **City's** Testing Agency by providing casting schedules when requested.
- F. Special Inspection:
 - 1. Field testing and inspection will be made by a certified Special Inspection Agency selected and paid by the **City**. Retention by the **City** of an independent testing agency shall in no way relieve the contractor of responsibility for performing all work in accordance with the contract requirements.
 - 2. The Contractor shall provide to independent testing or consulting firm access to work, facilities, and incidental labor required for testing and inspection.
 - 3. This firm shall inspect precast plant at intervals as directed by Engineer, but not less than an average of one month intervals during production and issue report, certified by qualified Professional Engineer, registered in New York and state in which precast concrete fabricated, verifying that materials, methods, products and quality control meet all PCI requirements necessary for a PCI Certified Plant.
 - 4. If report indicates to contrary, Engineer, at Contractor's expense, will inspect and, at Engineer's option, reject any or all products produced during period of non-compliance with above requirements.
- G. Concrete Testing:

1. Precast supplier shall perform and pay for compression tests for all precast concrete Work. Testing is subject to observation by independent testing agency, hired by **City**. Use certified test equipment. Unless otherwise specified, conform with:
 - a. PCI MNL 116 for all members.
 2. Precast Structural Concrete Testing: Sample, test and report concrete in accordance with PCI MNL 116, with following exceptions:
 - a. Placement is defined as 150 cubic yards (or fraction thereof) placed for each day of production.
 - b. Make six cylinders per placement.
 - c. Two cylinders made for each placement need be cured per MNL-116. Test these cylinders to verify concrete compressive strength at transfer of prestress.
 - d. Other cylinders may be cured as per Section 033010 and tested at 28 days to verify design compressive strength of concrete.
 - e. Discard remaining cylinders after 56 days unless required to verify design compressive strength of concrete.
 3. Manufacture keep test records as required by PCI MNL 116 and shall submit copies of these test records to **City**, engineer or independent testing agency upon request.
- H. Precaster shall provide casting schedule to Architect/Engineer with first Shop Drawing submittal. Precaster shall notify Architect/Engineer 48 hours in advance of casting of each piece type so that Architect/Engineer or his designee may review reinforcement fabrication at precaster's plant before casting. Architect/Engineer may request notification for specific piece marks.
- I. Independent Testing and Inspection:
1. Inspect all precast concrete member bearing pad placements prior to placement of cast-in-place washes. Report location of all bearing pads, which do not meet placement tolerances of Section 3.2.I. Improperly located bearing pads will not be accepted by Engineer and shall be relocated or modified at expense of Contractor.
 2. The testing agency shall perform tests in the fabricators shop in accordance with AWS D1.1 as follows: This testing is required to be performed during scheduled shop visits only.
 - a. All Welds: 100% Visual
 - b. Partial penetration welds: One spot test per member: Magnetic particle.
 - c. Full penetration welds: 100% ultrasonic
 - d. All other welds: 10% magnetic particle.
 3. The testing agency shall inspect prestressing operations at the fabrications shop to verify

compliance with Section 18.18 of ACI 318.

4. The testing agency shall test field welds in accordance with AWS D1.1 as follows:
 - a. All Welds: 100% Visual
 - b. Fillet Welds: One spot test per member: Magnetic particle.
 - c. Partial penetration welds: One spot test per member: Magnetic particle.
 - d. Full penetration welds: 100% ultrasonic
 - e. All other welds: 10% magnetic particle.
5. Bolted Connections: Visually inspect all connections. Check proper pre-tension with calibrated torque wrench at minimum of two bolts of every connection.
6. Report location of all precast concrete, which does not conform to contract drawings or approved shop drawings to the Engineer.
7. Limitations as to the amount of structural patching which will be permitted is subject to acceptance of Engineer and Architect.
8. In-place precast pieces may be rejected for **exceeding tolerances, damage, finish deficiencies, or improper placement based on PCI MNL-116 requirements.**
9. Any defective work, which cannot be repaired to satisfaction of Engineer, whether found at site or at shop at any time before completion and acceptance of Project, will be rejected regardless of previous reviews and shall be remade or reconstructed to satisfaction of Engineer.
10. Pre-Installation Inspection:
 - a. Inspect surfaces to receive precast concrete work.
 - b. Report immediately in writing to Engineer any deficiencies in work, which render it unsuitable to receive precast concrete pieces.
 - c. Prior to start of erection, check location of all embedded anchor bolts, plates, angles, etc., and report deviations from the setting plans to the **Construction Manager.**
 - d. Do not allow work to proceed until deficiencies or deviations have been corrected.

1.5 REFERENCE STANDARDS

A. American Concrete Institute (ACI):

1. ACI 318, "Building code Requirements for Reinforced Concrete".
2. ACI 301 "Specification for Structural Concrete"

B. Prestressed Concrete Institute (PCI):

1. PCI MNL 116, "Manual for Quality control for Plants and Production of Precast Prestressed Concrete Products".
 2. PCI MNL 120, "PCI Design Handbook".
 3. PCI MNL 123, "Design for Fire Resistance of Precast Prestressed Concrete".
 4. PCI MNL 127, "Erection Manual Standards and Guidelines for the Erection of Precast Concrete Products".
 5. PCI MNL 135, "Tolerance Manual for Precast and Prestressed Concrete Construction".
- C. Concrete Reinforcing Steel Institute (CRSI):
1. CRSI MSP, "Manual of Standard Practice".
- E. American Society for Testing and Materials (ASTM):
1. ASTM A123, "Specification for Zinc (Hot Galvanized) Coatings on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars, and Strip".
 2. ASTM A164, "Specification for Electro Deposited Coatings of Zinc on Steel".
 3. ASTM A386, "Specification for Welded Steel Wire Fabric for Concrete Reinforcement".
 4. Additional ASTM Standards as referenced in PART 2 - PRODUCTS section.
- F. American Welding Society (AWS):
1. AWS D1.1, "Structural Welding Code-Steel".
 2. AWS D1.4, "Structural Welding – Reinforcing Steel".
 3. AWS D1.6, "Structural Welding Code – Stainless Steel".
 4. AWS C5.4, "Recommended Practices for Stud Welding".

1.6 SUBMITTALS

~~A. Sustainability Data: For each Sustainability Focus Material in accordance with Section 018113 "Sustainability Requirements."~~

B. Shop Drawings:

1. Submit Shop Drawings showing complete information for fabrication and installation of precast concrete pieces. Indicate piece dimensions and cross-section; location, size, and type of reinforcement, including special reinforcement and lifting devices necessary for handling and erection.
2. Show layout, dimensions, and identification of each precast piece corresponding to sequence of installation.
3. Show location and details of anchorage devices to be embedded in other construction.
4. Show welded connections using AWS standard symbols. Detail inserts, connections, and joints, including accessories and construction at all changes in cross section of precast pieces.
5. ~~Show all dead, live and other applicable loads used in the design.~~
6. ~~Show fire rating.~~
7. Provide description of all loose hardware, including designation of who furnishes it.
8. Show all major openings as described in section 2.4.M. It is the **Construction Manager's** responsibility to provide a Trade coordinated opening drawing for all openings clearly dimensioning any deviations from the Architectural and Structural drawings and any additional MEP openings or sleeves not shown on Architectural or Structural drawings.

C. Design Calculations:

1. Where design is required by precast concrete manufacturer, submit design calculations for all pieces **including applicable design loads and load path, and material and product specifications** with Shop Drawings to Engineer before production.
2. Submit calculations for each type, shape, loading condition, **fire-rating**, and span of precast unit called for on the Drawings and all related supports and connections. Design of precast units shall be under the direct supervision of a professional Engineer, registered in the State of New York, calculations shall bear his seal and signature.

D. Erection Certification:

1. Before construction, submit letter of certification from contractor-hired professional engineer registered in New York stating that erection sequence and all details for temporary bearing, temporary shimming, guying, staying and shoring all precast pieces have been reviewed and approved by said engineer, who shall be responsible for erection and direction to Contractor during construction phase.
2. Do not rely on capacity of column base connections or foundation to provide temporary structural stability before completion of permanent connections.

E. Concrete Mix Design: Submit concrete mix design to Engineer in accordance with Section 033010 before production of precast concrete pieces.

- F. Concrete Test Reports: Semi-monthly, and/or upon request during production of precast concrete pieces, submit for Engineer's review reports of testing of concrete used in precast concrete pieces.
- G. Bearing Pads: Submit affidavit to Engineer certifying that bearing pads conform to Specifications.
- H. Proof of certification of precast concrete supplier's plant under Prestressed Concrete Institute plant certification program.
- I. Copies of AWS welder's certificates for all welders to be employed on Project.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store pieces at Project site to prevent cracking, distortion, warping, staining, or other physical damage and so that markings are visible.
- B. Manufacturing, delivery and erection schedules shall be coordinated by Contractor.
- C. Allow adequate time for curing of precast pieces prior to erection as required herein.

1.8 (NOT USED)

1.9 ALTERNATES

- A. Alternate structural systems, if proposed. All clearances shall be provided as shown on Drawings. See Paragraph 1.11 for additional requirements.
- B. Drawings showing construction details for any alternate must be submitted with Bid to Engineer for review before alternates will be considered. At time of bidding, submittals shall include sufficient detail to show all deviations from contract Documents and shall include listing of all deviations and add or deduct cost associated with each change.
- C. Precast contractor shall be required to employ or have on staff qualified professional, legally registered structural engineer in New York (referred to as precast Designer), to perform design of any alternates to Engineer's design of precast members. Precast Designer will be requested to submit calculations for such alternate to Engineer's design to Engineer for review before any fabrication and construction for Project. Precast Designer shall also prepare and seal drawings and calculations for pieces for which he has design responsibility, for submittal to proper governing authorities as required. See Paragraph 1.11 for further requirements.
- D. Precast Shop Drawings and all other drawings, calculations and specifications prepared by precast Designer shall bear seal and signature of designer before submittal for review. See Paragraph 1.11 for further requirements.

- E. Cost to **City** for Engineering Fees and any increased construction cost resulting from need to review and accommodate in finished Work such precast superstructure alternates shall be borne by Contractor.

1.10 SYSTEM DESCRIPTION

- A. Drawings show precast member size assumed and used as basis for Architectural Drawings and Details and foundations design. Alternate member sizes will be accepted for all pieces only if structurally required and if of no significant architectural impact.
- B. Compressive strength of concrete at transfer of prestressing force: 3500 psi unless noted otherwise.
- C. All precast concrete pieces shown on Drawings require design by precast concrete manufacturer.
- D. Design of individual pieces and connections between pieces to transfer diaphragm forces shall be designed by the concrete manufacturer.
- E. Design structural reinforcement required to resist handling and erection stresses.

1.11 SYSTEM DESCRIPTION - PERFORMANCE SPECIFICATION

- A. Contract Drawings are based on performance type design for all precast members. This implies preparation of Design Drawings, Calculations, and Shop Drawings required in accordance with this Section, with specifications necessary for fabrication and construction of all precast concrete pieces and accessories in accordance with all code and engineering requirements.
- B. Precast supplier shall employ qualified registered professional engineer, legally registered in New York to perform precast design. Precast design shall meet criteria established in these documents. This professional (hereinafter referred to as precast Designer) shall prepare and seal final structural **shop drawings** (hereinafter referred to as precast Design Documents) submitted to Engineer for review. Precast Designer shall be responsible for precast structural design for the Project and will be required to submit design calculations and shop drawings to Engineer for review prior to any fabrication and construction for the Project. For those pieces for which precast Designer has design responsibility, precast Designer shall also prepare and seal drawings and calculations for submittal to proper governing authorities as required (**Precast Contractor not responsible for physical submission to authorities**). Precast supplier shall submit Design Documents to Engineer for review in ample time to allow such review before proceeding with any fabrication or construction.
- C. Designer's Insurance and Certificate: Designer will be required to furnish **City** a Certificate of Professional Liability Insurance in minimum amount of \$5,000,000. All Design Documents prepared by Designer shall be certified (bear seal and signature of Designer registered in New York before they are submitted for review.)

D. Minimum Durability Design Requirements:

1. Provide three (2) gallons of corrosion inhibitor per cubic yard of concrete in all double tee beams, inverted tee girders, stair landings, and stair risers ~~and cast in place concrete topping areas.~~
2. Galvanize all connection hardware and end bearing plate assemblies. [As noted on the drawings]. Touch up galvanizing with Z.R.C. Paint [and epoxy coating with epoxy coating patching material] after field welds are made.
3. Tee-to-tee connectors to be stainless steel.
4. Provide extra reinforcing around all openings, including door openings as per General Notes.
5. Clear Penetrating Sealer: **See Section 07 19 00.**
6. Water Borne Penetrating Sealer: **See Section 07 19 00.**
7. See Section **071000 WATERPROOFING** for joint detail and warranty requirements for sealant and expansion joint seal.

E. General Design Criteria:

1. Unless noted otherwise, all design shall be in accordance with governing codes, standards and references listed in General Notes and in this SpecificationSection.
2. Minimum concrete strengths shall be per General Notes and as noted herein.
3. Pieces shall be designed considering all vertical loads, lateral loads due to wind, seismic, temperature differentials, shrinkage, shortening, and effects due to prestressing.
4. Design structural precast to resist forces due to restrained volumetric changes per "PCI Design Handbook – Precast Pre-stressed Concrete", 7th Edition, Chapter 4.
5. Ultimate design capacity of inserts, coil rods, and coil bolts in tension shall not be greater than ninety percent (90%) of yield capacity of the weakest piece.
6. Minimum concrete cover of reinforcement, prestressing strands, etc. shall be as per General Notes.

F. Precast System Design Criteria:

1. Shear Walls:
 - a. Precast shear walls shall be as shown on the Drawings.

- b. Design shall include number and location of vertical reinforcement, vertical reinforcement splices, shear reinforcement, concrete haunch design, including dowels and anchorage at foundation. Splice locations shall be as shown on the drawings.
- c. Connections between precast pieces and precast and cast-in-place elements shall be as required to uniformly transfer lateral loads to the shear walls without overstress of any connected elements. See Section **1.11.F.2**

2. Connections:

- a. Where forces are shown on Contract Drawings, they are minimum and are intended to establish standard of performance. Engineer reserves right to accept or reject alternate details. Design as necessary to transfer gravity loads, lateral loads, torsion forces and forces due to volume change effects.
- b. Minimum additional load factor of 1.3 shall be used for design of all connections if alternate connections are submitted. Restraint developed by friction between bearing pads and connection pieces shall not be considered to contribute to connection. Positive connections shall be made by welds, bolts, or cast-in-place reinforcement. Design in accordance with "PCI Design Handbook – Precast Prestressed Concrete", 7th Edition.
- c. Bearing pads shall be provided by precast subcontractor as shown on Contract Drawings. Refer to Section 2.2.G for additional information.

3. Double Tees:

- a. Design shall include type, number, and location of strands, flange reinforcement, shear reinforcement, cast-in-place concrete topping reinforcement, end bearing plate and confinement reinforcement. Pre-stress in accordance with provisions of this Specification and referenced standards, codes, etc.
- b. Design flanges to support design dead load and either uniform (design) live load or concentrated wheel live load as shown on General Notes.
- c. Maximum tensile stress at bottom of tee for dead load plus live load shall be per ACI 318, section 18.4. **Allowable tensile stress increase to twelve times square root of f'_c per 18.4.2d permitted only for dead plus live plus snow load case.**
- d. As determined by project conditions, design as "restrained" or "unrestrained" piece for purposes of fire rating requirements. Use ASTM E119, Appendix X3 and Table X3.1 to determine restraint conditions. Minimum cover of reinforcement, pre-stressing strands, etc., and other fire rating design criteria shall be based on this premise.
- e. Surface to receive topping shall be rough to allow proper bond.

- f. Flange-to-flange connections shall be as shown on Contract Drawings.
4. Beams: Exterior and Interior "L", Inverted Tee, and Spandrel (Non-Load Bearing).
- a. Design shall include type, number, and location of longitudinal reinforcements, shear and torsion reinforcement, end bearing plates and confinement reinforcement, connection requirements, and ledge reinforcement. Ledge reinforcement shall be designed per PCI Design handbook, 7th Edition, Section 4.5. Continuity shall be maintained between both faces of reinforcement at ends of pieces.
 - b. Design Bumper load shall be 7,000 lbs. working stress at 18"-27" above finished floor, selected to produce maximum load effect.
 - c. If piece is to be prestressed, maximum tensile stress at bottom of beam for dead load plus design live load shall be per ACI 318, Section 18.4. Allowable, tensile stress increase to 12 times square root of f'_c per 18.4.2d is permitted only for dead plus live plus snow load case.
 - d. Where pieces are designed so that torsional restraint is provided by beam/column connection, beam shall be designed to resist torsional moment due to total dead and live load applied over entire length of beam (ACI 318, Section 11.5.2.4 and 11.5.2.5 shall not apply). Where tees bear on beams, pieces shall be designed for shear due to total dead and live loads applied over entire length of beam (ACI 318, Sections 11.1.3.1 and 11.1.3.2 shall not apply to these pieces). Additional reinforcement shall be provided to satisfy torsion and shear requirements for longitudinal and vertical stirrup reinforcement per ACI 318, Section 11.5. Design yield-strength of such reinforcement shall not exceed 60,000 psi. Such design shall be based on paper "Torsion Design of Prestressed Concrete" by Paul Zia and W. Dennis McGee, published in PCI Journal, March-April, 1974, with following modifications:
 - Use alpha per paper when spec ratio lies between 1 and 3.33. Use alpha equal to 0.33 when aspect ratio is greater than or equal to 3.33. Such design shall NOT be based on PCI Design Handbook.
 - e. Skew ends of beams as required for sloping bays.

PART 2 – PRODUCTS

2.1 SUSTAINABILITY CHARACTERISTICS

- A. Sustainability Focus Materials: Sustainability Characteristics in accordance with Section 018113.

2.2 MATERIALS

- A. Concrete: in accordance with Section 033010 except:
 - 1. Structural precast concrete: Use ASTM C150 Type I or III cement, 28-day minimum compressive strength of 5000psi or higher as required by precast design. Minimum release strength of 3500psi.
 - 2. Admixtures:
 - a. Water Reducing, Retarding, Accelerating, High-Range Water Reducing Admixtures: ASTM C494.
 - b. Air Entraining Admixtures: ASTM C260.
 - 3. Aggregates: ASTM C33 or C330
 - 4. Water: Potable or free from foreign materials in amounts harmful to concrete and embedded steel.
 - 5. Use of calcium chloride or admixtures containing chlorides is not permitted.
- B. Welded wire fabric: ASTM A185 or ASTM A497.
- C. Prestressing strand: Uncoated, 4, 6, 7 or 8-Wire, Low Lax strand: ASTM A416 (including supplement) – Grade 250K or 270K.
- D. Steel reinforcement: In accordance with Section 033000. All bars to be:
 - 1. Deformed Steel, ASTM A615 Gr 60
 - 2. Deformed Low Alloy Steel, ASTM A706 Gr 60 for welded locations.
- E. Plates and structural shapes: ASTM A36.
- F. Inserts and Coil Rods:
 - 1. Provide sizes shown on Drawings.
 - 2. Yield Strength: 65,000 psi minimum.
 - 3. Acceptable manufacturer, general:
 - a. Richmond Screw Anchor Co, Inc., Fort Worth, TX.
 - b. Dayton-Superior Corporation, Miamisburg, OH.
- G. Bearing Pads:

1. For type, size, thickness and location, see drawings. Unless otherwise indicated, elastomeric pads to be neoprene, 70 durometer hardness or approved equal.
 2. Beams: Horizontal bearing pads:
 - a. Preformed fabric pads.
 - b. AASHTO Standard Specifications for Highway Bridges (1983), Division II, Sections 10.3.12 and 25. Test reports in accordance with Section 25 shall be provided with each lot of elastomeric pads used on Project.
 - c. Acceptable materials:
 - "Sorbtex", Voss Engineering Co., Chicago, Illinois.
 - "Alert 15175 Shock Pads", Alert Manufacturing and Supply Co., Chicago, Illinois.
 - "Capralon", JVI, Inc., Skokie, Illinois.
 3. Shims for bearing pads: Galvanized ASTM A36 steel or HDP. Do not stack steel shims more than 3 high.
- H. Backer rod for grouted and sealed joints: Ethafoam rod stock.
- I. Welding electrodes: Welding galvanized steel: E7013, E7016, or E7018.
- J. Galvanizing:
1. Loose plates, angles, structural steel, and assembled products: Hot Galvanized Coating, ASTM A123.
 2. Inserts, coil rods and threaded parts: See 2.2.F.3.
 3. Touch-up painting after erection: "Z.R.C. Cold Galvanizing Compound", Z.R.C. Chemical Products, Quincy, Massachusetts.
- K. Thermal Spray Zinc Metallizing:
1. Use only with written permission of Engineer.
 2. Conform to AWS C2.2, "Recommended Practices for Metallizing with Aluminum and Zinc for Protection of Iron and Steel". In using AWS C2.2, substitute "shall" for "should" wherever latter appears.
 3. Protection Level: 0.003 inch thickness, minimum, of zinc, with no subsequent treatment.
- L. ~~Grout: See section 036000 Grout~~
- M. Dovetail Anchors:

1. Provide continuous dovetail slots with filler strips cast into precast elements as required for connection of adjacent masonry construction.
 2. Dovetail slots prefabricated of 24 gauge galvanized steel, unless otherwise noted, and shall accommodate 1" dovetail masonry anchors installed by others.
- N. Reinforcing Splices: Mechanical splices for reinforcing shall develop 125% of the specified yield strength fly of the bar. Subject to compliance with the requirements use one of the following:
- a. DB Grout sleeve system by Richmond Screw Anchor Co.
 - b. NMB splice sleeve type O-X by Sleeve Splice North America, Inc.
 - c. Or approval equal.
- O. Concrete Anchors: See **plans**.
- P. Welded Studs: In accordance with AWS D1.1
- Q. Bearing Strips (when supported by Cast-in-place concrete or Concrete Masonry or where otherwise specified on the contract documents:
1. Plastic: Multi-monomer plastic strips shall be non-leaching and support construction loads with no visible overall expansion.
 2. Korolath: 1/8" x 2"
- 2.3 (NOT USED)
- 2.4 FABRICATION
- A. Fabricate precast concrete pieces in accordance with ACI 318 and MNL 116 in approved forms to achieve specified finishes.
 - B. After stripping, keep precast pieces in surface damp condition at minimum temperature of 50 degrees F. Protect pieces from exposure to weather until strength of concrete has reached 3500 psi minimum. Do not ship precast pieces to Project site until piece can safely support all imposed handling stress.
 - C. For protection against corrosion, coat exposed ends of prestressing strands in all prestressed pieces with Tnemec 46 – 465, or approved equivalent.
 - D. Furnish and cast in all inserts and steel shapes as shown on Drawings.
 - E. Locate lift loops and erection inserts so as not to be visible in completed construction. Provide all lift loops and erection inserts with 1 ½ inch minimum non-shrink cover in completed construction. Any left loops or erection inserts that must be located in areas that will be exposed to public view in completed construction shall be recessed and patched with:

1. Minimum of 1 ½ inch drypack, latex modified concrete grout.
- F. Cover connections indicated on Drawings as concealed with:
1. Minimum of 1 ½ inch drypack, latex modified concrete grout to match surrounding concrete.
- G. Galvanize inserts, angles and other cast-in-steel devices exposed on surface of precast concrete where shown on Drawings.
- H. Welding:
1. Use proper preheat for welding high-strength steels.
 2. Welding processes shall not reduce cross-sectional area of concrete reinforcement.
 3. Obtain prior written authorization of Engineer for welding concrete reinforcement.
 3. Conform to AWS procedures when welding galvanized steel pieces.
- I. Finishes:
1. Structural Precast Concrete: Provide **"Standard Grade Finish" as per MNL-116 Appendix C.**
 2. Ends of prestressed elements exposed to view **at exterior face:** Strands to be recessed 3/4" minimum, and ends of member shall receive smooth dense standard finish.
- J. (NOT USED)
- K. Patching: Minor patching in the plant will be acceptable providing the structural adequacy of the product and the appearance is not impaired. Cosmetic patching of other members will be allowed only after the Architects approval of methods and workmen to be used. All patching shall be done by the manufacturer. Limitations as to amount of cosmetic patching, which will be permitted is subject to acceptance of Architect.
- L. Manufacturing Tolerances:
1. Tolerances for manufacture and erection of precast concrete are not accumulative.
 2. EXCEPT AS MODIFIED HEREIN, tolerances for manufacture of precast concrete pieces shall be in accordance with:
 - a. PCI Design Handbook, Latest Edition.
 - b. PCI MNL 116.
 - ~~3. Dimensions of block-outs: all precast pieces: Plus or minus ¼ inch.~~
 - ~~4. Position of sleeves and inserts: All precast pieces: Plus or minus ¼ inch.~~

- ~~5. Bearing surface deviation from specified plans: All precise pieces: ¼ inch.~~
- ~~6. Differential camber between adjacent pieces of same design: Per 10 feet of length: ¼ inch.
Total maximum: ½ inch.~~
- ~~Camber control and monitoring in accordance with Section 6.3 of MNL 116. Stress transfer:
At approximately equal strengths for all pieces.~~
- ~~7. Length of precast units: Plus or minus ½ inch of the length indicated on approved shop drawings.~~
- ~~8. Width of precast units: Plus or minus ¼ inch.~~
- ~~9. Thickness of precast units: Plus or minus ¼ inch.~~
- ~~10. Squareness of ends (vertical and horizontal alignment): Plus or minus ¼ inch.~~

- M. Openings: The manufacturer shall provide sleeves or Blockouts for all openings 8" and larger shown on the Drawings and all grouped openings, including those smaller than 8". Single openings in the smaller than 8" may be core drilled or saw cut after erection by the trade requiring same **following Precast Contractor provided criteria.**

The **Construction Manager** is responsible for warning other trades against indiscriminate cutting of prestressed concrete members.

- N. Plates, Anchorages, and Embedded Items: All steel anchors, anchor plates, or angles built into the work of other trades which will support precast members, will be provided by the precaster and installed by the trade responsible for the material in which they are located.

All steel or threaded inserts cast into precast, weld plates between sections of precast, and loose steel items needed for erection of precast shall be furnished and installed by the precast subcontractor.

- 2.5 Grout: Portland Cement Grout: Mixture consisting of Portland Cement and sand proportioned to achieve at 28-day compressive strength of 5000 psi.
- 2.6 Dovetail Anchors: Provide continuous dovetail slots with filler strips cast into precast elements as required for connection of adjacent masonry construction. Dovetail slots prefabricated of 24 gauge galvanized steel, unless otherwise noted, and shall accommodate 1" dovetail masonry anchors installed by Others.

PART 3 – EXECUTION

3.1 NOT USED

3.2 ERECTION

- A. Erection of precast concrete shall be performed by workers skilled in this Work under direction of supervisor with at least five years of experience in erecting precast Work similar to that of this project.
- B. All precast concrete pieces shall have 28 day specified strength before permanent welded or cast-in- place concrete connections are made to those pieces. Maintain adequate support and bracing at all times.
- C. Lift pieces with suitable equipment at lifting points provided by manufacturer.
- D. Temporary shoring and bracing, if required, shall comply with manufacturer's recommendations.
- E. Set each piece in position as assigned on erection drawings, level out variations between adjacent members by jacking, loading or any other feasible method recommended by the manufacturer and acceptable to the Engineer. Members must be positioned so that cumulative dimensional errors do not occur.
- F. Welding: Field welding shall be accompanied by certified welding operators only, using equipment and materials compatible to the base material. Methods and materials shall be in accordance with AWS D1.1 and AWS D1.4. Protect all units from damage by field welding or cutting operations.
- G. Erection Tolerances: **The precast structure shall be erected within tolerances as defined in PCI MNL-127 and MNL-135.**

~~1. Erect precast concrete pieces to tolerances indicated in 2.4.L. EXCEPT AS MODIFIED HEREIN:~~

- ~~a. Variation from specified location in plan: 3/8 inch.~~
- ~~b. Variation of specified clearance from adjacent independent piece or from specified joint width: Plus or minus 1/4 inch.~~

~~2. Pre Topped Decks: 1/4 inch.~~

- ~~a. Variation from specified bearings on supports: Beams and spandrel panels:
Length on support: Minus 0 inch.
Width on support: Minus 0 inch.~~

- ~~b. Variation from specified bearing on supports: Structural tee deck pieces:
Length on support: Minus 0 inch.
Width on support: Minus 0 inch.~~

~~e. Additional requirements for structural tee deck pieces:~~

~~Deviation in plan from straight line parallel to specified linear building line: Any tee, 1/2 inch.~~

~~Variation in elevation from specified elevation: Any tee, any end: Plus 1/4" or minus 1/3".~~

~~Deviation in elevation from line parallel to specified grade line:~~

~~Longitudinal: 3/4 inch.~~

~~Transverse: 3/8" inch.~~

~~d. Camber differential between adjacent units after installation:~~

~~Roof units without concrete toppings: 1/2".~~

~~Floor units without concrete toppings, 1/4".~~

3. ~~Column and Wall Units~~

~~a. Deviation from plumb of the working line of an individual unit: 1:500.~~

~~b. Deviation from established center line of the working points of an individual unit:~~

~~• Units adjacent to elevator shafts: 1" in the first 20 stories plus 1/32" for each additional story but not to exceed 2".~~

~~• Exterior units in the dimension perpendicular to the building line: 1" inward or 2" outward in the first 20 stories plus 1/16" for each additional story but not to exceed 2" inward or 3" outward.~~

~~c. Deviations from established center line of the base working point of the lowest units: 3/8".~~

~~d. At any splice in elevation, the working points of all units shall fall within a horizontal envelope parallel to the established building line having a total width of 1 1/2" for building lines up to 300 feet in length, plus 1/2" for each additional 100 feet of length, but not to exceed 3".~~

~~e. Deviation from established elevation of the top working point of an individual unit: plus 1/4" or minus 1/3".~~

~~f. Bowing differential between adjacent wall units after installation: 3/8" per 10 feet of length but not to exceed 1/2".~~

4. Structure shall be brought within tolerances and tolerances for deviation from plumb shall be checked by Registered Surveyor **employed by the Construction Manager** before placement of any cast-in-place concrete or grout on superstructure.

H. Welding galvanized steel: Either grind-off galvanizing before welding with conventional E70 electrodes OR do not grind and use E7013, E7016, or E7018 electrodes.

I. Touch-up all damaged galvanized surfaces with "Z.R.C. Cold Galvanizing Compound" to minimum dry film thickness of 8 mils.

- J. Repair: Units damaged during erection may be repaired providing such damage does not impair the structural adequacy or appearance of the member. Cosmetic patching will be allowed only after the Architect's acceptance of materials, methods, and workmen to be used.
- K. Grouting of Precast Unit Joints: After leveling and plumbing, grout joints between precast units with the specified Portland Cement grout where indicated.
 - 1. Cement grout: Grout shall be a mixture of not less than one part Portland cement to three parts fine sand, and the consistency shall be such that joints can be completely filled without seepage over adjacent surfaces. The grout shall achieve a minimum 28-day compressive strength of 3,000 psi. Any grout that seeps from the joint shall be completely removed before it hardens. Typically non-shrink grout is not required.
 - 2. Grout keys shall be filled and cured properly prior to loading the deck with building materials, equipment or field cut openings.
 - 3. Loading the deck with building materials and equipment should be reviewed with the manufacturer.
 - 4. Cold Weather construction requirements shall apply when grouting in winter conditions.

3.3 CLEANING

Clean all exposed surfaces as necessary to remove dirt and stains, which may be on surfaces after erection. Clean precast units only after all installation procedures are completed. Wash and rinse exposed surfaces in accordance with precast manufacturer's recommendations. Remove all weld stains.

Clean up after erection is the responsibility of the precast subcontractor. Any subsequent cleanup required is the responsibility of the **Construction Manager** and the trade involved.

3.4 ATTACHMENT

Insert or anchors required for support of the work of other trades shall be installed in a manner that protects the precast units from damage. No drilling or installation of power-driven fasteners may be undertaken in precast/prestressed units without prior acceptance by the Architect and Structural Engineer.

END OF SECTION

SECTION 03 45 00 - PRECAST ARCHITECTURAL CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Architectural Precast Concrete Cladding and Load-Bearing units.
 - 2. Brick-faced, architectural precast concrete units.
- B. Related Sections include the following:
 - 1. Division 05 Section "Metal Fabrications" for kickers and other miscellaneous steel shapes.
 - 2. Division 07 Section "Water Repellents" for water-repellent finish treatments.

1.3 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide architectural precast concrete units and connections capable of withstanding the following design loads within limits and under conditions indicated:
 - 1. Loads: Pieces shall be designed considering all vertical loads, lateral loads due to wind, seismic, temperature differentials, shrinkage, shortening, and effects due to prestressing.
 - 2. Design framing system and connections to maintain clearances at openings, to allow for fabrication and construction tolerances, to accommodate live-load deflection, shrinkage and creep of primary building structure, and other building movements as follows:
 - a. Upward and downward movement of $L/300$.
 - 3. Thermal Movements: Provide for in-plane thermal movements resulting from annual ambient temperature changes of 80 deg F - 120 deg F.
 - 4. Fire-Resistance Rating: Select material and minimum thicknesses to provide 2-hour fire rating.
 - 5. Vehicular Impact Loads: Design spandrel beams acting as vehicular barriers for passenger cars to resist a single 6000-lb service load and 10,000-lb (44.5-kN) ultimate load applied horizontally in any direction to the spandrel beam, with anchorages or attachments capable of transferring this load to the structure. Design spandrel beams assuming the load to act at a height of 18 inches and 27

inches (not concurrently) above the floor or ramp surface on an area not to exceed 1 sq. ft. (0.93 sq. m).

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Design Mixtures: For each precast concrete mixture. Include compressive strength and water-absorption tests.
- C. Shop Drawings: Detail fabrication and installation of architectural precast concrete units. Indicate locations, plans, elevations, dimensions, shapes, and cross sections of each unit. Indicate joints, reveals, and extent and location of each surface finish. Indicate details at building corners.
 - 1. Indicate separate face and backup mixture locations and thicknesses.
 - 2. Indicate welded connections by AWS standard symbols. Detail loose and cast-in hardware and connections.
 - 3. Indicate locations, tolerances, and details of anchorage devices to be embedded in or attached to structure or other construction.
 - 4. Indicate locations, extent, and treatment of dry joints if two-stage casting is proposed.
 - 5. Include plans and elevations showing unit location and sequence of erection for special conditions.
 - 6. Indicate location of each architectural precast concrete unit by same identification mark placed on panel.
 - 7. Indicate relationship of architectural precast concrete units to adjacent materials.
 - 8. Indicate locations and details of brick units, including corner units and special shapes, and joint treatment.
 - 9. Indicate locations and details of stone facings, anchors, and joint widths.
 - 10. Design Modifications: If design modifications are proposed to meet performance requirements and field conditions, submit design calculations and Shop Drawings. Do not adversely affect the appearance, durability, or strength of units when modifying details or materials and maintain the general design concept.
 - 11. Comprehensive engineering analysis signed and sealed by the qualified professional engineer responsible for its preparation. Show governing panel types, connections, and types of reinforcement, including special reinforcement. Indicate location, type, magnitude, and direction of loads imposed on the building structural frame from architectural precast concrete.
- D. Samples: For each type of finish indicated on exposed surfaces of architectural precast concrete units, in sets of 3, illustrating full range of finish, color, and texture variations expected; approximately 12 by 12 by 2 inches (300 by 300 by 50 mm).
 - 1. When other faces of precast concrete unit are exposed, include Samples illustrating workmanship, color, and texture of backup concrete as well as facing concrete.
 - 2. Samples for each brick unit required, showing full range of color and texture expected. Include Sample showing color and texture of joint treatment.

- a. Grout Samples for Initial Selection: Color charts consisting of actual sections of grout showing manufacturer's full range of colors.
- b. Grout Samples for Verification: Showing color and texture of joint treatment.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer, fabricator and testing agency.
- B. Welding certificates.
- C. Material Certificates: For the following items, signed by manufacturers:
 - 1. Cementitious materials.
 - 2. Reinforcing materials and prestressing tendons.
 - 3. Admixtures.
 - 4. Bearing pads.
 - 5. Structural-steel shapes and hollow structural sections.
 - 6. Brick units and accessories.
 - 7. Stone anchors.
- D. Material Test Reports: For aggregates.
- E. Source quality-control test reports.
- F. Field quality-control test and special inspection reports.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A precast concrete erector shall be fully certified by PCI, prior to beginning any work at the job site to erect Category A (Architectural Systems) for non-load bearing members.
- B. Fabricator Qualifications: A firm that assumes responsibility for engineering architectural precast concrete units to comply with performance requirements. This responsibility includes preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.
 - 1. Participates in PCI's plant certification program at time of bidding and is designated a PCI-certified plant for Group A, Category A1 - Architectural Cladding and Load Bearing Units or participates in APA's "Plant Certification Program for Production of Architectural Precast Concrete Products" and is designated an APA-certified plant.
- C. Design Standards: Comply with ACI 318 (ACI 318M) and design recommendations of PCI MNL 120, "PCI Design Handbook - Precast and Prestressed Concrete," applicable to types of architectural precast concrete units indicated.
- D. Quality-Control Standard: For manufacturing procedures and testing requirements, quality-control recommendations, and dimensional tolerances for types of units required,

comply with PCI MNL 117, "Manual for Quality Control for Plants and Production of Architectural Precast Concrete Products."

- E. Welding: Qualify procedures and personnel according to AWS D1.1/D.1.1M, "Structural Welding Code - Steel"; and AWS D1.4, "Structural Welding Code - Reinforcing Steel."
- F. Calculated Fire-Test-Response Characteristics: Where indicated, provide architectural precast concrete units whose fire resistance has been calculated according to ACI 216.1/TMS 0216.1, "Standard Method for Determining Fire Resistance of Concrete and Masonry Construction Assemblies," or PCI MNL 124, "Design for Fire Resistance of Precast Prestressed Concrete," and is acceptable to authorities having jurisdiction.
- G. Sample Panels: After sample approval and before fabricating architectural precast concrete units, produce a minimum of 2 sample panels approximately 50 sq. ft. in area for review by Architect. Incorporate full-scale details of architectural features, finishes, textures, and transitions in sample panels.
 - 1. Locate panels where indicated or, if not indicated, as directed by Architect.
 - 2. Damage part of an exposed-face surface for each finish, color, and texture, and demonstrate adequacy of repair techniques proposed for repair of surface blemishes.
 - 3. After acceptance of repair technique, maintain one sample panel at manufacturer's plant and one at Project site in an undisturbed condition as a standard for judging the completed Work.
 - 4. Demolish and remove sample panels when directed.
- H. Range Samples: After sample panel approval and before fabricating architectural precast concrete units, produce a minimum of 3 sets of samples, approximately 16 sq. ft. (1.5 sq. m) in area, representing anticipated range of each color and texture on Project's units. Following range sample, maintain one set of samples at Project site and remaining sample sets at manufacturer's plant as color and texture approval reference.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver architectural precast concrete units in such quantities and at such times to limit unloading units temporarily on the ground.
- B. Support units during shipment on nonstaining shock-absorbing material.
- C. Store units with adequate dunnage and bracing and protect units to prevent contact with soil, to prevent staining, and to prevent cracking, distortion, warping or other physical damage.
- D. Place stored units so identification marks are clearly visible, and units can be inspected.
- E. Handle and transport units in a position consistent with their shape and design in order to avoid excessive stresses which would cause cracking or damage.
- F. Lift and support units only at designated points shown on Shop Drawings.

1.8 SEQUENCING

- A. Furnish loose connection hardware and anchorage items to be embedded in or attached to other construction without delaying the Work. Provide locations, setting diagrams, templates, instructions, and directions, as required, for installation.

PART 2 - PRODUCTS

2.1 MOLD MATERIALS

- A. Molds: Rigid, dimensionally stable, non-absorptive material, warp and buckle free, that will provide continuous and true precast concrete surfaces within fabrication tolerances indicated; nonreactive with concrete and suitable for producing required finishes.
 - 1. Mold-Release Agent: Commercially produced liquid-release agent that will not bond with, stain or adversely affect precast concrete surfaces and will not impair subsequent surface or joint treatments of precast concrete.
- B. Form Liners: Units of face design, texture, arrangement, and configuration indicated. Furnish with manufacturer's recommended liquid-release agent that will not bond with, stain, or adversely affect precast concrete surfaces and will not impair subsequent surface or joint treatments of precast concrete.
- C. Surface Retarder: Chemical set retarder, capable of temporarily delaying final hardening of newly placed concrete mixture to depth of reveal specified.

2.2 REINFORCING MATERIALS

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.
- B. Low-Alloy-Steel Reinforcing Bars: ASTM A 706/A 706M, deformed.
- C. Galvanized Reinforcing Bars: ASTM A 767/A 767M, Class II zinc coated, hot-dip galvanized, and chromate wash treated after fabrication and bending.
- D. Epoxy-Coated Reinforcing Bars (If used): ASTM A 615/A 615M, Grade 60 (Grade 420) deformed bars, ASTM A 775/A 775M or ASTM A 934/A 934M epoxy coated.
- E. Steel Bar Mats: ASTM A 184/A 184M, fabricated from ASTM A 615/A 615M, Grade 60 (Grade 420) deformed bars, assembled with clips.
- F. Plain-Steel Welded Wire Reinforcement: ASTM A 1064/A 1064M, fabricated from as-drawn steel wire into flat sheets.
- G. Deformed-Steel Welded Wire Reinforcement: ASTM A 1064/A 1064M, flat sheet.

- H. Supports: Suspend reinforcement from back of mold or use bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place according to PCI MNL 117.

2.3 PRESTRESSING TENDONS

- A. Prestressing Strand: ASTM A 416/A 416M, Grade 270 (Grade 1860), uncoated, 7-wire, low-relaxation strand.
 - 1. Coat unbonded post-tensioning strand with corrosion inhibitor passing ASTM D 1743 and sheath with polypropylene tendon sheathing. Include anchorage devices and coupler assemblies.

2.4 CONCRETE MATERIALS

- A. Portland Cement: ASTM C 150, Type I or Type III, gray, unless otherwise indicated.
- B. Supplementary Cementitious Materials (if used):
 - 1. Fly Ash: ASTM C 618, Class C or F, with maximum loss on ignition of 3 percent.
 - 2. Metakaolin: ASTM C 618, Class N.
 - 3. Silica Fume: ASTM C 1240, with optional chemical and physical requirement.
 - 4. Slag Cement: ASTM C 989, Grade 100 or 120.
- C. Normal-Weight Aggregates: Except as modified by PCI MNL 117, ASTM C 33, with coarse aggregates complying with Class 5S. Stockpile fine and coarse aggregates for each type of exposed finish from a single source (pit or quarry) for Project.
 - 1. Face-Mixture-Coarse Aggregates: Selected, hard, and durable; free of material that reacts with cement or causes staining; to match selected finish sample.
 - a. Gradation: Uniformly graded
 - 2. Face-Mixture-Fine Aggregates: Selected, natural or manufactured sand of same material as coarse aggregate, unless otherwise approved by Architect.
- D. Water: Potable; free from deleterious material that may affect color stability, setting, or strength of concrete and complying with chemical limits of PCI MNL 117.
- E. Air-Entraining Admixture: ASTM C 260, certified by manufacturer to be compatible with other required admixtures.
- F. Chemical Admixtures (if used, not currently required): Certified by manufacturer to be compatible with other admixtures and to not contain calcium chloride, or more than 0.15 percent chloride ions by weight of admixture.
 - 1. Coloring Admixture: ASTM C 979, synthetic or natural mineral-oxide pigments or colored water-reducing admixtures, temperature stable, and nonfading.
 - 2. Water-Reducing Admixtures: ASTM C 494/C 494M, Type A.

3. Retarding Admixture: ASTM C 494/C 494M, Type B.
4. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
5. Water-Reducing and Accelerating Admixture: ASTM C 494/C 494M, Type E.
6. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
7. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
8. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017 M.

2.5 STEEL CONNECTION MATERIALS

- A. Carbon-Steel Shapes and Plates: ASTM A 36/A 36M.
- B. Carbon-Steel-Headed Studs: ASTM A 108, AISI 1018 through AISI 1020, cold finished, AWS D1.1/D1.1M, Type A or B, with arc shields and with minimum mechanical properties of PCI MNL 117, Table 3.2.3.
- C. Carbon-Steel Plate: ASTM A 283/A 283M.
- D. Malleable Iron Castings: ASTM A 47/A 47M.
- E. Carbon-Steel Castings: ASTM A 27/A 27M, Grade 60-30 (Grade 415-205).
- F. High-Strength, Low-Alloy Structural Steel: ASTM A 572/A 572M.
- G. Carbon-Steel Structural Tubing: ASTM A 500, Grade B.
- H. Wrought Carbon-Steel Bars: ASTM A 675/A 675M, Grade 65 (Grade 450).
- I. Deformed-Steel Wire or Bar Anchors: ASTM A 1064 or ASTM A 706/A 706M.
- J. Carbon-Steel Bolts and Studs: ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); carbon-steel, hex-head bolts and studs; carbon-steel nuts, ASTM A 563 (ASTM A 563M); and flat, unhardened steel washers, ASTM F 844.
- K. High-Strength Bolts and Nuts: ASTM A 325 (ASTM A 325M), Type 1, heavy hex steel structural bolts; heavy hex carbon-steel nuts, ASTM A 563 (ASTM A 563M); and hardened carbon-steel washers, ASTM F 436 (ASTM F 436M).
- L. Zinc-Coated Finish: For exterior steel items, steel in exterior walls, and items indicated for galvanizing, apply zinc coating by hot-dip process according to ASTM A 123/A 123M or ASTM A 153/A 153M
 1. For steel shapes, plates, and tubing to be galvanized, limit silicon content of steel to less than 0.03 percent or to between 0.15 and 0.25 percent or limit sum of silicon and 2.5 times phosphorous content to 0.09 percent.
 2. Galvanizing Repair Paint: High-zinc-dust-content paint with dry film containing not less than 94 percent zinc dust by weight, and complying with DOD-P-21035A or SSPC-Paint 20.

- M. Shop-Primed Finish: Prepare surfaces of nongalvanized steel items, except those surfaces to be embedded in concrete, according to requirements in SSPC-SP 3 and shop-apply lead- and chromate-free, rust-inhibitive primer, complying with performance requirements in MPI 79 according to SSPC-PA 1.
- N. Welding Electrodes: Comply with AWS standards.

2.6 STAINLESS-STEEL CONNECTION MATERIALS (WHERE REQUIRED BY 01 12 00 BASIS OF DESIGN OR PROPOSED BY PRECASTER)

- A. Stainless-Steel Plate: ASTM A 666, Type 304, of grade suitable for application.
- B. Stainless-Steel Bolts and Studs: ASTM F 593, Alloy 304 or 316, hex-head bolts and studs; stainless-steel nuts; and flat, stainless-steel washers.
 - 1. Lubricate threaded parts of stainless-steel bolts with an antiseize thread lubricant during assembly.
- C. Stainless-Steel-Headed Studs: ASTM A 276, with minimum mechanical properties of PCI MNL 117, Table 3.2.3.

2.7 ACCESSORIES

- A. Reglets: Stainless steel, Type 302 or 304 felt or fiber filled, or with face opening of slots covered.
- B. Precast Accessories: Provide clips, hangers, plastic or steel shims, and other accessories required to install architectural precast concrete units.

2.8 GROUT MATERIALS

- A. Sand-Cement Grout: Portland cement, ASTM C 150, Type I, and clean, natural sand, ASTM C 144 or ASTM C 404. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.
- B. Nonmetallic, Nonshrink Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage-compensating agents, plasticizing and water-reducing agents, complying with ASTM C 1107, Grade A for drypack and Grades B and C for flowable grout and of consistency suitable for application within a 30-minute working time.
- C. Epoxy-Resin Grout: Two-component, mineral-filled epoxy resin; ASTM C 881/C 881M, of type, grade, and class to suit requirements.

2.9 THIN BRICK UNITS

A. Thin Brick

1. Thickness not less than ½ in. (13mm) nor more than 1 in. (25mm)
2. Face size: Modular: 2-1/4 in. (57mm) high by 7-5/8 in. (190mm) long
3. Size, color, texture: Match Architect's approved samples: Summitville 594 Olde Chicago for basis of bid.
4. Special shapes: Include corners, edge corners, and end edge corners
5. Back surface texture: Ribbed

B. Dimensional Tolerances – measure in accordance with ASTM C67

1. Thickness: Plus 0 in., minus 1/16 in. (+0, -1.6mm)
2. Face size: Plus 0 in., minus 1/16 in. for dimensions 8 in. (200mm) or less. Plus 0 in., minus 3/32 in. (+0, -2.4mm) for dimensions greater than 8 in. (200mm)
3. Warpage: not more than 1/16 in. (1.6mm) either concave or convex from a consistent plane
4. Out of square: Plus or minus 1/16 in. (±1.6mm)
5. Shape angle: Plus or minus 1 degree from specified angle

C. Properties

1. Breaking strength: Not less than 250 psi (1.7 MPa) tested in accordance with ASTM C67
2. Cold water absorption: Maximum 6% at 24 hours tested in accordance with ASTM C67
3. Efflorescence: Rated “not effloresced” when tested in accordance with ASTM C67
4. Freeze thaw resistance:
 - a. Uncoated brick: No detectable deterioration (spalling, cracking, or breaking) after 300 cycles tested in accordance with ASTM C666, Method A or B on assembled specimens
 - b. Surface coloring: No observable difference in the applied finish when viewed at a distance of 20 ft (6m) after 50 cycles tested in accordance with ASTM C67. In addition, the brick shall undergo ASTM C666 test described above
5. Pull-out strength: Not less than 150 psi (1.0 MPa) from base concrete before and after freeze thaw testing tested in accordance with specified modification to ASTM E488.
6. Chemical resistance: Rated “not affected” when tested with a 10% hydrochloric acid solution in accordance with ASTM C650.

D. Testing requirements:

1. Minimum number of test specimens: In accordance with appropriate ASTM specifications except as specified in D.1.a.

- a. Exception for freeze thaw and pull-out strength tests: Ten (10) assembled specimens measuring 8 in. by 16 in. (200mm by 405mm) long with the brick embedded into the concrete substrate (assembled specimens). The ten (10) assembled specimens are divided into five (5) Sample A assemblies and five (5) Sample B assemblies. The precast concrete substrate shall have a minimum thickness of 2-1/2 in. (63mm) plus the embedded brick thickness. The precast concrete shall have a minimum compressive strength of at least 5000 psi (34.5 MPa) and 4 to 6% entrained air. The embedded brick coursing pattern for testing purposes shall be modular size brick on a half running bond pattern with a formed raked joint geometry of no less than 3/8 in. (9mm) wide and a depth no greater than 1/4 in. (6mm) from the exterior face of the brick.

One brick from the center of each sample assembly shall be tested for pull-out strength. Each Sample B assembly shall first be tested for freeze thaw resistance. In place of anchor specified in ASTM E488, use 3/8 in. (9mm) minimum thickness steel plate of same size as single brick face bonded with epoxy to a single brick face for each pull-out strength test. The steel plate shall have a centrally located pull-rod welded to the plate.

2. Back surface texture of samples for pull-out strength and freeze thaw resistance testing shall be the same.
3. Frequency of testing:
 - a. Dimensional tolerances shall be checked prior to shipping on each run of brick supplied to the project.
 - b. Cold water 24 hour absorption testing shall be conducted on every clay body/color of project specific brick prior to each shipment. Submit written documentation. The buyer reserves the right to conduct the same test prior to first shipment.
 - c. All other tests specified shall be conducted for each clay body at an accredited laboratory at least every six years.

2.10 CONCRETE MIXTURES

- A. Prepare design mixtures for each type of precast concrete required.
 1. Limit use of fly ash and silica fume to 20 percent of portland cement by weight; limit metakaolin and silica fume to 10 percent of portland cement by weight.
- B. Design mixtures may be prepared by a qualified independent testing agency or by qualified precast plant personnel at architectural precast concrete fabricator's option.
- C. Limit water-soluble chloride ions to maximum percentage by weight of cement permitted by ACI 318 (ACI 318M) or PCI MNL 117 when tested according to ASTM C 1218/C 1218M.
- D. Normal-Weight Concrete Mixtures: Proportion face and backup mixtures or full-depth mixtures, at fabricator's option by either laboratory trial batch or field test data methods

according to ACI 211.1, with materials to be used on Project, to provide normal-weight concrete with the following properties:

1. Compressive Strength (28 Days): 5000 psi (34.5 MPa) minimum.
 2. Maximum Water-Cementitious Materials Ratio: 0.45.
- E. Water Absorption: 6 percent by weight or 14 percent by volume, tested according to PCI MNL 117.
- F. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content complying with PCI MNL 117.
- G. When included in design mixtures, add other admixtures to concrete mixtures according to manufacturer's written instructions.

2.11 MOLD FABRICATION

- A. Molds: Accurately construct molds, mortar tight, of sufficient strength to withstand pressures due to concrete-placement operations and temperature changes and for prestressing and detensioning operations. Coat contact surfaces of molds with release agent before reinforcement is placed. Avoid contamination of reinforcement and prestressing tendons by release agent.
1. Place form liners accurately to provide finished surface texture indicated. Provide solid backing and supports to maintain stability of liners during concrete placement. Coat form liner with form-release agent.
- B. Maintain molds to provide completed architectural precast concrete units of shapes, lines, and dimensions indicated, within fabrication tolerances specified.
1. Form joints are not permitted on faces exposed to view in the finished work.
 2. Edge and Corner Treatment: Uniformly chamfered.

2.12 THIN BRICK FACINGS

- A. Place form liner templates accurately to provide grid for thin brick facings. Provide solid backing and supports to maintain stability of liners while placing thin bricks and during concrete placement.
- B. Securely place thin brick units face down into form liner pockets and place concrete backing mixture.
- C. For Repairs: Completely fill joint cavities between thin brick units with sand-cement mortar, and place precast concrete backing mixture while sand-cement mortar is still fluid enough to ensure bond.
- D. For Repairs: Mix and install grout according to ANSI A108.10. Completely fill joint cavities between thin brick units with grout, and compress into place without spreading

grout onto faces of thin brick units. Remove excess grout immediately to prevent staining of brick.

1. Tool joints to a **slightly concave** shape when pointing grout is thumbprint hard.

E. Clean faces and joints of brick facing.

2.13 FABRICATION

A. Cast-in Anchors, Inserts, Plates, Angles, and Other Anchorage Hardware: Fabricate anchorage hardware with sufficient anchorage and embedment to comply with design requirements. Accurately position for attachment of loose hardware, and secure in place during precasting operations. Locate anchorage hardware where it does not affect position of main reinforcement or concrete placement.

1. Weld-headed studs and deformed bar anchors used for anchorage according to AWS D1.1/D1.1M and AWS C5.4, "Recommended Practices for Stud Welding."

B. Furnish loose hardware items including steel plates, clip angles, seat angles, anchors, dowels, cramps, hangers, and other hardware shapes for securing architectural precast concrete units to supporting and adjacent construction.

C. Cast-in reglets, slots, holes, and other accessories in architectural precast concrete units as indicated on the Contract Drawings.

D. Cast-in openings larger than 10 inches (250 mm) in any dimension. Do not drill or cut openings or prestressing strand without Design Professionals approval.

E. Reinforcement: Comply with recommendations in PCI MNL 117 for fabricating, placing, and supporting reinforcement.

1. Clean reinforcement of loose rust and mill scale, earth, and other materials that reduce or destroy the bond with concrete. When damage to epoxy-coated reinforcing exceeds limits specified in ASTM A 775/A 775M, repair with patching material compatible with coating material and epoxy coat bar ends after cutting.
2. Accurately position, support, and secure reinforcement against displacement during concrete-placement and consolidation operations. Completely conceal support devices to prevent exposure on finished surfaces.
3. Place reinforcement to maintain at least 3/4-inch (19-mm) minimum coverage. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position while placing concrete. Direct wire tie ends away from finished, exposed concrete surfaces.
4. Place reinforcing steel and prestressing strand to maintain at least 3/4-inch (19-mm) minimum concrete cover. Increase cover requirements for reinforcing steel to 1-1/2 inches (38 mm) when units are exposed to corrosive environment or severe exposure conditions. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position while placing concrete. Direct wire tie ends away from finished, exposed concrete surfaces.

5. Install welded wire fabric in lengths as long as practicable. Lap adjoining pieces at least one full mesh spacing and wire tie laps, where required by design. Offset laps of adjoining widths to prevent continuous laps in either direction.
- F. Reinforce architectural precast concrete units to resist handling, transportation, and erection stresses.
- G. Prestress tendons for architectural precast concrete units by either pretensioning or post-tensioning methods. Comply with PCI MNL 117.
 1. Delay detensioning or post-tensioning of precast, prestressed architectural concrete units until concrete has reached its indicated minimum design release compressive strength as established by test cylinders cured under same conditions as concrete.
 2. Detension pretensioned tendons either by gradually releasing tensioning jacks or by heat-cutting tendons, using a sequence and pattern to prevent shock or unbalanced loading.
 3. If concrete has been heat cured, detension while concrete is still warm and moist to avoid dimensional changes that may cause cracking or undesirable stresses.
 4. Protect strand ends and anchorages with bituminous, zinc-rich, or epoxy paint to avoid corrosion and possible rust spots.
- H. Comply with requirements in PCI MNL 117 and requirements in this Section for measuring, mixing, transporting, and placing concrete. After concrete batching, no additional water may be added.
- I. Place face mixture to a minimum thickness after consolidation of the greater of 1 inch (25 mm) or 1.5 times the maximum aggregate size, but not less than the minimum reinforcing cover specified.
- J. Place concrete in a continuous operation to prevent seams or planes of weakness from forming in precast concrete units.
 1. Place backup concrete mixture to ensure bond with face-mixture concrete.
- K. Thoroughly consolidate placed concrete by internal and external vibration without dislocating or damaging reinforcement and built-in items, and minimize pour lines, honeycombing, or entrapped air on surfaces. Use equipment and procedures complying with PCI MNL 117.
 1. Place self-consolidating concrete without vibration according to PCI TR-6, "Interim Guidelines for the Use of Self-Consolidating Concrete in Precast/Prestressed Concrete Institute Member Plants."
- L. Comply with PCI MNL 117 for hot- and cold-weather concrete placement.
- M. Identify pickup points of architectural precast concrete units and orientation in structure with permanent markings, complying with markings indicated on Shop Drawings. Imprint or permanently mark casting date on each architectural precast concrete unit on a surface that will not show in finished structure.

- N. Cure concrete, according to requirements in PCI MNL 117, by moisture retention without heat or by accelerated heat curing using low-pressure live steam or radiant heat and moisture. Cure units until compressive strength is high enough to ensure that stripping does not have an effect on performance or appearance of final product. Limit concrete temperature to 140° F during accelerated curing unless test data is submitted that cement is not subject to delayed ettringite formation (DEF).
- O. Discard and replace architectural precast concrete units that do not comply with requirements, including structural, manufacturing tolerance, and appearance, unless repairs meet requirements in PCI MNL 117 and Architect's approval.

2.14 INSULATED PANEL CASTING

- A. Cast and screed supported wythe over mold.
- B. Place insulation boards abutting edges and ends of adjacent boards. Insert wythe connectors through insulation, and consolidate concrete around connectors according to connector manufacturer's written instructions.
- C. Cast and screed top wythe to meet required finish.

2.15 FABRICATION TOLERANCES

- A. Per section **00 34 10**

2.16 FINISHES

- A. Panel faces shall be free of joint marks, grain, and other obvious defects. Corners, including false joints shall be uniform, straight, and sharp. Finish exposed-face surfaces of architectural precast concrete units to match approved design reference sample and sample panels and as follows:
 - 1. Exterior Architectural precast including spandrels, columns and shear walls to be built from normal cement with natural aggregates and texture to be medium sandblast finish.
 - 2. All other precast members including Double Tees to be precast concrete color. For finishes on precast members refer to specification 034100
- B. Finish exposed top, bottom, and back surfaces of architectural precast concrete units by smooth, steel-trowel finish.
- C. Finish unexposed surfaces of architectural precast concrete units by float finish.

2.17 SOURCE QUALITY CONTROL

- A. Quality-Control Testing: Test and inspect precast concrete according to PCI MNL 117 requirements. If using self-consolidating concrete, also test and inspect according to

PCI TR-6, "Interim Guidelines for the Use of Self-Consolidating Concrete in Precast/Prestressed Concrete Institute Member Plants."

- B. City will employ an independent testing agency to evaluate architectural precast concrete fabricator's quality-control and testing methods.
 - 1. Allow City's testing agency access to material storage areas, concrete production equipment, concrete placement, and curing facilities. Cooperate with City's testing agency and provide samples of materials and concrete mixtures as may be requested for additional testing and evaluation.
- C. Strength of precast concrete units will be considered deficient if units fail to comply with ACI 318 (ACI 318M) requirements for concrete strength.
- D. Testing: If there is evidence that strength of precast concrete units may be deficient or may not comply with ACI 318 (ACI 318M) requirements, precaster will employ an independent testing agency to obtain, prepare, and test cores drilled from hardened concrete to determine compressive strength according to ASTM C 42/C 42M.
 - 1. A minimum of three representative cores will be taken from units of suspect strength, from locations directed by Architect.
 - 2. Cores will be tested in an air-dry condition.
 - 3. Strength of concrete for each series of 3 cores will be considered satisfactory if average compressive strength is equal to at least 85 percent of 28-day design compressive strength and no single core is less than 75 percent of 28-day design compressive strength.
 - 4. Test results will be made in writing on same day that tests are performed, with copies to Architect, Contractor, and precast concrete fabricator. Test reports will include the following:
 - a. Project identification name and number.
 - b. Date when tests were performed.
 - c. Name of precast concrete fabricator.
 - d. Name of concrete testing agency.
 - e. Identification letter, name, and type of precast concrete unit(s) represented by core tests; design compressive strength; type of break; compressive strength at breaks, corrected for length-diameter ratio; and direction of applied load to core in relation to horizontal plane of concrete as placed.
- E. Patching: If core test results are satisfactory and precast concrete units comply with requirements, clean and dampen core holes and solidly fill with precast concrete mixture that has no coarse aggregate, and finish to match adjacent precast concrete surfaces.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine supporting structural frame or foundation and conditions for compliance with requirements for installation tolerances, true and level bearing surfaces, and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. Do not install precast concrete units until supporting cast-in-place building structural framing has attained minimum allowable design compressive strength or supporting steel or other structure is complete.

3.2 INSTALLATION

- A. Install clips, hangers, bearing pads, and other accessories required for connecting architectural precast concrete units to supporting members and backup materials.
- B. Erect architectural precast concrete level, plumb, and square within specified allowable tolerances. Provide temporary supports and bracing as required to maintain position, stability, and alignment as units are being permanently connected.
 - 1. Install temporary steel or plastic spacing shims or bearing pads as precast concrete units are being erected. Tack weld steel shims to each other to prevent shims from separating.
 - 2. Maintain horizontal and vertical joint alignment and uniform joint width as erection progresses.
 - 3. Remove projecting lifting devices and grout fill voids within recessed lifting devices flush with surface of adjacent precast surfaces when recess is exposed.
 - 4. Unless otherwise indicated, maintain uniform joint widths of 3/4 inch (19 mm).
- C. Connect architectural precast concrete units in position by bolting, welding, grouting, or as otherwise indicated on Shop Drawings. Remove temporary shims, wedges, and spacers as soon as practical after connecting and grouting are completed.
 - 1. Do not permit connections to disrupt continuity of roof flashing.
- D. Welding: Comply with applicable AWS D1.1/D1.1M and AWS D1.4 for welding, welding electrodes, appearance, quality of welds, and methods used in correcting welding work.
 - 1. Protect architectural precast concrete units and bearing pads from damage by field welding or cutting operations, and provide noncombustible shields as required.
 - 2. Welds not specified shall be continuous fillet welds, using no less than the minimum fillet as specified by AWS.
 - 3. Clean weld-affected metal surfaces with chipping hammer followed by brushing, and apply a minimum 4.0-mil- (0.1-mm-) thick coat of galvanized repair paint to galvanized surfaces according to ASTM A 780.
 - 4. Remove, reweld, or repair incomplete and defective welds.

- E. At bolted connections, use lock washers, tack welding, or other approved means to prevent loosening of nuts after final adjustment.
 - 1. Where slotted connections are used, verify bolt position and tightness. For sliding connections, properly secure bolt but allow bolt to move within connection slot. For friction connections, apply specified bolt torque and check 25 percent of bolts at random by calibrated torque wrench.
- F. Grouting Connections: Grout connections where required or indicated. Retain grout in place until hard enough to support itself. Pack spaces with stiff grout material, tamping until voids are completely filled. Place grout to finish smooth, level, and plumb with adjacent concrete surfaces. Keep grouted joints damp for not less than 24 hours after initial set. Promptly remove grout material from exposed surfaces before it affects finishes or hardens.

3.3 ERECTION TOLERANCES

- A. Erect architectural precast concrete units level, plumb, square, true, and in alignment without exceeding the noncumulative erection tolerances of PCI MNL 117, Appendix I.

3.4 FIELD QUALITY CONTROL

- A. Special Inspections: City will engage a qualified special inspector to perform the following special inspections and prepare reports:
 - 1. Erection of precast concrete members.
- B. Testing Agency: City will engage a qualified testing agency to perform tests and inspections and prepare test reports.
- C. Field welds will be subject to visual inspections and nondestructive testing according to ASTM E 165 or ASTM E 709. High-strength bolted connections will be subject to inspections.
- D. Testing agency will report test results promptly and in writing to Contractor and Architect.
- E. Repair or remove and replace work where tests and inspections indicate that it does not comply with specified requirements.
- F. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.5 REPAIRS

- A. Repair architectural precast concrete units if permitted by Architect. The Architect reserves the right to reject repaired units that do not comply with requirements.
- B. Mix patching materials and repair units so cured patches blend with color, texture, and uniformity of adjacent exposed surfaces and show no apparent line of demarcation

between original and repaired work, when viewed in typical daylight illumination from a distance of 20 feet (6 m).

- C. Prepare and repair damaged galvanized coatings with galvanizing repair paint according to ASTM A 780.
- D. Wire brush, clean, and paint damaged prime-painted components with same type of shop primer.
- E. Remove and replace damaged architectural precast concrete units when repairs do not comply with requirements.

3.6 CLEANING

- A. Precast is to be erected in a clean condition, any soiling that occurs after erection or during shipping is to be cleaned by the trade responsible for the soiling. Clean soiled exterior surfaces of precast concrete units exposed to view.
- B. Clean mortar, plaster, fireproofing, weld slag, and other deleterious material from concrete surfaces and adjacent materials immediately.
- C. Clean exposed surfaces of precast concrete units after erection and completion of joint treatment to remove weld marks, other markings, dirt, and stains.
 - 1. Perform cleaning procedures, if necessary, according to precast concrete fabricator's recommendations. Clean soiled precast concrete surfaces with detergent and water, using stiff fiber brushes and sponges, and rinse with clean water. Protect other work from staining or damage due to cleaning operations.
 - 2. Do not use cleaning materials or processes that could change the appearance of exposed concrete finishes or damage adjacent materials.

END OF SECTION 03 45 00

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SECTION 04 20 00 - UNIT MASONRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Concrete masonry units.
 - 2. Building (common) brick.
 - 3. Hollow brick.
 - 4. Glazed brick.
 - 5. Structural clay facing tile.
 - 6. Mortar and grout.
 - 7. Steel reinforcing bars.
 - 8. Masonry-joint reinforcement.
 - 9. Ties and anchors.
 - 10. Embedded flashing.
 - 11. Miscellaneous masonry accessories.
 - 12. Masonry-cell fill.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For the following:
 - 1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.
 - 2. Reinforcing Steel: Detail bending, lap lengths, and placement of unit masonry reinforcing bars. Comply with ACI 315.[Show elevations of reinforced walls.]

1.4 INFORMATIONAL SUBMITTALS

- A. Material Certificates: For each type and size of the following:
 - 1. Masonry units.
 - a. Include data on material properties
 - b. For masonry units used in structural masonry, include data and calculations establishing average net-area compressive strength of units.

2. Integral water repellent used in CMUs.
 3. Cementitious materials. Include name of manufacturer, brand name, and type.
 4. Mortar admixtures.
 5. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
 6. Grout mixes. Include description of type and proportions of ingredients.
 7. Reinforcing bars.
 8. Joint reinforcement.
 9. Anchors, ties, and metal accessories.
- B. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.
1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C 109/C 109M for compressive strength, ASTM C 1506 for water retention, and ASTM C 91/C 91M for air content.
 2. Include test reports, according to ASTM C 1019, for grout mixes required to comply with compressive strength requirement.
- C. Statement of Compressive Strength of Masonry: For each combination of masonry unit type and mortar type, provide statement of average net-area compressive strength of masonry units, mortar type, and resulting net-area compressive strength of masonry determined according to TMS 602/ACI 530.1/ASCE 6.
- D. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to ASTM C 1093 for testing indicated.
- B. Sample Panels: **See Division 03 Precast Concrete for requirements for precast concrete samples which include brick DELIVERY, STORAGE, AND HANDLING**
- C. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.
- D. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- E. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.
- F. Deliver preblended, dry mortar mix in moisture-resistant containers. Store preblended, dry mortar mix in delivery containers on elevated platforms in a dry location or in covered weatherproof dispensing silos.

- G. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.6 FIELD CONDITIONS

- A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
 - 1. Extend cover a minimum of 24 inches (600 mm) down both sides of walls, and hold cover securely in place.
- B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three days after building masonry walls or columns.
- C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.
 - 1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
 - 2. Protect sills, ledges, and projections from mortar droppings.
 - 3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
 - 4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.
- D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.
 - 1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F (4 deg C) and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.
- E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Provide unit masonry that develops indicated net-area compressive strengths at 28 days.

1. Determine net-area compressive strength of masonry from average net-area compressive strengths of masonry units and mortar types (unit-strength method) according to TMS 602/ACI 530.1/ASCE 6.

2.2 UNIT MASONRY, GENERAL

- A. Masonry Standard: Comply with TMS 602/ACI 530.1/ASCE 6, except as modified by requirements in the Contract Documents.
- B. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated. Do not use units where such defects are exposed in the completed Work and will be within 20 feet (6 m) vertically and horizontally of a walking surface].

2.3 CONCRETE MASONRY UNITS

- A. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.
 1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
 2. Provide bullnose units for outside corners unless otherwise indicated.
- B. Integral Water Repellent: Provide units made with integral water repellent for exposed units and where indicated.
 1. Integral Water Repellent: Liquid polymeric, integral water-repellent admixture that does not reduce flexural bond strength. Units made with integral water repellent, when tested according to ASTM E 514/E 514M as a wall assembly made with mortar containing integral water-repellent manufacturer's mortar additive, with test period extended to 24 hours, shall show no visible water or leaks on the back of test specimen.
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1) ACM Chemistries.
 - 2) BASF Corporation; Construction Systems.
 - 3) Grace Construction Products; W.R. Grace & Co. -- Conn.
- C. CMUs: ASTM C 90.
 1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2150 psi (14.8 MPa)
 2. Density Classification: Normal weight unless otherwise indicated.
 3. Size (Width): Manufactured to dimensions 3/8 inch (10 mm) less than nominal dimensions.

4. Exposed Faces: Provide color and texture matching the range represented by Architect's sample.

2.4 CONCRETE AND MASONRY LINTELS

- A. Concrete Lintels: Precast or formed-in-place concrete lintels complying with requirements in Division 03 Section "Cast-in-Place Concrete," and with reinforcing bars indicated.
- B. Masonry Lintels: Prefabricated or built-in-place masonry lintels made from bond beam CMUs matching adjacent CMUs in color, texture, and density classification, with reinforcing bars placed as indicated and filled with coarse grout. Cure precast lintels before handling and installing. Temporarily support built-in-place lintels until cured.

2.5 MORTAR AND GROUT MATERIALS

- A. Portland Cement: ASTM C 150/C 150M, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.
- B. Hydrated Lime: ASTM C 207, Type S.
- C. Aggregate for Mortar: ASTM C 144.
 1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
 2. For joints less than 1/4 inch (6 mm) thick, use aggregate graded with 100 percent passing the No. 16 (1.18-mm) sieve.
 3. White-Mortar Aggregates: Natural white sand or crushed white stone.
 4. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.
- D. Water: Potable.

2.6 REINFORCEMENT

- A. Uncoated-Steel Reinforcing Bars: ASTM A 615/A 615M or ASTM A 996/A 996M, Grade 60 (Grade 420).
- B. Masonry-Joint Reinforcement, General: ASTM A 951/A 951M.
 1. Interior Walls: Hot-dip galvanized carbon steel.
 2. Exterior Walls: Hot-dip galvanized carbon steel.
 3. Wire Size for Side Rods: 0.148-inch (3.77-mm) diameter.
 4. Wire Size for Cross Rods: 0.148-inch (3.77-mm) diameter.

- C. Masonry-Joint Reinforcement for Single-Wythe Masonry: Ladder[**or truss**] type with single pair of side rods.

2.7 MISCELLANEOUS MASONRY ACCESSORIES

- A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene urethane or PVC.

2.8 MASONRY-CELL FILL

- A. Loose-Fill Insulation: Perlite complying with ASTM C 549, Type II (surface treated for water repellency and limited moisture absorption) or Type IV (surface treated for water repellency and to limit dust generation).

2.9 MASONRY CLEANERS

- A. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Diedrich Technologies, Inc.; a division of Sandell Construction Solutions.
 - b. EaCo Chem, Inc.
 - c. PROSOCO, Inc.

2.10 MORTAR AND GROUT MIXES

- A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.
 - 1. Do not use calcium chloride in mortar or grout.
 - 2. Use portland cement-lime masonry cement or mortar cement mortar unless otherwise indicated.
 - 3. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.

- B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.
- C. Mortar for Unit Masonry: Comply with ASTM C 270, Specification. Provide the following types of mortar for applications stated unless another type is indicated.
 - 1. For masonry below grade or in contact with earth, use Type M.
 - 2. For reinforced masonry, use Type M or Type S.
 - 3. For exterior, above-grade, load-bearing and nonload-bearing walls and parapet walls; for interior load-bearing walls; for interior nonload-bearing partitions; and for other applications where another type is not indicated, use Type N.
 - 4. For interior nonload-bearing partitions, Type O may be used instead of Type N.
- D. Grout for Unit Masonry: Comply with ASTM C 476.
 - 1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with TMS 602/ACI 530.1/ASCE 6 for dimensions of grout spaces and pour height.
 - 2. Proportion grout in accordance with ASTM C 476, Table 1 or [paragraph 4.2.2 for specified 28-day compressive strength indicated, but not less than 2000 psi (14 MPa).
 - 3. Provide grout with a slump of 8 to 11 inches (200 to 280 mm) as measured according to ASTM C 143/C 143M.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
 - 1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
 - 2. Verify that foundations are within tolerances specified.
 - 3. Verify that reinforcing dowels are properly placed.
 - 4. Verify that substrates are free of substances that impair mortar bond.
- B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Thickness: Build cavity and composite walls and other masonry construction to full thickness shown. Build single-wythe walls to actual widths of masonry units, using units of widths indicated.
- B. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match construction immediately adjacent to opening.
- C. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.
- D. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures. Mix units from several pallets or cubes as they are placed.

3.3 LAYING MASONRY WALLS

- A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.
- B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less-than-nominal 4-inch (100-mm) horizontal face dimensions at corners or jambs.
- C. Stopping and Resuming Work: Stop work by stepping back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.
- D. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.
- E. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below, and rod mortar or grout into core.
- F. Fill cores in hollow CMUs with grout 24 inches (600 mm) under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.
- G. Build nonload-bearing interior partitions full height of story to underside of solid floor or roof structure above unless otherwise indicated.
 - 1. Install compressible filler in joint between top of partition and underside of structure above.
 - 2. At fire-rated partitions, treat joint between top of partition and underside of structure above to comply with Division 07 Section "Joint Firestopping."

3.4 MORTAR BEDDING AND JOINTING

- A. Lay solid masonry units[**and hollow brick**] with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.
- B. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.

3.5 MASONRY-CELL FILL

- A. Pour lightweight-aggregate fill into cavities to fill void spaces. Maintain inspection ports to show presence of fill at extremities of each pour area. Close the ports after filling has been confirmed. Limit the fall of fill to one story high, but not more than 20 feet (6 m).

3.6 CONTROL AND EXPANSION JOINTS

- A. General: Install control- and expansion-joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.
- B. Form control joints in concrete masonry using one of the following methods:
 - 1. Fit bond-breaker strips into hollow contour in ends of CMUs on one side of control joint. Fill resultant core with grout, and rake out joints in exposed faces for application of sealant.
 - 2. Install preformed control-joint gaskets designed to fit standard sash block.
 - 3. Install interlocking units designed for control joints. Install bond-breaker strips at joint. Keep head joints free and clear of mortar, or rake out joint for application of sealant.
 - 4. Install temporary foam-plastic filler in head joints, and remove filler when unit masonry is complete for application of sealant.

3.7 LINTELS

- A. Provide concrete or masonry lintels where shown and where openings of more than 12 inches (305 mm) for brick-size units and 24 inches (610 mm) for block-size units are shown without structural steel or other supporting lintels.
- B. Provide minimum bearing of 8 inches (200 mm) at each jamb unless otherwise indicated.

3.8 REINFORCED UNIT MASONRY INSTALLATION

- A. Placing Reinforcement: Comply with requirements in TMS 602/ACI 530.1/ASCE 6.

- B. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.
 - 1. Comply with requirements in TMS 602/ACI 530.1/ASCE 6 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
 - 2. Limit height of vertical grout pours to not more than 12.67 ft. (3.86 m)

3.9 FIELD QUALITY CONTROL

- A. Testing and Inspecting: City will engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas as needed to perform tests and inspections. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.
- B. Inspections: Special inspections according to Level in TMS 402/ACI 530/ASCE 5.
 - 1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.
 - 2. Place grout only after inspectors have verified compliance of grout spaces and of grades, sizes, and locations of reinforcement.
 - 3. Place grout only after inspectors have verified proportions of site-prepared grout.
- C. Testing Prior to Construction: One set of tests.
- D. Testing Frequency: One set of tests for each 5000 sq. ft. (464 sq. m) of wall area or portion thereof.
- E. Concrete Masonry Unit Test: For each type of unit provided, according to ASTM C 140 for compressive strength.
- F. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, according to ASTM C 780.
- G. Mortar Test (Property Specification): For each mix provided, according to ASTM C 780. Test mortar for **compressive strength**.
- H. Grout Test (Compressive Strength): For each mix provided, according to ASTM C 1019.

3.10 REPAIRING, POINTING, AND CLEANING

- A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.
- B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.

- C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.
- D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
 - 1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
 - 2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
 - 3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
 - 4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
 - 5. Clean concrete masonry by applicable cleaning methods indicated in NCMA TEK 8-4A.

3.11 MASONRY WASTE DISPOSAL

- A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.
- B. Waste Disposal as Fill Material: Dispose of clean masonry waste, including excess or soil-contaminated sand, waste mortar, and broken masonry units, by crushing and mixing with fill material as fill is placed.
 - 1. Crush masonry waste to less than 4 inches (100 mm) in each dimension.
 - 2. Mix masonry waste with at least two parts of specified fill material for each part of masonry waste. Fill material is specified in Division 31 Section "Earth Moving."
 - 3. Do not dispose of masonry waste as fill within 18 inches (450 mm) of finished grade.
- C. Masonry Waste Recycling: Return broken CMUs not used as fill to manufacturer for recycling.
- D. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above or recycled, and other masonry waste, and legally dispose of off City's property.

END OF SECTION 04 20 00

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SECTION 05 50 00 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

1. Steel framing and supports for overhead doors.
2. Steel framing and supports for mechanical and electrical equipment.
3. Steel framing and supports for applications where framing and supports are not specified in other Sections.
4. Elevator machine beams hoist beams
5. Steel shapes for supporting elevator door sills.
6. Shelf angles.
7. Metal ladders.
8. Ladder safety cages.
9. Metal floor plate and supports.
10. Elevator pit sump covers.
11. Metal bollards.
12. Wire rope parking garage guards.
13. Pipe & Downspout guards.
14. Abrasive metal nosings & treads, thresholds

- B. Products furnished, but not installed, under this Section include the following:

1. Loose steel lintels.
2. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.

- C. Related Requirements:

1. Division 03 Section "Cast-in-Place Concrete" for installing anchor bolts, steel pipe sleeves, slotted-channel inserts, wedge-type inserts, and other items cast into concrete.
2. Division 04 Section "Unit Masonry" for installing loose lintels, anchor bolts, and other items built into unit masonry.
3. Division 05 Section "Structural Steel Framing."

1.3 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of metal fabrications that are anchored to or that receive other work. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.4 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Nonslip aggregates and nonslip-aggregate surface finishes.
 - 2. Metal nosings and treads.
 - 3. Paint products.
 - 4. Grout.
- B. Sustainable Design Submittals:
 - 1. **Product Data:** For recycled content, indicating postconsumer and preconsumer recycled content and cost.
- C. Shop Drawings: Show fabrication and installation details. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items. Provide Shop Drawings for the following:
 - 1. Steel framing and supports for mechanical and electrical equipment.
 - 2. Steel framing and supports for applications where framing and supports are not specified in other Sections.
 - 3. Elevator machine beams, hoist beams
 - 4. Steel shapes for supporting elevator door sills.
 - 5. Shelf angles.
 - 6. Metal ladders.
 - 7. Ladder safety cages.
 - 8. Metal floor plate and supports
 - 9. Elevator pit sump covers.
 - 10. Metal bollards.
 - 11. Wire rope parking garage guards.
 - 12. Pipe, Downspout guards.
 - 13. Abrasive metal nosings, treads, and thresholds.
 - 14. Loose steel lintels.
- D. Samples for Verification: For each type and finish of extruded nosing and tread.
- E. Delegated-Design Submittal: For ladders, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For professional engineer.
- B. Mill Certificates: Signed by stainless-steel manufacturers, certifying that products furnished comply with requirements.
- C. Welding certificates.
- D. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.
- E. Research/Evaluation Reports: For post-installed anchors, from ICC-ES.

1.6 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 - 2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."

1.7 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Division 01 Section "Quality Control," to design ladders.
- B. Structural Performance of Aluminum Ladders: Aluminum ladders, **including landings**, shall withstand the effects of loads and stresses within limits and under conditions specified in ANSI A14.3.
- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.
 - 1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces

2.2 METALS

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.
- B. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than [25] <Insert value> percent.
- C. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- D. Steel Tubing: ASTM A 500/A 500M, cold-formed steel tubing.
- E. Steel Pipe: ASTM A 53/A 53M, Standard Weight (Schedule 40) unless otherwise indicated.
- F. Zinc-Coated Steel Wire Rope: ASTM A 741.
 - 1. Wire-Rope Fittings: Hot-dip galvanized-steel connectors with capability to sustain, without failure, a load equal to minimum breaking strength of wire rope with which they are used.
- G. Cast Iron: Either gray iron, ASTM A 48/A 48M, or malleable iron, ASTM A 47/A 47M, unless otherwise indicated.
- H. Aluminum Plate and Sheet: ASTM B 209 (ASTM B 209M), Alloy 6061-T6.
- I. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), Alloy 6063-T6.
- J. Aluminum-Alloy Rolled Tread Plate: ASTM B 632/B 632M, Alloy 6061-T6.
- K. Aluminum Castings: ASTM B 26/B 26M, Alloy 443.0-F.

2.3 FASTENERS

- A. General: Unless otherwise indicated, provide **Type 304** stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.
 - 1. Provide stainless-steel fasteners for fastening aluminum.
 - 2. Provide stainless-steel fasteners for fastening stainless steel.
 - 3. Provide stainless-steel fasteners for fastening nickel silver.
 - 4. Provide bronze fasteners for fastening bronze.
- B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with hex nuts, ASTM A 563 (ASTM A 563M); and, where indicated, flat washers.

- C. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 325, Type 3 (ASTM A 325M, Type 3); with hex nuts, ASTM A 563, Grade C3 (ASTM A 563M, Class 8S3); and, where indicated, flat washers.
- D. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, ASTM A 563 (ASTM A 563M); and, where indicated, flat washers.
 - 1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.
- E. Anchors, General: Anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488/E 488M, conducted by a qualified independent testing agency.
- F. Cast-in-Place Anchors in Concrete: Either threaded type or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A 47/A 47M malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F 2329.
- G. Post-Installed Anchors: Torque-controlled expansion anchors.
 - 1. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy **Group 1 (A1)** stainless-steel bolts, ASTM F 593 (ASTM F 738M), and nuts, ASTM F 594 (ASTM F 836M).
- H. Slotted-Channel Inserts: Cold-formed, hot-dip galvanized-steel box channels (struts) complying with MFMA-4, 1-5/8 by 7/8 inches (41 by 22 mm) by length indicated with anchor straps or studs not less than 3 inches (75 mm) long at not more than 8 inches (200 mm) o.c. Provide with temporary filler and tee-head bolts, complete with washers and nuts, all zinc-plated to comply with ASTM B 633, Class Fe/Zn 5, as needed for fastening to inserts.

2.4 MISCELLANEOUS MATERIALS

- A. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
 - 1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.
- B. Water-Based Primer: Emulsion type, anticorrosive primer for mildly corrosive environments that is resistant to flash rusting when applied to cleaned steel, complying with MPI#107 and compatible with topcoat.
- C. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.
- D. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish paint systems indicated.

- E. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- F. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.
- G. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- H. Concrete: Comply with requirements in Division 03 Section "Cast-in-Place Concrete" for normal-weight, air-entrained, concrete with a minimum 28-day compressive strength of 3000 psi (20 MPa).

2.5 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- D. Form exposed work with accurate angles and surfaces and straight edges.
- E. Weld corners and seams continuously to comply with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.
- G. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

- H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.
- I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.
- J. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches (3.2 by 38 mm), with a minimum 6-inch (150-mm) embedment and 2-inch (50-mm) hook, not less than 8 inches (200 mm) from ends and corners of units and 24 inches (600 mm) o.c., unless otherwise indicated.

2.6 MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.
- B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.
 - 1. Fabricate units from slotted channel framing where indicated.
 - 2. Furnish inserts for units installed after concrete is placed.
- C. Galvanize miscellaneous framing and supports where indicated.
- D. Prime miscellaneous framing and supports with **zinc-rich primer** where indicated.

2.7 SHELF ANGLES

- A. Fabricate shelf angles from steel angles of sizes indicated and for attachment to concrete framing. Provide horizontally slotted holes to receive 3/4-inch (19-mm) bolts, spaced not more than 6 inches (150 mm) from ends and 24 inches (600 mm) o.c., unless otherwise indicated.
 - 1. Provide mitered and welded units at corners.
 - 2. Provide open joints in shelf angles at expansion and control joints. Make open joint approximately 2 inches (50 mm) larger than expansion or control joint.
- B. For cavity walls, provide vertical channel brackets to support angles from backup masonry and concrete.
- C. Galvanize and prime shelf angles located in exterior walls.
- D. Furnish wedge-type concrete inserts, complete with fasteners, to attach shelf angles to cast-in-place concrete.

2.8 METAL LADDERS

A. General:

1. Comply with ANSI A14.3, except for elevator pit ladders.
2. For elevator pit ladders, comply with ASME A17.1/CSA B44.

B. Steel Ladders:

1. Space siderails 16 inches (406 mm)] apart unless otherwise indicated.
2. Siderails: Continuous, 3/8-by-2-1/2-inch (9.5-by-64-mm) steel flat bars, with eased edges.
3. Rungs: 3/4-inch- (19-mm-) diameter 3/4-inch- (19-mm-) square steel bars.
4. Fit rungs in centerline of siderails; plug-weld and grind smooth on outer rail faces.
5. Provide nonslip surfaces on top of each rung, either by coating rung with aluminum-oxide granules set in epoxy-resin adhesive or by using a type of manufactured rung filled with aluminum-oxide grout.
6. Provide nonslip surfaces on top of each rung by coating with abrasive material metallically bonded to rung.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Harsco Industrial IKG, a division of Harsco Corporation.
 - 2) SlipNOT Metal Safety Flooring; W.S. Molnar Company.
7. Provide platforms as indicated fabricated from welded or pressure-locked steel bar grating, supported by steel angles. Limit openings in gratings to no more than 1/2 inch (12 mm) in least dimension.
8. Support each ladder at top and bottom and not more than 60 inches (1500 mm) o.c. with welded or bolted steel brackets.
9. Galvanize and prime ladders, including brackets.
10. Prime ladders, including brackets and fasteners, with zinc-rich primer.

C. Aluminum Ladders:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ACL Industries, Inc.
 - b. Alco-Lite Industrial Products.
 - c. Halliday Products.
 - d. O'Keeffe's Inc.
 - e. Precision Ladders, LLC.
 - f. Royalite Manufacturing, Inc.
 - g. Thompson Fabricating, LLC.
2. Space siderails 16 inches (406 mm) apart unless otherwise indicated.
3. Siderails: Continuous extruded-aluminum channels or tubes, not less than 2-1/2 inches (64 mm) deep, 3/4 inch (19 mm) wide, and 1/8 inch (3.2 mm) thick.

4. Rungs: Extruded-aluminum tubes, not less than 3/4 inch (19 mm) deep and not less than 1/8 inch (3.2 mm) thick, with ribbed tread surfaces.
5. Fit rungs in centerline of siderails; fasten by welding or with stainless-steel fasteners or brackets and aluminum rivets.
6. Provide platforms as indicated fabricated from pressure-locked aluminum bar grating or extruded-aluminum plank grating, supported by extruded-aluminum framing. Limit openings in gratings to no more than 1/2 inch (12 mm) in least dimension.
7. Support each ladder at top and bottom and not more than 60 inches (1500 mm) o.c.] with welded or bolted aluminum brackets.
8. Provide minimum 72-inch- (1830-mm-) high, hinged security door with padlock hasp at foot of ladder to prevent unauthorized ladder use.

2.9 LADDER SAFETY CAGES

A. General:

1. Fabricate ladder safety cages to comply with ANSI A14.3. Assemble by welding or with stainless-steel fasteners.
2. Provide primary hoops at tops and bottoms of cages and spaced not more than 20 feet (6 m) o.c. Provide secondary intermediate hoops spaced not more than 48 inches (1200 mm) o.c. between primary hoops.
3. Fasten assembled safety cage to ladder rails and adjacent construction by welding or with stainless-steel fasteners unless otherwise indicated.

B. Steel Ladder Safety Cages:

1. Primary Hoops: 1/4-by-4-inch (6.4-by-100-mm) flat bar hoops.
2. Secondary Intermediate Hoops: 1/4-by-2-inch (6.4-by-50-mm) flat bar hoops.
3. Vertical Bars: 3/16-by-1-1/2-inch (4.8-by-38-mm) flat bars secured to each hoop.
4. Galvanize and prime ladder safety cages, including brackets and fasteners.
5. Prime ladder safety cages, including brackets and fasteners, with zinc-rich primer.

C. Aluminum Ladder Safety Cages:

1. Primary Hoops: 1/4-by-4-inch (6.4-by-100-mm) flat bar hoops.
2. Secondary Intermediate Hoops: 1/4-by-2-inch (6.4-by-50-mm) flat bar hoops.
3. Vertical Bars: 1/4-by-2-inch (6.4-by-50-mm) flat bars secured to each hoop.

2.10 ELEVATOR PIT SUMP COVERS

- A. Fabricate from 1/8-inch (3.2-mm) rolled-steel floor abrasive-surface floor plate with four 1-inch- (25-mm-) diameter holes for water drainage and for lifting.
- B. Fabricate from welded or pressure-locked steel bar grating Limit openings in gratings to no more than 3/4 inch (19 mm) in least dimension.
- C. Provide steel angle supports as indicated.

2.11 MISCELLANEOUS STEEL TRIM

- A. Unless otherwise indicated, fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.
- B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.
 - 1. Provide with integrally welded steel strap anchors for embedding in concrete or masonry construction.
- C. Galvanize[**and prime**] [**exterior**] miscellaneous steel trim.

2.12 METAL BOLLARDS

- A. Fabricate metal bollards from Schedule 40 steel pipe 1/4-inch (6.4-mm) wall-thickness rectangular steel tubing.
 - 1. Cap bollards with 1/4-inch- (6.4-mm-) thick steel plate.
 - 2. Where bollards are indicated to receive controls for door operators, provide cutouts for controls and holes for wire.
 - 3. Where bollards are indicated to receive light fixtures, provide cutouts for fixtures and holes for wire.
- B. Fabricate bollards with 3/8-inch- (9.5-mm-) thick steel baseplates for bolting to concrete slab. Drill baseplates at all four corners for 3/4-inch (19-mm) anchor bolts.
 - 1. Where bollards are to be anchored to sloping concrete slabs, angle baseplates for plumb alignment of bollards.
- C. Fabricate sleeves for bollard anchorage from steel pipe or tubing with 1/4-inch- (6.4-mm-) thick steel plate welded to bottom of sleeve. Make sleeves not less than 8 inches (200 mm) deep and 3/4 inch (19 mm) larger than OD of bollard.
- D. Fabricate internal sleeves for removable bollards from Schedule 40 steel pipe or 1/4-inch (6.4-mm) wall-thickness steel tubing with an OD approximately 1/16 inch (1.5 mm) less than ID of bollards. Match drill sleeve and bollard for 3/4-inch (19-mm) steel machine bolt.
- E. Prime bollards with zinc-rich primer.

2.13 WIRE ROPE PARKING GARAGE GUARDS

- A. Wire Rope Parking Garage Guards: 3/4-inch- (19-mm-) diameter, zinc-coated steel wire ropes with wire rope fittings for securing to parking garage columns and walls and for tightening wire rope.

2.14 PIPE / DOWNSPOUT GUARDS

- A. Fabricate pipe/downspout guards from 3/8-inch- (9.5-mm-) thick by 12-inch- (300-mm-) wide steel plate, bent to fit flat against the wall or column at both ends and to fit around pipe with 2-inch (50-mm) clearance between pipe and pipe guard. Drill each end for two 3/4-inch (19-mm) anchor bolts.
- B. Galvanize and prime pipe/downspout guards.
- C. Prime pipe/downspout guards with zinc-rich primer.

2.15 ABRASIVE METAL [NOSINGS] [TREADS] [AND] [THRESHOLDS]

- A. Cast-Metal Units: Cast iron or aluminum, with an integral-abrasive, as-cast finish consisting of aluminum oxide, silicon carbide, or a combination of both. Fabricate units in lengths necessary to accurately fit openings or conditions.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Safety Tread Co., Inc.
 - b. Balco, Inc.
 - c. Barry Pattern & Foundry Co., Inc.
 - d. Granite State Casting Co.
 - e. Safe-T-Metal Company, Inc.
 - f. Wooster Products Inc.
 - 2. Nosings: Cross-hatched units, 4 inches (100 mm) wide with 1/4-inch 6-mm lip, for casting into concrete.
 - 3. Treads: Cross-hatched units, full depth of tread with 3/4-by-3/4-inch (19-by-19-mm) nosing, for application over bent plate treads or existing stairs.
 - 4. Thresholds: Fluted-saddle-type units, 5 inches (125 mm) wide by 1/2 inch (12 mm) high, with tapered edges.
 - 5. Thresholds: Fluted-interlocking- (hook-strip-) type units, 5 inches (125 mm) wide by 5/8 inch (16 mm) high, with tapered edge.
 - 6. Thresholds: Plain-stepped- (stop-) type units, 5 inches (125 mm) wide by 1/2 inch (12 mm) high, with 1/2-inch (12-mm) step.
- B. Extruded Units: Aluminum, with abrasive filler consisting of aluminum oxide, silicon carbide, or a combination of both, in an epoxy-resin binder. Fabricate units in lengths necessary to accurately fit openings or conditions.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ACL Industries, Inc.
 - b. American Safety Tread Co., Inc.
 - c. Amstep Products.
 - d. Armstrong Products, Inc.

- e. [Balco, Inc.](#)
 - f. [Granite State Casting Co.](#)
 - g. [Nystrom, Inc.](#)
 - h. [Wooster Products Inc.](#)
- 2. Provide ribbed units, with abrasive filler strips projecting 1/16 inch (1.5 mm) above aluminum extrusion.
 - 3. Provide solid-abrasive-type units without ribs.
 - 4. Nosings: Square-back units, 3 inches (75 mm) wide, for casting into concrete steps.
 - 5. Treads: Beveled-back units, full depth of tread with 1-3/8-inch (35-mm) lip, for application over existing stairs.
- C. Provide anchors for embedding units in concrete, either integral or applied to units, as standard with manufacturer.
- D. Drill for mechanical anchors and countersink. Locate holes not more than 4 inches (100 mm) from ends and not more than 12 inches (300 mm) o.c., evenly spaced between ends, unless otherwise indicated. Provide closer spacing if recommended by manufacturer.
- 1. Provide two rows of holes for units more than 5 inches (125 mm) wide, with two holes aligned at ends and intermediate holes staggered.
- E. Apply bituminous paint to concealed surfaces of cast-metal units.
- F. Apply clear lacquer to concealed surfaces of extruded units.

2.16 LOOSE STEEL LINTELS

- A. Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated. Fabricate in single lengths for each opening unless otherwise indicated. Weld adjoining members together to form a single unit where indicated.
- B. Size loose lintels to provide bearing length at each side of openings equal to 1/12 of clear span, but not less than 8 inches (200 mm) unless otherwise indicated.
- C. Galvanize and prime loose steel lintels located in exterior walls.
- D. Prime loose steel lintels located in exterior walls with zinc-rich primer.

2.17 STEEL WELD PLATES AND ANGLES

- A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with no fewer than two integrally welded steel strap anchors for embedding in concrete.

2.18 FINISHES, GENERAL

- A. Finish metal fabrications after assembly.
- B. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.19 STEEL AND IRON FINISHES

- A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.
 - 1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
- B. Preparation for Shop Priming Galvanized Items: After galvanizing, thoroughly clean railings of grease, dirt, oil, flux, and other foreign matter, and treat with metallic phosphate process.
- C. Shop prime iron and steel items unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.
- D. Preparation for Shop Priming: Prepare surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning." Or SSPC-SP 3, "Power Tool Cleaning." requirements indicated below:
 - 1. Exterior Items: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 - 2. Items Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 - 3. Items Indicated to Receive Primers Specified in Division 09 Section "High-Performance Coatings": SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 - 4. Other Items: SSPC-SP 3, "Power Tool Cleaning."
- E. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.
 - 1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

2.20 ALUMINUM FINISHES

- A. As-Fabricated Finish: AA-M12.
- B. Clear Anodic Finish: AAMA 611, Class I, AA-M12C22A41.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- C. Field Welding: Comply with the following requirements:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.
- E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
- F. Corrosion Protection: Coat concealed surfaces of aluminum that come into contact with grout, concrete, masonry, wood, or dissimilar metals with the following:
 - 1. Cast Aluminum: Heavy coat of bituminous paint.
 - 2. Extruded Aluminum: Two coats of clear lacquer.

3.2 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.
- B. Anchor supports for overhead doors and overhead grilles securely to, and rigidly brace from, building structure.
- C. Support steel girders on solid grouted masonry, concrete, or steel pipe columns. Secure girders with anchor bolts embedded in grouted masonry or concrete or with bolts through top plates of pipe columns.

1. Where grout space under bearing plates is indicated for girders supported on concrete or masonry, install as specified in "Installing Bearing and Leveling Plates" Article.
- D. Install pipe columns on concrete footings with grouted baseplates. Position and grout column baseplates as specified in "Installing Bearing and Leveling Plates" Article.
 1. Grout baseplates of columns supporting steel girders after girders are installed and leveled.

3.3 INSTALLING METAL BOLLARDS

- A. Fill metal-capped bollards solidly with concrete and allow concrete to cure seven days before installing.
 1. Do not fill removable bollards with concrete.
- B. Anchor bollards to existing construction with through bolts. Provide four 3/4-inch (19-mm) bolts at each bollard unless otherwise indicated.
- C. Anchor bollards in concrete with pipe sleeves preset and anchored into concrete. Fill annular space around bollard solidly with nonshrink grout; mixed and placed to comply with grout manufacturer's written instructions. Slope grout up approximately 1/8 inch (3 mm) toward bollard.
- D. Anchor bollards in place with concrete footings. Center and align bollards in holes 3 inches (75 mm) above bottom of excavation. Place concrete and vibrate or tamp for consolidation. Support and brace bollards in position until concrete has cured.
- E. Anchor internal sleeves for removable bollards in concrete by inserting in pipe sleeves preset into concrete. Fill annular space around internal sleeves solidly with nonshrink grout; mixed and placed to comply with grout manufacturer's written instructions. Slope grout up approximately 1/8 inch (3 mm) toward internal sleeve.
- F. Anchor internal sleeves for removable bollards in place with concrete footings. Center and align sleeves in holes 3 inches (75 mm) above bottom of excavation. Place concrete and vibrate or tamp for consolidation. Support and brace sleeves in position until concrete has cured.
- G. Place removable bollards over internal sleeves and secure with 3/4-inch (19-mm) machine bolts and nuts. After tightening nuts, drill holes in bolts for inserting padlocks. City furnishes padlocks.
- H. Fill bollards solidly with concrete, mounding top surface to shed water.
 1. Do not fill removable bollards with concrete.

3.4 INSTALLING WIRE ROPE PARKING GARAGE GUARDS

- A. Install wire rope parking garage guards at locations indicated, mounted at 18 and 27 inches (457 and 686 mm) above the parking surface. Secure wire ropes to parking garage columns and walls and tighten to remove slack.

3.5 INSTALLING PIPE GUARDS

- A. Provide pipe guards at exposed vertical pipes in parking garage where not protected by curbs or other barriers. Install by bolting to wall or column with expansion anchors. Provide four 3/4-inch (19-mm) bolts at each pipe guard. Mount pipe guards with top edge 26 inches (660 mm) above driving surface.

3.6 INSTALLING NOSINGS, TREADS, AND THRESHOLDS

- A. Center nosings on tread widths unless otherwise indicated.
- B. For nosings embedded in concrete steps or curbs, align nosings flush with riser faces and level with tread surfaces.
- C. Seal thresholds exposed to exterior with elastomeric sealant complying with Division 07 Section Concrete Joint Sealants to provide a watertight installation.

3.7 ADJUSTING AND CLEANING

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - 1. Apply by brush or spray to provide a minimum 2.0-mil (0.05-mm) dry film thickness.
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780/A 780M.

END OF SECTION 05 50 00

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SECTION 05 52 13 - PIPE AND TUBE RAILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Steel pipe and tube railings.

1.3 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- C. Schedule installation so wall attachments are made only to completed walls. Do not support railings temporarily by any means that do not satisfy structural performance requirements.

1.4 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Manufacturer's product lines of mechanically connected railings.
 - 2. Railing brackets.
 - 3. Grout, anchoring cement, and paint products.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.
- B. Welding certificates.
- C. Mill Certificates: Signed by manufacturers of stainless-steel products certifying that products furnished comply with requirements.
- D. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.
- E. Product Test Reports: For pipe and tube railings, for tests performed by a qualified testing agency, according to ASTM E 894 and ASTM E 935.
- F. Evaluation Reports: For post-installed anchors, from ICC-ES.

1.6 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

1.8 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Steel Pipe and Tube Railings:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. VIVA Railings, LLC.
 - b. Wagner, R & B, Inc.

2.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Division 01 Section "Quality Control," to design railings, including attachment to building construction.
 - 1. Designer's Insurance and Certificate: Designer will be required to furnish City a Certificate of Professional Liability Insurance in minimum amount of \$2,000,000 per claim. All Design Documents prepared by Designer shall be certified (bear seal and signature of Designer registered in New York before they are submitted for review.
- B. Structural Performance: Railings, including attachment to building construction, shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
 - 1. Handrails and Top Rails of Guards:
 - a. Uniform load of 50 lbf/ ft. (0.73 kN/m) applied in any direction.
 - b. Concentrated load of 200 lbf (0.89 kN) applied in any direction.
 - c. Uniform and concentrated loads need not be assumed to act concurrently.
 - 2. Infill of Guards:
 - a. Concentrated load of 50 lbf (0.22 kN) applied horizontally on an area of 1 sq. ft. (0.093 sq. m).
 - b. Infill load and other loads need not be assumed to act concurrently.
- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
 - 1. Temperature Change: [120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces

2.3 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.
- B. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.

2.4 STEEL AND IRON

- A. Tubing: ASTM A 500 (cold formed) or ASTM A 513.
- B. Pipe: ASTM A 53/A 53M, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.

1. Provide galvanized finish for exterior installations and where indicated.
- C. Plates, Shapes, and Bars: ASTM A 36/A 36M.
- D. Cast Iron: Either gray iron, ASTM A 48/A 48M, or malleable iron, ASTM A 47/A 47M, unless otherwise indicated.

2.5 FASTENERS

- A. General: Provide the following:
 1. Hot-Dip Galvanized Railings: Type 304 stainless-steel or hot-dip zinc-coated steel fasteners complying with ASTM A 153/A 153M or ASTM F 2329 for zinc coating.
 2. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.
- B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.
- C. Fasteners for Interconnecting Railing Components:
 1. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless exposed fasteners are unavoidable or are the standard fastening method for railings indicated.
 2. Provide tamper-resistant flat-head machine screws for exposed fasteners unless otherwise indicated.
- D. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors capable of sustaining, without failure, a load equal to 6 times the load imposed when installed in unit masonry and 4 times the load imposed when installed in concrete, as determined by testing according to ASTM E 488/E 488M, conducted by a qualified independent testing agency.

2.6 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
- B. Etching Cleaner for Galvanized Metal: Complying with MPI#25.
- C. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- D. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.
- E. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

- F. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound.
 - 1. Water-Resistant Product: At exterior locations provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended by manufacturer for exterior use.

2.7 FABRICATION

- A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage but not less than that required to support structural loads.
- B. Shop assemble railings to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.
- C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately $\frac{1}{32}$ inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- D. Form work true to line and level with accurate angles and surfaces.
- E. Fabricate connections that are exposed to weather in a manner that excludes water. Provide weep holes where water may accumulate.
- F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.
- G. Connections: Fabricate railings with welded connections unless otherwise indicated.
- H. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove flux immediately.
 - 4. At exposed connections, finish exposed surfaces smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces.
- I. Nonwelded Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.
 - 1. Fabricate splice joints for field connection using an epoxy structural adhesive if this is manufacturer's standard splicing method.

- J. Form Changes in Direction as Follows:
 - 1. By flush bends or by inserting prefabricated flush-elbow fittings.
- K. For changes in direction made by bending, use jigs to produce uniform curvature for each repetitive configuration required. Maintain cross-section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.
- L. Close exposed ends of railing members with prefabricated end fittings.
- M. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is **1/4 inch (6 mm)** or less.
- N. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.

2.8 STEEL AND IRON FINISHES

- A. Galvanized Railings:
 - 1. Hot-dip galvanize steel railings, including hardware, after fabrication.
 - 2. Comply with ASTM A 123/A 123M for hot-dip galvanized railings.
 - 3. Comply with ASTM A 153/A 153M for hot-dip galvanized hardware.
 - 4. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
 - 5. Fill vent and drain holes that are exposed in the finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.
- B. For galvanized railings, provide hot-dip galvanized fittings, brackets, fasteners, sleeves, and other ferrous components.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Fit exposed connections together to form tight, hairline joints.
- B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.
 - 1. Do not weld, cut, or abrade surfaces of railing components that are coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
 - 2. Set posts plumb within a tolerance of **1/16 inch in 3 feet (2 mm in 1 m)**.

3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed **1/4 inch in 12 feet (6 mm in 3.5 m)**.
- C. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.
 1. Coat, with a heavy coat of bituminous paint, concealed surfaces of aluminum that are in contact with grout, concrete, masonry, wood, or dissimilar metals.
- D. Adjust railings before anchoring to ensure matching alignment at abutting joints.
- E. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.2 RAILING CONNECTIONS

- A. Nonwelded Connections: Use mechanical or adhesive joints for permanently connecting railing components. Seal recessed holes of exposed locking screws using plastic cement filler colored to match finish of railings.
- B. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article whether welding is performed in the shop or in the field.
- C. Expansion Joints: Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve extending **2 inches (50 mm)** beyond joint on either side, fasten internal sleeve securely to one side, and locate joint within **6 inches (150 mm)** of post.

3.3 ATTACHING RAILINGS

- A. Anchor railing ends at walls with round flanges anchored to wall construction and welded to railing ends.
- B. Anchor railing ends to metal surfaces with flanges bolted to metal surfaces and welded to railing ends.
- C. Attach railings to wall with wall brackets. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.
- D. Secure wall brackets and railing end flanges to building construction as follows:
 1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
 2. For hollow masonry anchorage, use toggle bolts.

3.4 ADJUSTING AND CLEANING

- A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas, and repair galvanizing to comply with ASTM A 780/A 780M.

3.5 PROTECTION

- A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

END OF SECTION 05 52 13

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SECTION 07 10 00 - WATERPROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Polyurethane waterproofing.
 - 2. Polyethylene waterproofing
 - 3. Latex-rubber waterproofing.
- B. Related Requirements:
 - 1. Section 07 18 00 "Traffic Coatings" for exposed, fluid-applied membrane with an integral wearing surface.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference via digital format
 - 1. Review waterproofing requirements including, but not limited to, the following:
 - a. Surface preparation specified in other Sections.
 - b. Minimum curing period.
 - c. Forecasted weather conditions.
 - d. Special details and sheet flashings.
 - e. Repairs.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, and tested physical and performance properties of waterproofing.
 - 2. Include manufacturer's written instructions for evaluating, preparing, and treating substrate.
- B. Shop Drawings:

1. Show locations and extent of waterproofing.
 2. Include details for substrate joints and cracks, sheet flashings, penetrations, inside and outside corners, tie-ins with adjoining waterproofing, and other termination conditions.
- C. Samples: For each exposed product and for each color and texture specified, including the following products:
1. Flashing sheet, 8 by 8 inches (200 by 200 mm).
 2. Membrane-reinforcing fabric, 8 by 8 inches (200 by 200 mm).

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Field quality-control reports.
- C. Sample Warranties: For special warranties.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by waterproofing manufacturer.
- B. Mockups: Build mockups to verify selections made under Sample submittals and to set quality standards for installation.
1. Build mockup for each typical waterproofing installation including accessories to demonstrate surface preparation, crack and joint treatments, inside and outside corner treatments, and protection.
 - a. Size: [100 sq. ft. (9.3 sq. m).
 - b. Description: Each type of wall and horizontal surface
 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 FIELD CONDITIONS

- A. Environmental Limitations: Apply waterproofing within the range of ambient and substrate temperatures recommended in writing by waterproofing manufacturer.
1. Do not apply waterproofing to a damp or wet substrate, when relative humidity exceeds 85 percent, or when temperatures are less than 5 deg F (3 deg C) above dew point.

2. Do not apply waterproofing in snow, rain, fog or mist, or when such weather conditions are imminent during application and curing period.

- B. Maintain adequate ventilation during application and curing of waterproofing materials.

1.8 WARRANTY

- A. Manufacturer's Special Warranty: Manufacturer agrees to repair or replace waterproofing that fails in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

- B. Installer's Special Warranty: Specified form, signed by Installer, covering Work of this Section, for warranty period of two years.

1. Warranty includes removing and reinstalling protection board, drainage panels, insulation, pedestals, and pavers on plaza decks.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Source Limitations for Waterproofing System: Obtain waterproofing materials protection course, and molded-sheet drainage panels from single source from single manufacturer.

2.2 SINGLE-COMPONENT POLYURETHANE WATERPROOFING

- A. Single-Component, Modified Polyurethane Waterproofing: ASTM C 836/C 836M and coal-tar free.

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

- a. Anti-Hydro International, Inc; A-H Seamless Membrane.
- b. BASF Construction Chemicals, LLC, Building Systems; MasterSeal HLM 5000.
- c. Carlisle Coatings & Waterproofing Inc; [CCW-525] [MiraSEAL].
- d. CETCO; LDC 60.
- e. Neogard; Neogard 7401.
- f. Pacific Polymers International, Inc; [Elasto-Deck B.T.] [Elasto-Deck B.T. 100% Solids] [Elasto-Deck B.T. H20] [Elasto-Mat D& amp; G].
- g. Polyguard Products, Inc; Polyguard PG-250.
- h. Tremco Incorporated; [TREMproof 201/60] [TREMproof 250 GC].
- i. United Coatings; Elastall 1000.

- B. Single-Component, Reinforced, Modified Polyurethane Waterproofing: ASTM C 836/C 836M and coal-tar free.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. BASF Construction Chemicals, LLC, Building Systems; MasterSeal HLM 5000.
 - b. Carlisle Coatings & Waterproofing Inc; [CCW-525-H] [MiraSEAL].
 - c. Liquid Plastics Inc; [Beta 10] [Delta 25] [Gama 20] [Omega 15].
 - d. Pacific Polymers International, Inc; Elasto-Mat 100 (concrete).
 - e. Urethane Polymers International, Inc; Elast-O-Meric BG-7011.

2.3 TWO-COMPONENT POLYURETHANE WATERPROOFING

- A. Two-Component, Modified Polyurethane Waterproofing: ASTM C 836/C 836M and coal-tar free.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Pacific Polymers, Inc; Elasto-Deck B.T. 1000.
- B. Two-Component, Unmodified Polyurethane Waterproofing: ASTM C 836/C 836M.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Carlisle Coatings & Waterproofing Inc; CCW 703 Liqueiseal.
 - b. Gaco Western LLC; GacoFlex LM-60.
 - c. Pacific Polymers International, Inc; Elasto-Deck B.T. Two-Component.
 - d. Tremco Incorporated; Vulkem 102.
 - e. Urethane Polymers International, Inc; UIM-6430.
- C. Two-Component, Reinforced, Unmodified Polyurethane Waterproofing: ASTM C 836/C 836M.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Kemper System, Inc; Kemperol 2K-PUR.
 - b. Or Approved Equal

2.4 POLYETHYLENE WATERPROOFING

- A. HDPE Film Waterproofing:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Grace Construction Products; W.R. Grace & Co; Preprufe 300R & 160R

b. Or Approved Equal

2.5 LATEX-RUBBER WATERPROOFING

- A. Two-Component, Unreinforced, Latex-Rubber Waterproofing: ASTM C 836/C 836M; coal-tar free.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Grace Construction Products; W.R. Grace & Co. -- Conn; Procor.
 - 2. Hydrostatic-Head Resistance: 65 feet (20 m) minimum; ASTM D 5385.
- B. Two-Component, Reinforced, Latex-Rubber Waterproofing: ASTM C 836/C 836M; coal-tar free.
 - 1. Products: Subject to compliance with requirements,
 - a. Grace Construction Products; W.R. Grace & Co. -- Conn; Procor Deck System 3R.
 - 2. Hydrostatic-Head Resistance: 197 feet (60 m) minimum; ASTM D 5385.

2.6 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials recommended in writing by waterproofing manufacturer for intended use and compatible with one another and with waterproofing.
 - 1. Furnish liquid-type auxiliary materials that comply with VOC limits of authorities having jurisdiction.
- B. Primer: Manufacturer's standard primer, sealer, or surface conditioner; factory-formulated acrylic latex, polyurethane, or epoxy.
- C. Sheet Flashing: 50-mil- (1.3-mm-) minimum, nonstaining, uncured sheet neoprene.
 - 1. Adhesive: Manufacturer's recommended contact adhesive.
- D. Joint Reinforcing Strip: Manufacturer's recommended fiberglass mesh or polyester fabric.
- E. Joint Sealant: Multicomponent polyurethane sealant, compatible with waterproofing; [ASTM C 920, Type M, Class 25 or greater; Grade NS for sloping and vertical applications and Grade P for deck applications; Use NT exposure as recommended by manufacturer for substrate and joint conditions.
 - 1. Backer Rod: Closed-cell polyethylene foam.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
 - 1. Verify that concrete has cured and aged for minimum time period recommended in writing by waterproofing manufacturer.
 - 2. Verify that substrate is visibly dry and within the moisture limits recommended in writing by manufacturer. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean, prepare, and treat substrates according to manufacturer's written instructions. Provide clean, dust-free, and dry substrates for waterproofing application.
- B. Mask off adjoining surfaces not receiving waterproofing to prevent spillage and overspray affecting other construction.
- C. Close off penetrations to prevent spillage and migration of waterproofing fluids.
- D. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, acid residues, and other penetrating contaminants or film-forming coatings from concrete.
- E. Remove fins, ridges, and other projections, and fill honeycomb, aggregate pockets, holes, and other voids.

3.3 PREPARATION AT TERMINATIONS, PENETRATIONS, AND CORNERS

- A. Prepare surfaces at terminations and penetrations through waterproofing and at expansion joints, drains, sleeves, and corners according to waterproofing manufacturer's written instructions and to recommendations in ASTM C 898/C 898M and ASTM C 1471.
- B. Apply waterproofing in two separate applications, and embed a joint reinforcing strip in the first preparation coat when recommended by waterproofing manufacturer.

3.4 JOINT AND CRACK TREATMENT

- A. Prepare, treat, rout, and fill joints and cracks in substrate according to waterproofing manufacturer's written instructions and to recommendations in ASTM C 898/C 898M and ASTM C 1471. Before coating surfaces, remove dust and dirt from joints and cracks according to ASTM D 4258.

1. Comply with ASTM C 1193 for joint-sealant installation.
 2. Apply bond breaker on sealant surface, beneath preparation strip.
 3. Prime substrate along each side of joint and apply a single thickness of preparation strip at least 6 inches (150 mm) wide along each side of joint. Apply waterproofing in two separate applications and embed a joint reinforcing strip in the first preparation coat.
- B. Install sheet flashing and bond to deck and wall substrates where required according to waterproofing manufacturer's written instructions.
1. Extend sheet flashings for 4 inches (100 mm) onto perpendicular surfaces and items penetrating substrate.

3.5 WATERPROOFING APPLICATION

- A. Apply waterproofing according to manufacturer's written instructions and to recommendations in ASTM C 898/C 898M and ASTM C 1471.
- B. Start installing waterproofing in presence of manufacturer's technical representative.
- C. Apply primer over prepared substrate unless otherwise instructed in writing by waterproofing manufacturer.
- D. Unreinforced Waterproofing Applications: Mix materials and apply waterproofing by spray, roller, notched squeegee, trowel, or other application method suitable to slope of substrate.
1. Apply one or more coats of waterproofing to obtain a seamless membrane free of entrapped gases and pinholes, with a dry film thickness of 90 mils (2.25 mm).
 2. Apply waterproofing to prepared wall terminations and vertical surfaces.
 3. Verify manufacturer's recommended wet film thickness of waterproofing every 100 sq. ft. (9.3 sq. m).
- E. Reinforced Waterproofing Applications: Mix materials and apply waterproofing by roller, notched squeegee, trowel, or other suitable application method.
1. Apply first coat of waterproofing, embed membrane-reinforcing fabric, and apply second coat of waterproofing to completely saturate reinforcing fabric and to obtain a seamless reinforced membrane free of entrapped gases and pinholes, with an average dry film total thickness of [80 mils (2 mm).
 2. Apply reinforced waterproofing to prepared wall terminations and vertical surfaces.
 3. Verify manufacturer's recommended wet film thickness of waterproofing every 100 sq. ft. (9.3 sq. m).
- F. Cure waterproofing, taking care to prevent contamination and damage during application and curing.
- G. Install protection course with butted joints over waterproofing before starting subsequent construction operations.

1. For horizontal applications, install protection course loose laid over fully cured membrane.
2. For vertical applications, set protection course in nominally cured membrane, which will act as an adhesive. If membrane cures before application of protection course, use adhesive.

3.6 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections:

Testing agency shall verify thickness of waterproofing during application for each 600 sq. ft. (56 sq. m) of installed waterproofing or part thereof.

- B. Manufacturer's Field Service: Engage a site representative qualified by waterproofing membrane manufacturer to inspect substrate conditions, surface preparation, membrane application, flashings, protection, and drainage components and to furnish daily reports.
- C. If test results or inspections show waterproofing does not comply with requirements, remove and replace or repair the waterproofing as recommended in writing by manufacturer, and make further repairs after retesting and inspecting until waterproofing installation passes.
- D. Prepare test and inspection reports.

3.7 PROTECTION

- A. Do not permit foot or vehicular traffic on unprotected membrane.
- B. Protect waterproofing from damage and wear during remainder of construction period.
- C. Correct deficiencies in or remove waterproofing that does not comply with requirements; repair substrates, reapply waterproofing, and repair sheet flashings.
- D. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended in writing by manufacturer of affected construction.

END OF SECTION 07 10 00

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SECTION 07 18 00 – TRAFFIC COATINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. A single installer shall be responsible for providing complete water proofing system including all products specified in following Sections:
 - 1. Division 07 Section, "Traffic Coatings"
 - 2. Division 07 Section, "Water Repellents"
 - 3. Division 07 Section, "Concrete Joint Sealants"
 - 4. Division 07 Section, "Expansion Joint Assemblies"
- B. This Section includes traffic coating: Fluid applied, waterproofing, traffic-bearing elastomeric membrane with integral wearing surface, where surface to which membrane is to be applied is one or more of following:
 - 1. Over enclosed rooms including:
 - a. Electrical room
 - b. Elevator machine room
 - c. Mechanical room
 - d. Communications room
 - e. Storage room
- C. Materials shall be compatible with materials or related Work with which they come into contact, and with materials covered by this Section.
- D. Related Sections: Following Sections contain requirements that relate to this Section.
 - 1. Division 03 Section, "Cast-in-Place Concrete."
 - 2. Division 03 Section, "Precast Architectural Concrete."
 - 3. Division 03 Section, "Precast Structural Concrete."
 - 4. Division 07 Section, "Water Repellents"
 - 5. Division 07 Section, "Concrete Joint Sealants"
 - 6. Division 07 Section, "Expansion Joint Assemblies"
 - 7. Division 09 Section, "Pavement Markings."

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Distribute reviewed submittals to all others whose Work is related.
 - 2. Materials shall be compatible with materials or related work with which they come into contact, and with materials covered by this section.
- B. Make submittals in accordance with requirements of Division 01 Section, "Submittal Procedures."
- C. Submittals and Resubmittals: Engineer will review each of Contractor's shop drawings and/or submittal data initial time and, should resubmittal be required, one additional time to verify that reasons for resubmittal have been addressed by Contractor and

corrections made. Resubmittal changes/revisions/corrections shall be circled. Engineer will review only circled items and will not be responsible for non-circled changes/revisions/corrections and additions. Should additional resubmittals be required, Contractor shall reimburse City for all costs incurred, including cost of Engineer's services made necessary to review such additional resubmittals. City shall in turn reimburse Engineer.

D. Requests for Information

1. Engineer reserves right to reject, unprocessed, any Request for Information (RFI) that Engineer, at its sole discretion, deems frivolous.
2. Engineer reserves right to reject, unprocessed, any Request for Information (RFI) that Engineer, at its sole discretion, deems already answered in the Contract Documents.
3. RFI process shall not be used for requesting substitutions. Procedures for substitutions are clearly specified elsewhere in Contract documents.

1.4 ACTION SUBMITTALS

A. Product Data: For each system indicated, submit the following at least 60 days prior to application.

1. Product description, technical data, appropriate applications and limitations.
2. Primer type and application rate
3. Material, and wet mils required to obtain specified dry thickness for each coat.
4. Type, gradation and aggregate loading required within each coat.

B. Samples:

1. One 4 in. by 4 in. stepped sample showing each component for each system indicated.

C. Sample Warranty: For each system indicated.

1.5 INFORMATION SUBMITTALS

A. Certificates

1. Certification that products and installation comply with applicable federal, state of New York and local EPA, OSHA and VOC requirements regarding health and safety hazards
2. Certification from Manufacturer that finishes as specified are acceptable for system to be installed at least 1 month before placement of any concrete which will receive traffic coating.
3. Certification stating static coefficient of friction meets minimum requirements of Americans with Disabilities Act (ADA).
4. Certification stating materials have been tested and listed for UL 790 Class "A" rated materials/system by UL for traffic coating application specified on project. Containers shall bear UL labels.
5. Certification from manufacturer confirming compatibility with existing underlying coatings and/or substrate.

B. Manufacturer's Instructions: for each system indicated.

1. Crack treatment and surface preparation method and acceptance criteria.
2. Method of application of each coat.

3. Maximum and minimum allowable times between coats.
 4. Final cure time before resumption of parking and/or paint striping.
 5. Any other special instructions required to ensure proper installation.
- C. Field Quality Control:
1. Quality Control Plan as defined in Part 3.
 2. Two copies each of manufacturer's technical representative's log for each visit.
 3. Testing agency field reports.
- D. Qualification Statements
1. Manufacturer's qualifications as defined in "Quality Assurance" article.
 2. Installer's qualifications as defined in "Quality Assurance" article.
 3. Signed statement from applicator certifying that applicator has read, understood, and shall comply with all requirements of this Section.

1.6 CLOSEOUT SUBMITTALS

- A. Three copies of System Maintenance Manual.
- B. Five copies of snow removal guidelines for areas covered by Warranty.
- C. Final executed Warranty.

1.7 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: City retains right to reject any manufacturer.
1. Evidence of acceptable previous work on WALKER-designed projects. If none, so state.
 2. Evidence of financial stability acceptable to Engineer/Architect.
 3. Listing of 20 or more projects completed with submitted system, to include:
 - a. Name and location of project.
 - b. Type of system applied.
 - c. On-Site contact with phone number.
- B. Manufacturer's technical representative, acceptable to Engineer/Architect, shall be on site during surface preparation and initial stages of installation.
- C. Installer's Qualifications: City retains right to reject any manufacturer.
1. Evidence of compliance with Summary article paragraph "A single installer. . ."
 2. Evidence that installer has successfully performed or has qualified staff who have successfully performed at least 5 verifiable years of installations similar to those involved in this Contract, and minimum 10 projects with submitted system.
 3. Listing of 5 or more installations in climate and size similar to this Project performed by installer's superintendent.
- D. Testing Agency: Independent testing laboratory employed by City and acceptable to Engineer/Architect.
- E. Certifications
1. Traffic coating shall satisfy current National Volatile Organic Compound (VOC) Emission Standards for Architectural Coatings.

2. Licensing/certification document from manufacturer that confirms system installer is a licensed/certified applicator for the manufacturer and is legally licensed to perform work in the New York State this project is being constructed.
3. Licensing/certification agreement shall include following information:
 - a. Applicator's financial responsibility for warranty burden under agreement terms.
 - b. Manufacturer's financial responsibility for warranty burden under agreement terms.
 - c. Process for dispute settlement between manufacturer and applicator in case of system failures where cause is not evident or cannot be assigned.
 - d. Authorized signatures for both Applicator Company and Manufacturer.
 - e. Commencement date of agreement and expiration date (if applicable).

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver all materials to site in original, unopened containers, bearing following information:
 1. Name of product.
 2. Name of manufacturer.
 3. Date of preparation.
 4. Lot or batch number.
- B. Store materials under cover and protect from weather. Replace packages or materials showing any signs of damage with new material at no additional cost to City.

1.9 FIELD CONDITIONS

- A. Weather and Substrate Conditions: Proceed with work only when existing and forecast weather and temperature of concrete substrate will permit work in accordance with manufacturer's recommendations.

1.10 WARRANTY

- A. System Manufacturer (New Application): Furnish City with written total responsibility Joint and Several Warranty, detailing responsibilities of manufacturer and applicator with regard to warranty requirements (Joint and Several). Warranty shall provide that system will be free of defects, water penetration and chemical damage related to system design, workmanship or material deficiency, consisting of:
 1. Any adhesive or cohesive failures.
 2. Spalling surfaces.
 3. Weathering.
 4. Surface crazing (does not apply to traffic coating protection course).
 5. Abrasion or tear failure resulting from normal traffic use.
 6. Failure to bridge cracks less than 0.0625 in. or cracks existing at time of traffic coating installation on double tees only.
- B. If material surface shows any of defects listed above, supply labor and material to repair all defective areas and to repaint all damaged line stripes.
- C. Warranty period shall be a 5 year Joint and Several Warranty commencing with date of acceptance of work.
- D. Perform any repair under this warranty at no cost to City.

- E. Address following in terms of Warranty: length of warranty, change in value of warranty – if any- based on length of remaining warranty period, transferability of warranty, responsibilities of each party, notification procedures, dispute resolution procedures, and limitations of liability for direct and consequential damages.
- F. Snowplows, vandalism, studded snow tires and abnormally abrasive maintenance equipment are not normal traffic use and are exempted from warranty.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturer: Subject to compliance with requirements, provide products of 1 of following, only where specifically named in product category:
 - 1. Advanced Polymer Technology (APT), Harmony, PA
 - 2. BASF Building Systems (BASF), Shakopee, MN
 - 3. Deneef Construction Chemicals (Deneef), Houston, TX.
 - 4. Lymtal International Inc. (Lymtal), Lake Orion, MI.
 - 5. Neogard Division of Jones-Blair Company (Neogard), Dallas, TX.
 - 6. Pacific Polymers, Inc. a Division of ITW (Pacific Polymers), Garden Grove, CA
 - 7. Poly-Carb Inc. (Poly-Carb), Twinsburg, OH.
 - 8. Polycoat Products Division of Amer. Polymers (Polycoat), Santa Fe Springs, CA.
 - 9. Pecora Corporation (Pecora), Harleysville, PA
 - 10. Sika Corporation (Sika), Lyndhurst, NJ.
 - 11. Technical Barrier Systems, Inc. (TBS), Oakville, Ontario.
 - 12. Tremco (Tremco), Cleveland, OH.

2.2 MATERIALS, TRAFFIC COATING

- A. Acceptable low odor coatings are listed below. Coatings shall be compatible with all other materials in this Section and related work.
 - 1. Heavy Duty:
 - a. Autogard HD-48, Autogard E, Neogard.
 - b. Elasto-Deck 5000-HT, Pacific Polymers.
 - c. Iso-Flex 750U-HL HVT/760U-HL HVT Deck Coating System, LymTal.
 - d. MasterSeal Traffic 1500, BASF.
 - e. Qualideck Heavy Vehicular (152/252/372/512), APT
 - f. Sikalastic 710/715, Sika.
 - g. Vulkem 350/950NF/951NF Deck Coating System, Tremco.
 - h. Pecora-Deck 800 Series.
 - i. Kelmar TE Exposure 3, TBS.
 - 2. VOC Compliant, Extreme Low Odor, High-Solids, Fast Cure, Heavy Duty Coating System:
 - a. AutoGard FC HD-48, Autogard E, Neogard.
 - b. Flexodeck Mark 170.2, Poly-Carb.
 - c. Iso-Flex 760 U HL AR and 760 U HL AL, Lymtal.
 - d. Kelmar FCW III, Exposure 3, TBS.
 - e. MasterSeal Traffic 2500, BASF.
 - f. Sikalastic 720/745 or 390/391/395, Sika.
 - g. Vulkem 360NF/950NF and 951NF, Tremco.

3. Hybrid VOC Compliant, Extreme Low Odor, High-Solids, Heavy Duty Coating System:
 - a. AutoGard E, Neogard.
 - b. Mark-170.2 Flexodeck II, Poly-Carb.
 - c. Iso-Flex 750EU HVT, Lymtal.
 - d. Kelmar FCW III, Exposure 3, TBS.
 - e. MasterSeal Traffic 2530, BASF.
 - f. Qualideck (152/252/532E/512), APT
 - g. Sikalastic 22 Lo-Mod Hybrid (720/22 LM/745 AL), Sika.
 - h. Vulkem EWS, Tremco
- B. Provide ultraviolet screening for all traffic coating placed on this project.
- C. Finish top coat shall be colored grey.
- D. Substitutions: None for this project. Contact Engineer/Architect for consideration for future projects.

2.3 MATERIALS, CRACK SEALER

- A. Repair for isolated random horizontal cracks 0.01 in. to 0.06 in. wide. Acceptable products:
 1. Denedeck Crack Sealer, Deneef.
 2. Iso-Flex 609 Epoxy Crack Sealer, Lymtal.
 3. MasterSeal 630, BASF.
 4. Sikadur 55 SLV Epoxy Crack Healer/Sealer, Sika.
 5. SikaPronto 19TF, Sika.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces to receive Work and report immediately in writing to Engineer/Architect any deficiencies in surface which render it unsuitable for proper execution of Work.
- B. Coordinate and verify that related Work meets following requirements before beginning surface preparation and application:
 1. Concrete surfaces are finished as acceptable for system to be installed. Correct all high points, ridges, and other defects in a manner acceptable to Engineer/Architect.
 2. Curing compounds used on concrete surfaces are compatible with system to be installed.
 3. Concrete surfaces have completed proper curing period for system selected.
 4. Joint Sealants are compatible with traffic coatings.

3.2 PREPARATION

- A. Seal all openings to occupied space to prevent cleaning materials, solvents and fumes from infiltration. All protective measures and/or ventilating systems required to prevent infiltration are incidental to this Work.

- B. Acid etching is prohibited.
- C. Remove all laitance and surface contaminants, including oil, grease and dirt as specified by manufacturer's written recommendations.
- D. Before applying materials, apply system to small area to assure that it will adhere to substrate and joint sealants and dry properly and to evaluate appearance.
- E. All cracks on concrete surface shall be prepared in accordance with manufacturer's recommendations.
- F. Mask off adjoining surfaces not to receive traffic coating and mask off drains to prevent spillage and migration of liquid materials outside membrane area. Provide neat/straight lines at termination of traffic coating.

3.3 INSTALLATION/APPLICATION

- A. Installation should include all of the following steps:
 - 1. Surface Preparation: Prepare concrete for system application.
 - 2. Crack/Construction/Control/Cove Joint Sealing: Detail for crack bridging.
 - 3. Primer Coat: Insure proper adhesion of membrane to substrate.
 - 4. Base Coat: Provide crack spanning in conjunction with Crack Detail noted above.
 - 5. Aggregate Coat – to hold aggregate in system, providing skid and wear close up resistance.
 - 6. Aggregate: Correct size, shape, hardness and amount necessary to insure proper skid and wear resistance.
 - 7. Top Coat: Lock aggregate into place, provide a maintainable surface and provide resistance to ponding water, UV degradation, color loss and chemical intrusion.
- B. Do all Work in accordance with manufacturer's written instructions and specifications including, but not limited to, moisture content of substrate, atmospheric conditions (including relative humidity and temperature), coverages, mil thicknesses and texture, and as shown on Drawings.
- C. A primer coat is required for all systems. No exception.
- D. Do not apply traffic coating material until concrete has been air dried at temperatures at or above 40°F for at least 30 days after curing period specified.
- E. Cease material installation under adverse weather conditions, or when temperatures are outside manufacturer's recommended limitations for installation, or when temperature of work area or substrate are below 40°F.
- F. All adjacent vertical surfaces shall be coated with traffic coating minimum of 4 in. above coated horizontal surface. Requirement includes, but is not limited to pipes, columns, walls, curbs (full height of vertical faces of all curbs) and islands.
- G. Complete all Work under this Section before painting line stripes.
- H. Clean off excess material and material smears adjacent to joints as work progresses using methods and materials approved by manufacturers.

3.4 FIELD QUALITY CONTROL

- A. Develop a quality control plan for assured specified uniform membrane thickness that utilizes grid system of sufficiently small size to designate coverage area of not more than 5 gallons at specified thickness. In addition, employ wet mil gauge to continuously

monitor thickness during application. Average specified wet mil thickness shall be maintained within grid during application with minimum thickness of not less than 80% of average acceptable thickness. Immediately apply more material to any area not maintaining these standards.

- B. Testing Agency employ wet mil gauge to periodically monitor thickness during application.
- C. Determine overall coating system mil thickness:
 - 1. Contractor shall provide 6 in. by 6 in. bond breaker (coating coupon) on concrete surface for each 25,000 sq ft, or fraction thereof, of coating to be placed as directed by Engineer/Architect and manufacturer. Dimensionally locate coupon for easy removal.
 - 2. Contractor shall assist Testing Agency in removing coating coupons from concrete surface at completion of manufacturer-specified cure period. Contractor shall repair coupon area per coating manufacturer's instructions.
 - 3. Testing Agency shall determine dry mil thickness of completed Traffic Coating System, including bond breaker. Take 9 readings (minimum), 3 by 3 pattern at 2 in. on center. No reading shall be taken closer than 1 in. from coupon edge. Report individual readings and overall coating system average to Engineer/Architect. Readings shall be made with micrometer or optical comparator.

END OF SECTION 07 18 00

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SECTION 07 19 00 – WATER REPELLENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Apply water repellent sealer to all supported precast and cast-in-place concrete that is walked on or driven on that does not receive a traffic bearing membrane.
- B. A single installer shall be responsible for providing complete water proofing system including all products specified in the following Sections:
 - 1. Division 07 Section, "Traffic Coatings"
 - 2. Division 07 Section, "Water Repellents"
 - 3. Division 07 Section, "Concrete Joint Sealants"
 - 4. Division 07 Section, "Expansion Joint Assemblies"
- C. This Section includes penetrating concrete sealer on these surfaces:
 - 1. Supported concrete floor and concrete roof surfaces including curbs, walks, islands and pour strips.
 - 2. Concrete stair treads and landings.
 - 3. Any slab-on-grade within parking facility reinforced with rebar larger than #3, including curbs, walks, and islands.
- D. Related Sections: Following Sections contain requirements that relate to this Section.
 - 1. Division 03 Section, "Precast Architectural Concrete."
 - 2. Division 03 Section, "Precast Structural Concrete."
 - 3. Division 07 Section, "Traffic Coatings"
 - 4. Division 07 Section, "Concrete Joint Sealants"
 - 5. Division 07 Section, "Expansion Joint Assemblies"

1.3 REFERENCES

- A. ASTM International (ASTM):
 - 1. ASTM D6489, "Standard Test Method for Determining the Water Absorption of Hardened Concrete Treated with a Water Repellent Coating."

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Materials shall be compatible with materials or related Work with which they come into contact, and with materials covered by this Section.
 - 2. Distribute reviewed submittals to all others whose Work is related.
- B. Submittals and Resubmittals: Engineer will review each of Contractor's shop drawings and/or submittal data the initial time and, should resubmittal be required, one additional

time to verify that reasons for resubmittal have been addressed by Contractor and corrections made. Resubmittal changes/revisions/corrections shall be circled. Engineer will review only circled items and will not be responsible for non-circled changes/revisions/corrections and additions. Should additional resubmittals be required, Contractor shall reimburse City for all costs incurred, including the cost of Engineer's services made necessary to review such additional resubmittals. City shall in turn reimburse Engineer.

C. Requests for Information

1. Engineer reserves the right to reject, unprocessed, any Request for Information (RFI) that the Engineer, at its sole discretion, deems frivolous.
2. Engineer reserves the right to reject, unprocessed, any RFI that the Engineer, at its sole discretion, deems already answered in the Contract Documents.
3. RFI process shall not be used for requesting substitutions. Procedures for substitutions are clearly specified elsewhere in the contract documents.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product indicated at least 60 days prior to application.

1. Product description, technical data, appropriate applications, and limitations.
2. Areas and application rates of materials to be applied.
3. Proposed alternate application methods, if any.

1.6 INFORMATION SUBMITTALS

A. Certificates

1. Certification that products and installation comply with applicable federal, state of New York, and local EPA, OSHA and VOC requirements regarding health and safety hazards.
2. Evidence of applicator's being certified by manufacturer. Evidence shall include complete copy of manufacturer's licensing/certification document, spelling out repair responsibility for warranty claims.

B. Field Quality Control

1. ASTM D6489 Test Results
2. Two copies of manufacturer's technical representative's log for each visit.

C. Qualification Statements

1. Manufacturer's qualifications as defined in the "Quality Assurance" article.
2. Installer's qualifications as defined in the "Quality Assurance" article.
3. Signed statement from applicator certifying that applicator has read, understood, and shall comply with all requirements of this Section.

1.7 QUALITY ASSURANCE

A. Manufacturer's Qualifications: City retains right to reject any manufacturer.

1. Evidence of acceptable previous work on WALKER-designed projects. If none, so state.
2. Evidence of financial stability acceptable to Engineer/Architect.
3. Listing of 20 or more projects completed with submitted system, to include:

- a. Name and location of project.
 - b. Type of system applied.
 - c. On-Site contact with phone number.
- B. Installer's Qualifications: City retains right to reject any installer.
1. Evidence of compliance with Summary article paragraph "A single installer. . ."
 2. Evidence that installer has successfully performed or has qualified staff who have successfully performed at least 5 verifiable years of installations similar to those involved in this Contract, and minimum 10 projects with submitted system.
 3. Listing of 5 or more installations in climate and size similar to this Project performed by installer's superintendent.
- C. Testing Agency: Independent testing laboratory employed by City and acceptable to Engineer/Architect.
- D. Certifications
1. Sealer shall satisfy the current national and local Volatile Organic Compound (VOC) Emission Standards for Architectural Coatings.
 2. Licensing/certification document from system manufacturer that confirms system installer is a licensed/certified applicator for the manufacturer and is legally licensed to perform work in the state of New York.
 3. Licensing/certification agreement must provide following information:
 - a. Applicator's financial responsibility for warranty burden under agreement terms.
 - b. Manufacturer's financial responsibility for warranty burden under agreement terms.
 - c. Process for dispute settlement between manufacturer and applicator in case of system failures where cause is not evident or cannot be assigned.
 - d. Officers' signatures for both Applicator Company and Manufacturer.
 - e. Commencement date of agreement and expiration date (if applicable).

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver all materials to site in original, unopened containers, bearing following information:
1. Name of product.
 2. Name of manufacturer.
 3. Date of preparation.
 4. Lot or batch number.
- B. Store materials under cover and protect from weather. Replace packages or materials showing any signs of damage with new material at no additional cost to City.

1.9 FIELD CONDITIONS

- A. Weather and Substrate Conditions: Do not proceed with application (except with written recommendation of manufacturer) under any of the following conditions:
1. Ambient temperature is less than 40° F.
 2. Substrate surfaces have cured for less than 1 month.
 3. Rain or temperatures below 40° F predicted for a period of 24 hours.
 4. Less than 24 hours after surfaces became wet.

5. Substrate is frozen or surface temperature is less than 40° F.
6. Wind velocities higher than manufacturer's specified limit to prevent solvent flash-off.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturer: Subject to compliance with requirements, provide products of one of following, only where specifically named in product category:
 1. Advanced Chemical Technologies Inc. (ACT), Oklahoma City, OK.
 2. BASF Building Systems (BASF), Shakopee, MN.
 3. GCP Applied Technologies (GCP), Cambridge, MA.
 4. Evonik Corporation (Evonik), Parsippany, NJ.
 5. Euclid Chemical Company (Euclid), Cleveland, OH.
 6. Lymtal International Inc. (Lymtal), Lake Orion, MI.
 7. Prosoco, Inc. (Prosoco), Lawrence, KS
 8. Sika Corporation (Sika), Lyndhurst, NJ.

2.2 MATERIALS, CONCRETE SEALER

- A. Silane (40% solids, 600 g/L or less VOC):
 1. MasterProtect H 440 HZ, 125 sf/g, BASF.
 2. Iso-flex 618-40 VOC, 125sf/g, Lymtal.
 3. Protectosil Chem-Trete 40 VOC, 125 sf/g, Evonik.
 4. Sikagard 740W ,125 sf/g, Sika
 5. Sil-Act ATS-42, 125 sf/g, ACT.
- B. Silane Water-Based, (50% solids, 400 g/L or less VOC):
 1. MasterProtect H 400, 125 sf/g, BASF.
 2. Iso-Flex 618-50 WB, 125 sf/g, LymTal.
 3. Protectosil Aqua-Trete 40, 125 sf/g, Evonik.
- C. Silane (90% or greater solids, 400 g/L or less VOC):
 1. MasterProtect H 1000, 200 sf/g, BASF.
 2. Iso-Flex 618-100 CRS, 200 sf/g, Lymtal.
 3. Protectosil BHN, 200 sf/g, Evonik Corp.
 4. Sikagard 705L ,200 sf/g, Sika.
 5. Sil-Act ATS-100 LV, 200 sf/g, ACT.
- D. Proposed substitutions: None for this project. Contact Engineer/Architect for consideration for future projects.

2.3 MATERIALS, CRACK SEALER

- A. Repair for isolated random non-moving (static) horizontal cracks 0.01 in. to 0.06 in. wide. Acceptable products:
 1. SikaPronto 19TF, Sika.
 2. Sikadur 55 SLV Epoxy Crack Healer/Sealer, Sika.
 3. MasterSeal 630, BASF.

4. DeNeef Denepox I-40,GCP.
 5. Iso-Flex 609 Epoxy Crack Sealer, Lymtal.
- B. Repair of isolated moving (dynamic) horizontal cracks shall be in accordance with Division 07, Section "Concrete Joint Sealants."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces to receive Work and report immediately in writing to Engineer/Architect any deficiencies in surface which render it unsuitable for proper execution of Work.
- B. Coordinate and verify that related Work meets following requirements before beginning surface preparation and application:
1. Concrete surface finishes are acceptable for system to be installed.
 2. Curing compounds used on concrete surfaces are compatible with system to be installed.
 3. Concrete surfaces have completed proper curing period for system selected.
 4. Control joint and expansion joint Work is complete and has been accepted by Engineer/Architect.

3.2 PREPARATION

- A. Seal all openings to occupied space to prevent cleaning materials, solvents and fumes from infiltration. All protective measures and/or ventilating systems required to prevent infiltration are incidental to this Work.
- B. Acid etching is prohibited.
- C. Repair or replace all sealant materials damaged by surface preparation operations.
- D. Shot blast clean all surfaces to be sealed as acceptable to sealer manufacturer before sealer application. **Shot blasting is not recommended or required for new slabs that are water cured per ACI 308, Paragraph 2.2.** Cleaning method and materials shall be sufficient to allow absorption criteria stated in Field Quality Control article to be met. Prepare by sandblasting all surfaces inaccessible to shotblast equipment.
- E. Equipment used during floor slab cleaning shall not exceed height limitation of facility and shall not exceed 3,000 lb axle load or vehicle gross weight of 6,000 lb.
- F. Mask off adjoining surfaces not to receive sealer and mask off drains to prevent spillage and migration of liquid materials outside sealer area. Provide neat/straight lines at termination of sealer.

3.3 INSTALLATION/APPLICATION

- A. Do all Work in accordance with manufacturer's written instructions and specifications including, but not limited to, moisture content of substrate, atmospheric conditions (including relative humidity and temperature), coverage, mil thickness and texture, and as shown on Drawings.

- B. Clean all surfaces affected by sealer material overspray and repair all damage caused by sealer material overspray to adjacent construction or property at no cost to City.
- C. Clean off excess material as work progresses using methods and materials approved by manufacturer.

3.4 FIELD QUALITY CONTROL

- A. Testing Agency shall take 3 cores as directed by Engineer/Architect after sealer application to test for sealer effectiveness in accordance with ASTM D6489. Concrete core samples shall be taken 14 days after application of sealer. Report water absorption through top and bottom surfaces of core. Sealer shall reduce water absorption by at least 85 percent when compared with the unsealed bottom surface.

3.5 NON-CONFORMING WORK

- A. Unsatisfactory Field Quality Control test results shall be grounds for rejection of sealer or sealer application rate. Perform sealer reapplication at no additional cost to City.

END OF SECTION 07 19 00

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SECTION 07 21 00 - THERMAL INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Glass-fiber blanket.
 - 2. Mineral-wool board.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each product, for tests performed by a qualified testing agency.
- B. Evaluation Reports: For foam-plastic insulation, from ICC-ES.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

PART 2 - PRODUCTS

2.1 GLASS-FIBER BLANKET

- A. Glass-Fiber Blanket, Unfaced: ASTM C665, Type I; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E84; passing ASTM E136 for combustion characteristics.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CertainTeed Corporation.
 - b. Johns Manville; a Berkshire Hathaway company.
 - c. Knauf Insulation.
 - d. Owens Corning.

2.2 MINERAL-WOOL BOARD INSULATION

- A. Recycled Content: Postconsumer recycled content plus one half of preconsumer recycled content not less than 70 percent.
- B. Unfaced, Mineral Wool Board Insulation: ASTM C 612; with maximum flame spread and smoke developed indexes of 15 and zero, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.
 1. Nominal density of 4 lb/cu. ft. (64 kg/cu. m), Types IA and IB, thermal resistivity of 4 deg F x h x sq. ft./Btu x in. at 75 deg F (27.7 K x m/W at 24 deg C).
 2. Fiber Color: Darkened.
- C. Foil Faced, Mineral Wool Board Insulation: ASTM C 612; faced on one side with foil scrim or foil scrim polyethylene vapor retarder; with maximum flame spread and smoke developed indexes of 25 and 5, respectively, per ASTM E 84.
 1. Nominal density of 4 lb/cu. ft. (64 kg/cu. m), Types IA and IB, thermal resistivity of 4 deg F x h x sq. ft./Btu x in. at 75 deg F (27.7 K x m/W at 24 deg C).
- D. Basis of Design: Owens Corning Thermafiber SAFB.

2.3 INSULATION FASTENERS

- A. Adhesively Attached, Spindle-Type Anchors: Plate welded to projecting spindle; capable of holding insulation of specified thickness securely in position with self-locking washer in place.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AGM Industries, Inc.
 - b. Gemco.
 2. Plate: Perforated, galvanized carbon-steel sheet, 0.030 inch (0.762 mm) thick by 2 inches (50 mm) square.
 3. Spindle: Copper-coated, low-carbon steel; fully annealed; 0.105 inch (2.67 mm) in diameter; length to suit depth of insulation.
- B. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick galvanized-steel sheet, with beveled edge for increased stiffness, sized as

required to hold insulation securely in place, but not less than **1-1/2 inches (38 mm)** square or in diameter.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AGM Industries, Inc.
 - b. Gemco.
2. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in the following locations:
 - a. Ceiling plenums.
- C. Insulation Standoff: Spacer fabricated from galvanized mild-steel sheet for fitting over spindle of insulation anchor to maintain air space of **2 inches (50 mm)** between face of insulation and substrate to which anchor is attached.
 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Gemco.
- D. Anchor Adhesive: Product with demonstrated capability to bond insulation anchors securely to substrates without damaging insulation, fasteners, or substrates.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AGM Industries, Inc.
 - b. Gemco.

2.4 ACCESSORIES

- A. Insulation for Miscellaneous Voids:
 1. Glass-Fiber Insulation: ASTM C764, Type II, loose fill; with maximum flame-spread and smoke-developed indexes of 5, per ASTM E84.
 2. Spray Polyurethane Foam Insulation: ASTM C1029, Type II, closed cell, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E84.
- B. Asphalt Coating for Cellular-Glass Block Insulation: Cutback asphalt or asphalt emulsion of type recommended by manufacturer of cellular-glass block insulation.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean substrates of substances that are harmful to insulation, including removing projections capable of puncturing insulation or vapor retarders, or that interfere with insulation attachment.

3.2 INSTALLATION, GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products and applications.
- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.
- C. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- D. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness or to achieve R-value.

3.3 INSTALLATION OF INSULATION IN FRAMED CONSTRUCTION

- A. Blanket Insulation: Install in cavities formed by framing members according to the following requirements:
 - 1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
 - 2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
 - 3. Maintain 3-inch (76-mm) clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
 - 4. For metal-framed wall cavities where cavity heights exceed 96 inches (2438 mm), support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.
 - 5. Vapor-Retarder-Faced Blankets: Tape joints and ruptures in vapor-retarder facings, and seal each continuous area of insulation to ensure airtight installation.
 - a. Exterior Walls: Set units with facing placed toward as indicated on Drawings.
- B. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:
 - 1. Glass-Fiber Insulation: Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu. ft. (40 kg/cu. m).
 - 2. Spray Polyurethane Insulation: Apply according to manufacturer's written instructions.

- C. Spray-Applied Cellulosic Insulation: Apply spray-applied insulation according to manufacturer's written instructions. Do not apply insulation until installation of pipes, ducts, conduits, wiring, and electrical outlets in walls is completed and windows, electrical boxes, and other items not indicated to receive insulation are masked. After insulation is applied, make flush with face of studs by using method recommended by insulation manufacturer.

3.4 PROTECTION

- A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION 07 21 00

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SECTION 07 53 23 - ETHYLENE-PROPYLENE-DIENE-MONOMER (EPDM) ROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Adhered ethylene-propylene-diene-terpolymer (EPDM) roofing system.
 - 2. Self-adhering, ethylene-propylene-diene-terpolymer (EPDM) roofing system.
 - 3. Mechanically fastened, ethylene-propylene-diene-terpolymer (EPDM) roofing system.
 - 4. Loosely laid and ballasted, ethylene-propylene-diene-terpolymer (EPDM) roofing system.
 - 5. Roof insulation.
- B. Related Requirements:
 - 1. Division 07, Section "Thermal Insulation" for insulation beneath the roof deck.
 - 2. Division 07, Section "Sheet Metal Flashing and Trim" for metal roof flashings and counter-flashings.
 - 3. Division 07, Section "Roof Specialties" for manufactured copings and roof edge flashings.
 - 4. Division 07, Section "Manufactured Roof Expansion Joints" for manufactured roof expansion-joint assemblies.
 - 5. Division 07, Section "Joint Sealants" for joint sealants, joint fillers, and joint preparation.
 - 6. Division 22, Section "Storm Drainage Piping Specialties" for roof drains.

1.3 DEFINITIONS

- A. Roofing Terminology: Definitions in ASTM D 1079 and glossary of NRCA's "The NRCA Roofing Manual: Membrane Roof Systems" apply to work of this Section.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. For insulation and roof system component fasteners, include copy of FM Approvals' RoofNav listing.

- B. Shop Drawings: Include roof plans, sections, details, and attachments to other work, including the following:
 - 1. Layout and thickness if insulation.
 - 2. Base flashings and membrane terminations.
 - 3. Flashing details at penetrations.
 - 4. Tapered insulation, thickness, and slopes.
- C. Samples for Verification: For the following products:
 - 1. Roof membrane and flashings of color required.
 - 2. Aggregate surfacing material in gradation[**and color**] required.
- D. Wind Uplift Resistance Submittal: For roofing system, indicating compliance with wind uplift performance requirements.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and manufacturer.
- B. Manufacturer Certificates:
 - 1. Performance Requirement Certificate: Signed by roof membrane manufacturer, certifying that roofing system complies with requirements specified in "Performance Requirements" Article.
 - a. Submit evidence of complying with performance requirements.
- C. Product Test Reports: For components of roof membrane and insulation, for tests performed by a qualified testing agency, indicating compliance with specified requirements.
- D. Field quality-control reports.
- E. Sample Warranties: For manufacturer's special warranties.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For roofing system to include in maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer that is UL listed for roofing system identical to that used for this Project.
- B. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing and mixing with other components.
- B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.
 - 1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.
- C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.
- D. Handle and store roofing materials, and place equipment in a manner to avoid permanent deflection of deck.

1.9 FIELD CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

1.10 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of roofing system that fail in materials or workmanship within specified warranty period.
 - 1. Special warranty includes roof membrane, base flashings, roof insulation, fasteners, and other components of roofing system.
 - 2. Warranty Period: 20 years from Date of Substantial Completion.
- B. Special Project Warranty: Submit roofing Installer's warranty, on warranty form at end of this Section, signed by Installer, covering the Work of this Section, including all components of roofing system such as roof membrane, base flashing, roof insulation, fasteners, for the following warranty period:
 - 1. Warranty Period: Two years from Date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. General Performance: Installed roofing system and base flashings shall withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Roofing and flashings shall remain watertight.
 - 1. Accelerated Weathering: Roof membrane shall withstand 2000 hours of exposure when tested according to ASTM G 152, ASTM G 154, or ASTM G 155.
 - 2. Impact Resistance: Roof membrane shall resist impact damage when tested according to ASTM D 3746, ASTM D 4272, or the Resistance to Foot Traffic Test in FM Approvals 4470.
- B. Material Compatibility: Roofing materials shall be compatible with one another and adjacent materials under conditions of service and application required, as demonstrated by roof membrane manufacturer based on testing and field experience.
- C. Wind Uplift Resistance: Design roofing system to resist the following wind uplift pressures when tested according to FM Approvals 4474, UL 580, or UL 1897:
- D. FM Approvals' RoofNav Listing: Roof membrane, base flashings, and component materials shall comply with requirements in FM Approvals 4450 or FM Approvals 4470 as part of a roofing system, and shall be listed in FM Approvals' RoofNav for Class 1 or noncombustible construction, as applicable. Identify materials with FM Approvals Certification markings.
 - 1. Fire/Windstorm Classification: Class 1A-75
 - 2. Hail-Resistance Rating: MH.
- E. Solar Reflectance Index (SRI): Three-year-aged SRI not less than 64 or initial SRI not less than 82 when calculated according to ASTM E 1980, based on testing identical products by a qualified testing agency.
- F. ENERGY STAR Listing: Roofing system shall be listed on the DOE's ENERGY STAR "Roof Products Qualified Product List" for low -slope roof products.
- G. Energy Performance: Roofing system shall have an initial solar reflectance of not less than 0.70 and an emissivity of not less than 0.75 when tested according to CRRC-1.
- H. Exterior Fire-Test Exposure: ASTM E 108 or UL 790, Class A; for application and roof slopes indicated; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
- I. Fire-Resistance Ratings: Comply with fire-resistance-rated assembly designs indicated. Identify products with appropriate markings of applicable testing agency.

2.2 ETHYLENE-PROPYLENE-DIENE-TERPOLYMER (EPDM) ROOFING

- A. EPDM Sheet: ASTM D 4637/D 4637M, Type II, scrim or fabric internally reinforced, EPDM sheet
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. [Carlisle SynTec Incorporated.](#)
 - b. [Firestone Building Products.](#)
 - c. [GenFlex Roofing Systems.](#)
 - d. [International Diamond Systems.](#)
 - e. [Johns Manville; a Berkshire Hathaway company.](#)
 - f. [Lexcan Limited.](#)
 - g. [Mule-Hide Products Co., Inc.](#)
 - h. [Roofing Products International, Inc.](#)
 - i. [Versico Incorporated.](#)
2. Thickness: 60 mils (1.5 mm), nominal.
 3. Exposed Face Color: Black

2.3 AUXILIARY ROOFING MATERIALS

- A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with other roofing components.
 1. Adhesive and Sealants: Comply with VOC limits of authorities having jurisdiction.
 2. [Adhesives and sealants shall comply with the following limits for VOC content:](#)
 - a. Plastic Foam Adhesives: 50 g/L.
 - b. Gypsum Board and Panel Adhesives: 50 g/L.
 - c. Multipurpose Construction Adhesives: 70 g/L.
 - d. Fiberglass Adhesives: 80 g/L.
 - e. Contact Adhesives: 80 g/L.
 - f. PVC Welding Compounds: 510 g/L.
 - g. Other Adhesives: 250 g/L.
 - h. Single-Ply Roof Membrane Sealants: 450 g/L.
 - i. Nonmembrane Roof Sealants: 300 g/L.
 - j. Sealant Primers for Nonporous Substrates: 250 g/L.
 - k. Sealant Primers for Porous Substrates: 775 g/L.
 3. [Adhesives and sealants shall comply](#) with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- B. Sheet Flashing: 60-mil- (1.5-mm-) thick EPDM, partially cured or cured, according to application.
- C. Protection Sheet: Epichlorohydrin or neoprene nonreinforced flexible sheet, **55 to 60 mils (1.4 to 1.5 mm)** thick, recommended by EPDM manufacturer for resistance to hydrocarbons, non-aromatic solvents, grease, and oil.
- D. Bonding Adhesive: Manufacturer's standard.

- E. Modified Asphaltic Fabric-Backed Membrane Adhesive: Roofing system manufacturer's standard modified asphalt, asbestos-free, cold-applied adhesive formulated for compatibility and use with fabric-backed membrane roofing.
- F. Water-Based, Fabric-Backed Membrane Adhesive: Roofing system manufacturer's standard water-based, cold-applied adhesive formulated for compatibility and use with fabric-backed membrane roofing.
- G. Low-Rise, Urethane, Fabric-Backed Membrane Adhesive: Roof system manufacturer's standard spray-applied, low-rise, two-component urethane adhesive formulated for compatibility and use with fabric-backed membrane roofing.
- H. Seaming Material: Manufacturer's standard, synthetic-rubber polymer primer and 3-inch-(75-mm-) wide minimum, butyl splice tape with release film.
- I. Lap Sealant: Manufacturer's standard, single-component sealant, colored to match membrane roofing.
- J. Water Cutoff Mastic: Manufacturer's standard butyl mastic sealant.
- K. Metal Termination Bars: Manufacturer's standard, predrilled stainless steel or aluminum bars, approximately 1 by 1/8 inch (25 by 3 mm) thick; with anchors.
- L. Metal Battens: Manufacturer's standard, aluminum-zinc-alloy-coated or zinc-coated steel sheet, approximately 1 inch wide by 0.05 inch thick (25 mm wide by 1.3 mm thick), prepunched.
- M. Ballast Retaining Bar: Perimeter securement system consisting of a slotted extruded-aluminum retention bar with an integrated compression fastening strip.
 - 1. Fasteners: 1-1/2-inch (38-mm) stainless steel fasteners with neoprene washers.
- N. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening components to substrate, and acceptable to roofing system manufacturer.
- O. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, molded pipe boot flashings, preformed inside and outside corner sheet flashings, reinforced EPDM securement strips, T-joint covers, in-seam sealants, termination reglets, cover strips, and other accessories.
- P. Liquid Coating: Product specifically formulated for coating EPDM membrane roofing, as follows:
 - 1. Type: Acrylic emulsion complying with ASTM D 6083.
 - 2. Type: Chlorosulfonated polyethylene complying with ASTM D 3468/D 3468M.
 - 3. Color: Black

2.4 ROOF INSULATION

- A. General: Preformed roof insulation boards manufactured by EPDM roof membrane manufacturer, approved for use in FM Approvals' RoofNav-listed roof assemblies.
- B. Extruded-Polystyrene Board Insulation: ASTM C 578, Type IV, 1.45-lb/cu. ft. (23-kg/cu. m) minimum density, 25-psi (173-kPa) minimum compressive strength square edged.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. DiversiFoam Products.
 - b. Dow Chemical Company (The).
 - c. Kingspan Insulation Limited.
 - d. Owens Corning.
- C. Molded (Expanded) Polystyrene Board Insulation: ASTM C 578, Type VIII, 1.15-lb/cu. ft. (18-kg/cu. m) minimum density, 13-psi (90-kPa) minimum compressive strength, square edge.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Carlisle SynTec Incorporated.
 - b. DiversiFoam Products.
 - c. Dyplast Products.
 - d. Insulfoam-a division of Carlisle Construction Materials Inc.
- D. Composite Molded (Expanded) Polystyrene Board Insulation: ASTM C 578, Type II, 1.35-lb/cu. ft. (22-kg/cu. m) minimum density, with factory-applied facings, as follows:
 - 1. Facer: ASTM C 208, Type II, Grade 2, cellulosic-fiber insulation board, asphalt coated, 1/2 inch (13 mm) thick.
 - 2. Facer: DOC PS 2, Exposure 1, oriented strand board, 7/16 inch (11 mm) thick.
- E. Polyisocyanurate Board Insulation: ASTM C 1289, Type II, Class 1, Grade 2 felt or glass-fiber mat facer on both major surfaces.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Atlas EPS; a Division of Atlas Roofing Corporation.
 - b. Atlas Roofing Corporation.
 - c. Carlisle SynTec Incorporated.
 - d. Dyplast Products.
 - e. Firestone Building Products.
 - f. GAF.
 - g. Hunter Panels.
 - h. Insulfoam-a division of Carlisle Construction Materials Inc.
 - i. Johns Manville; a Berkshire Hathaway company.
 - j. Rmax, Inc.

- F. Composite Polyisocyanurate Board Insulation: ASTM C 1289, with factory-applied facing board on one major surface, as indicated below by type, and felt or glass-fiber mat facer on the other.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Atlas EPS; a Division of Atlas Roofing Corporation.
 - b. Atlas Roofing Corporation.
 - c. Firestone Building Products.
 - d. GAF.
 - e. Homasote Company.
 - f. Hunter Panels.
 - g. Insulfoam-a division of Carlisle Construction Materials Inc.
 - h. Johns Manville; a Berkshire Hathaway company.
 2. Facer: Type IV, cellulosic-fiber-insulation-board facer, Grade 2, **1/2 inch (13 mm)** thick.
 3. Facer: Type V, oriented strand board facer, **7/16 inch (11 mm)** thick.
 4. Facer: Type VII, glass-mat-faced gypsum board facer, **1/4 inch (6 mm)** thick.
- G. Perlite Board Insulation: ASTM C 728, Type 1, rigid, mineral-aggregate thermal insulation board composed of expanded perlite, cellulosic fibers, binders, and waterproofing agents with top surface seal coated.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. GAF.
 - b. Johns Manville; a Berkshire Hathaway company.
- H. Tapered Insulation: Provide factory-tapered insulation boards.
1. Material: Match roof insulation
 2. Minimum Thickness: 1/4 inch (6.35 mm).
 3. Slope:
 - a. Roof Field: 1/4 inch per foot (1:48) unless otherwise indicated on Drawings.
 - b. Saddles and Crickets: 1/2 inch per foot (1:24) unless otherwise indicated on Drawings.

2.5 INSULATION ACCESSORIES

- A. General: Roof insulation accessories recommended by insulation manufacturer for intended use and compatibility with other roofing system components.
- B. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roof insulation to substrate, and acceptable to roofing system manufacturer.

- C. Insulation Adhesive: Insulation manufacturer's recommended adhesive formulated to attach roof insulation to substrate or to another insulation layer as follows:
1. Modified asphaltic, asbestos-free, cold-applied adhesive.
 2. Bead-applied, low-rise, one-component or multicomponent urethane adhesive.
 3. Full-spread, spray-applied, low-rise, two-component urethane adhesive.

2.6 ASPHALT MATERIALS

- A. Roofing Asphalt: ASTM D 312/D 312M, Type III or Type IV
- B. Asphalt Primer: ASTM D 41/D 41M.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
1. Verify that roof openings and penetrations are in place, curbs are set and braced, and roof-drain bodies are securely clamped in place.
 2. Verify that wood blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.
 3. Verify that concrete substrate is visibly dry and free of moisture, and that minimum concrete internal relative humidity is not more than 75 percent, or as recommended by roofing system manufacturer when tested according to ASTM F 2170.
 - a. Test Frequency: One test probe per each [1000 sq. ft. (93 sq. m)] , or portion thereof, of roof deck, with not less than three test probes.
 - b. Submit test reports within 24 hours of performing tests.
 4. Verify that concrete-curing compounds that will impair adhesion of roofing components to roof deck have been removed.
 5. Verify that joints in precast concrete roof decks have been grouted flush with top of concrete.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing system installation according to roofing system manufacturer's written instructions. Remove sharp projections.

- B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.
- C. Install sound-absorbing insulation strips according to acoustical roof deck manufacturer's written instructions.

3.3 ROOFING INSTALLATION, GENERAL

- A. Install roofing system according to roofing system manufacturer's written instructions, FM Approvals' RoofNav assembly requirements, and FM Global Property Loss Prevention Data Sheet 1-29.
- B. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at end of workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.

3.4 INSTALLATION OF INSULATION

- A. Coordinate installing roofing system components so insulation is not exposed to precipitation or left exposed at end of workday.
- B. Comply with roofing system and insulation manufacturer's written instructions for installing roof insulation.
- C. Installation Over Concrete Decks:
 - 1. Install base layer of insulation with joints staggered not less than 24 inches (610 mm) in adjacent rows.
 - a. Where installing composite and noncomposite insulation in two or more layers, install noncomposite board insulation for bottom layer and intermediate layers, if applicable, and install composite board insulation for top layer.
 - b. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
 - c. Make joints between adjacent insulation boards not more than 1/4 inch (6 mm) in width.
 - d. At internal roof drains, slope insulation to create a square drain sump with each side equal to the diameter of the drain bowl plus 24 inches (610 mm).
 - 1) Trim insulation so that water flow is unrestricted.
 - e. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
 - f. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.
 - g. Adhere base layer of insulation to concrete roof deck according to FM Approvals' RoofNav assembly requirements and FM Global Property Loss

Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification, as follows:

- 1) Set insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.
 - 2) Set insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.
2. Install upper layers of insulation and tapered insulation with joints of each layer offset not less than **12 inches (305 mm)** from previous layer of insulation.
- a. Staggered end joints within each layer not less than **24 inches (305 mm)** in adjacent rows.
 - b. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
 - c. Make joints between adjacent insulation boards not more than **1/4 inch (6 mm)** in width.
 - d. At internal roof drains, slope insulation to create a square drain sump with each side equal to the diameter of the drain bowl plus **24 inches (610 mm)**.
 - 1) Trim insulation so that water is unrestricted.
 - e. Fill gaps exceeding **1/4 inch (6 mm)** with insulation.
 - f. Cut and fit insulation within **1/4 inch (6 mm)** of nailers, projections, and penetrations.
 - g. Adhere each layer of insulation to substrate using adhesive according to FM Approvals' RoofNav assembly requirements and FM Global Property Loss Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification, as follows:
 - 1) Set each layer of insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.
 - 2) Set each layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

3.5 ADHERED ROOFING INSTALLATION

- A. Adhere roof membrane over area to receive roofing according to roofing system manufacturer's written instructions.
- B. Unroll membrane roof membrane and allow to relax before installing.
- C. Start installation of roofing in presence of roofing system manufacturer's technical personnel[**and City's testing and inspection agency**].
- D. Accurately align roof membrane, and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.
- E. Bonding Adhesive: Apply to substrate and underside of roof membrane at rate required by manufacturer, and allow to partially dry before installing roof membrane. Do not apply to splice area of roof membrane.

- F. Fabric-Backed Roof Membrane Adhesive: Apply to substrate at rate required by manufacturer, and install fabric-backed roof membrane.
- G. In addition to adhering, mechanically fasten roof membrane securely at terminations, penetrations, and perimeters.
- H. Apply roof membrane with side laps shingled with slope of roof deck where possible.
- I. Adhesive Seam Installation: Clean both faces of splice areas, apply splicing cement.
 - 1. Firmly roll side and end laps of overlapping roof membrane to ensure a watertight seam installation.
 - 2. Apply lap sealant and seal exposed edges of roofing terminations.
- J. Tape Seam Installation: Clean and prime both faces of splice areas, apply splice tape.
 - 1. Firmly roll side and end laps of overlapping roof membrane to ensure a watertight seam installation.
 - 2. Apply lap sealant and seal exposed edges of roofing terminations.
- K. Repair tears, voids, and lapped seams in roof membrane that do not comply with requirements.
- L. Spread sealant or mastic bed over deck-drain flange at roof drains, and securely seal roof membrane in place with clamping ring.
- M. Adhere protection sheet over roof membrane at locations indicated.

3.6 BASE FLASHING INSTALLATION

- A. Install sheet flashings and preformed flashing accessories, and adhere to substrates according to roofing system manufacturer's written instructions.
- B. Apply bonding adhesive to substrate and underside of sheet flashing at required rate, and allow to partially dry. Do not apply to seam area of flashing.
- C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.
- D. Clean splice areas, apply splicing cement, and firmly roll side and end laps of overlapping sheets to ensure a watertight seam installation. Apply lap sealant and seal exposed edges of sheet flashing terminations.
- E. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.

3.7 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to inspect substrate conditions, surface preparation, roof membrane application, sheet flashings, protection, and drainage components, and to furnish reports to Architect.
- B. Perform the following tests:
 - 1. Flood Testing: Flood test each roofing area for leaks, according to recommendations in ASTM D 5957, after completing roofing and flashing. Install temporary containment assemblies, plug or dam drains, and flood with potable water.
 - a. Perform tests before overlying construction is placed.
 - b. Flood to an average depth of **2-1/2 inches (65 mm)** with a minimum depth of **1 inch (25 mm)** and not exceeding a depth of **[4 inches (100 mm)]**. Maintain **2 inches (50 mm)** of clearance from top of base flashing.
 - c. Flood each area for 24 hours.
 - d. After flood testing, repair leaks, repeat flood tests, and make further repairs until roofing and flashing installations are watertight.
 - 1) Cost of retesting is Contractor's responsibility.
 - e. Testing agency shall prepare survey report indicating locations initial leaks, if any, and final survey report.
- C. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion, in presence of Architect, and to prepare inspection report.
- D. Repair or remove and replace components of roofing system where inspections indicate that they do not comply with specified requirements.
- E. Additional testing and inspecting, at Contractor's expense, will be performed to determine if replaced or additional work complies with specified requirements.

3.8 PROTECTING AND CLEANING

- A. Protect roofing system from damage and wear during remainder of construction period. When remaining construction does not affect or endanger roofing system, inspect roofing system for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and City.
- B. Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates, and repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.
- C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

3.9 ROOFING INSTALLER'S WARRANTY

- A. WHEREAS _____ of _____, herein called the "Roofing Installer," has performed roofing and associated work ("work") on the following project:
1. City: **<Insert name of City>**.
 2. Address: **<Insert address>**.
 3. Building Name/Type: **<Insert information>**.
 4. Address: **<Insert address>**.
 5. Area of Work: **<Insert information>**.
 6. Acceptance Date: _____.
 7. Warranty Period: **<Insert time>**.
 8. Expiration Date: _____.
- B. AND WHEREAS Roofing Installer has contracted (either directly with City or indirectly as a subcontractor) to warrant said work against leaks and faulty or defective materials and workmanship for designated Warranty Period,
- C. NOW THEREFORE Roofing Installer hereby warrants, subject to terms and conditions herein set forth, that during Warranty Period Roofing Installer will, at Roofing Installer's own cost and expense, make or cause to be made such repairs to or replacements of said work as are necessary to correct faulty and defective work and as are necessary to maintain said work in a watertight condition.
- D. This Warranty is made subject to the following terms and conditions:
1. Specifically excluded from this Warranty are damages to work and other parts of the building, and to building contents, caused by:
 - a. lightning;
 - b. peak gust wind speed exceeding 72 mph
 - c. fire;
 - d. failure of roofing system substrate, including cracking, settlement, excessive deflection, deterioration, and decomposition;
 - e. faulty construction of parapet walls, copings, chimneys, skylights, vents, equipment supports, and other edge conditions and penetrations of the work;
 - f. vapor condensation on bottom of roofing; and
 - g. activity on roofing by others, including construction contractors, maintenance personnel, other persons, and animals, whether authorized or unauthorized by City.
 2. When work has been damaged by any of foregoing causes, Warranty shall be null and void until such damage has been repaired by Roofing Installer and until cost and expense thereof have been paid by City or by another responsible party so designated.
 3. Roofing Installer is responsible for damage to work covered by this Warranty but is not liable for consequential damages to building or building contents resulting from leaks or faults or defects of work.

4. During Warranty Period, if City allows alteration of work by anyone other than Roofing Installer, including cutting, patching, and maintenance in connection with penetrations, attachment of other work, and positioning of anything on roof, this Warranty shall become null and void on date of said alterations, but only to the extent said alterations affect work covered by this Warranty. If City engages Roofing Installer to perform said alterations, Warranty shall not become null and void unless Roofing Installer, before starting said work, shall have notified City in writing, showing reasonable cause for claim, that said alterations would likely damage or deteriorate work, thereby reasonably justifying a limitation or termination of this Warranty.
5. During Warranty Period, if original use of roof is changed and it becomes used for, but was not originally specified for, a promenade, work deck, spray-cooled surface, flooded basin, or other use or service more severe than originally specified, this Warranty shall become null and void on date of said change, but only to the extent said change affects work covered by this Warranty.
6. City shall promptly notify Roofing Installer of observed, known, or suspected leaks, defects, or deterioration and shall afford reasonable opportunity for Roofing Installer to inspect work and to examine evidence of such leaks, defects, or deterioration.
7. This Warranty is recognized to be the only warranty of Roofing Installer on said work and shall not operate to restrict or cut off City from other remedies and resources lawfully available to City in cases of roofing failure. Specifically, this Warranty shall not operate to relieve Roofing Installer of responsibility for performance of original work according to requirements of the Contract Documents, regardless of whether Contract was a contract directly with City or as a subcontract with City's Construction Manager.

E. IN WITNESS THEREOF, this instrument has been duly executed this _____ day of _____, _____.

1. Authorized Signature: _____.
2. Name: _____.
3. Title: _____.

END OF SECTION 07 53 23

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SECTION 07 62 00 - SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Manufactured reglets with counterflashing.

1.3 COORDINATION

- A. Coordinate sheet metal flashing and trim layout and seams with sizes and locations of penetrations to be flashed, and joints and seams in adjacent materials.
- B. Coordinate sheet metal flashing and trim installation with adjoining roofing and wall materials, joints, and seams to provide leakproof, secure, and noncorrosive installation.

1.4 PRE-INSTALLATION MEETINGS

- A. Pre-installation Conference: Conduct conference at Project site.
 - 1. Review construction schedule. Verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - 2. Review special roof details, roof drainage, roof-penetration flashing, equipment curbs, and condition of other construction that affect sheet metal flashing and trim.
 - 3. Review requirements for insurance and certificates if applicable.
 - 4. Review sheet metal flashing observation and repair procedures after flashing installation.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each manufactured product and accessory.
- B. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
- C. Shop Drawings: For sheet metal flashing and trim.
1. Include plans, elevations, sections, and attachment details.
 2. Detail fabrication and installation layouts, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled work.
 3. Include identification of material, thickness, weight, and finish for each item and location in Project.
 4. Include details for forming, including profiles, shapes, seams, and dimensions.
 5. Include details for joining, supporting, and securing, including layout and spacing of fasteners, cleats, clips, and other attachments. Include pattern of seams.
 6. Include details of termination points and assemblies.
 7. Include details of expansion joints and expansion-joint covers, including showing direction of expansion and contraction from fixed points.
 8. Include details of roof-penetration flashing.
 9. Include details of edge conditions, including eaves, ridges, valleys, rakes, crickets, and counterflashings as applicable.
 10. Include details of special conditions.
 11. Include details of connections to adjoining work.
- D. Samples for Initial Selection: For each type of sheet metal and accessory indicated with factory-applied finishes.
- E. Samples for Verification: For each type of exposed finish.
1. Sheet Metal Flashing: **12 inches (300 mm)** long by actual width of unit, including finished seam and in required profile. Include fasteners, cleats, clips, closures, and other attachments.
 2. Trim, Metal Closures, Expansion Joints, Joint Intersections, and Miscellaneous Fabrications: **12 inches (300 mm)** long and in required profile. Include fasteners and other exposed accessories.
 3. Unit-Type Accessories and Miscellaneous Materials: Full-size Sample.
 4. Anodized Aluminum Samples: Samples to show full range to be expected for each color required.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For fabricator.
- B. Product Certificates: For each type of coping and roof edge flashing that is SPRI ES-1 tested.
- C. Product Test Reports: For each product, for tests performed by a qualified testing agency.
- D. Sample Warranty: For special warranty.

1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For sheet metal flashing and trim, and its accessories, to include in maintenance manuals.

1.8 QUALITY ASSURANCE

- A. Fabricator Qualifications: Employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.
 - 1. For copings and roof edge flashings that are SPRI ES-1 tested, shop shall be listed as able to fabricate required details as tested and approved.
- B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.
 - 1. Build mockup of typical roof edge, including fascia, approximately [**10 feet (3.0 m)**] long, including supporting construction cleats, seams, attachments, underlayment, and accessories.
 - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage. Store sheet metal flashing and trim materials away from uncured concrete and masonry.
- B. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to extent necessary for period of sheet metal flashing and trim installation.

1.10 WARRANTY

- A. Special Warranty on Finishes: Manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.

- b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
- c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

- 2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. General: Sheet metal flashing and trim assemblies shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.
- B. Sheet Metal Standard for Flashing and Trim: Comply with NRCA's "The NRCA Roofing Manual" and SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.
- C. Sheet Metal Standard for Copper: Comply with CDA's "Copper in Architecture Handbook." Conform to dimensions and profiles shown unless more stringent requirements are indicated.
- D. FM Approvals Listing: Manufacture and install copings & roof edge flashings that are listed in FM Approvals' "RoofNav" and approved for windstorm classification, Class 1-75 Identify materials with name of fabricator and design approved by FM Approvals.
- E. SPRI Wind Design Standard: Manufacture and install copings & roof edge flashings tested according to SPRI ES-1 and capable of resisting the following design pressure:
 - 1. Design Pressure: As indicated on Drawings.
- F. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces

2.2 SHEET METALS

- A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.

1. Brushed Satin (Lacquered): M32-06x (Mechanical Finish: directionally textured, medium satin; with clear organic coating); coating of "Incralac," solvent-borne, methyl methacrylate copolymer lacquer with UV inhibitor, applied by air spray in two coats per manufacturer's written instructions to total thickness of **1 mil (0.025 mm)**.
- B. Aluminum Sheet: **ASTM B 209 (ASTM B 209M)**, alloy as standard with manufacturer for finish required, with temper as required to suit forming operations and performance required; with smooth, flat surface.
 1. As-Milled Finish: Mill
 2. Alclad Finish: Metallurgically bonded surfacing alloy on both sides, forming aluminum sheet with reflective luster.
 3. Factory Prime Coating: Where painting after installation is required, pretreat metal with white or light-colored, factory-applied, baked-on epoxy primer coat; minimum dry film thickness of **0.2 mil (0.005 mm)**.
 4. Clear Anodic Finish, Coil Coated: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.
 5. Color Anodic Finish, Coil Coated: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or thicker.
 - a. Color: As selected by Architect from full range of industry colors and color densities.
 - b. Color Range: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.3 MISCELLANEOUS MATERIALS

- A. General: Provide materials and types of fasteners,, protective coatings, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and as recommended by manufacturer of primary sheet metal or manufactured item unless otherwise indicated.
- B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal.
 1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
 - a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating. Provide metal-backed EPDM or PVC sealing washers under heads of exposed fasteners bearing on weather side of metal.
 - b. Blind Fasteners: High-strength aluminum or stainless-steel rivets suitable for metal being fastened.
 - c. Spikes and Ferrules: Same material as gutter; with spike with ferrule matching internal gutter width.
 2. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.

3. Fasteners for Stainless-Steel Sheet: Series 300 stainless steel.
- C. Sealant Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape **1/2 inch (13 mm)** wide and **1/8 inch (3 mm)** thick.
- D. Elastomeric Sealant: ASTM C 920, elastomeric silicone polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.
- E. Bituminous Coating: Cold-applied asphalt emulsion according to ASTM D 1187.
- F. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required for application.

2.4 MANUFACTURED SHEET METAL FLASHING AND TRIM

- A. Reglets: Units of type, material, and profile required, formed to provide secure interlocking of separate reglet and counterflashing pieces, and compatible with flashing indicated with factory-mitered and -welded corners and junctions.
 1. **Manufacturers:** Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. [Cheney Flashing Company.](#)
 - b. [Fry Reglet Corporation.](#)
 - c. [Heckmann Building Products, Inc.](#)
 - d. [Hickman Company, W. P.](#)
 - e. [Hohmann & Barnard, Inc.](#)
 - f. [Keystone Flashing Company, Inc.](#)
 - g. [National Sheet Metal Systems, Inc.](#)
 - h. [Sandell Manufacturing Co., Inc.](#)
 2. Material: Aluminum, 0.024 inch (0.61 mm) thick.
 3. Surface-Mounted Type: Provide with slotted holes for fastening to substrate, with neoprene or other suitable weatherproofing washers, and with channel for sealant at top edge.
 4. Stucco Type: Provide with upturned fastening flange and extension leg of length to match thickness of applied finish materials.
 5. Concrete Type: Provide temporary closure tape to keep reglet free of concrete materials, special fasteners for attaching reglet to concrete forms, and guides to ensure alignment of reglet section ends.
 6. Masonry Type: Provide with offset top flange for embedment in masonry mortar joint.
 7. Accessories:
 - a. Flexible-Flashing Retainer: Provide resilient plastic or rubber accessory to secure flexible flashing in reglet where clearance does not permit use of

standard metal counterflashing or where Drawings show reglet without metal counterflashing.

- b. Counterflashing Wind-Restraint Clips: Provide clips to be installed before counterflashing to prevent wind uplift of counterflashing's lower edge.

- 8. Finish: Mill.

2.5 FABRICATION, GENERAL

- A. General: Custom fabricate sheet metal flashing and trim to comply with details shown and recommendations in cited sheet metal standard that apply to design, dimensions, geometry, metal thickness, and other characteristics of item required. Fabricate sheet metal flashing and trim in shop to greatest extent possible.
 - 1. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
 - 2. Obtain field measurements for accurate fit before shop fabrication.
 - 3. Form sheet metal flashing and trim to fit substrates without excessive oil canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.
 - 4. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.
- B. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of **1/4 inch in 20 feet (6 mm in 6 m)** on slope and location lines indicated on Drawings and within **1/8-inch (3-mm)** offset of adjoining faces and of alignment of matching profiles.
- C. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to tolerances specified in MCA's "Guide Specification for Residential Metal Roofing."
- D. Expansion Provisions: Form metal for thermal expansion of exposed flashing and trim.
 - 1. Form expansion joints of intermeshing hooked flanges, not less than **1 inch (25 mm)** deep, filled with butyl sealant concealed within joints.
 - 2. Use lapped expansion joints only where indicated on Drawings.
- E. Sealant Joints: Where movable, nonexpansion-type joints are required, form metal to provide for proper installation of elastomeric sealant according to cited sheet metal standard.
- F. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.
- G. Fabricate cleats and attachment devices of sizes as recommended by cited sheet metal standard for application, but not less than thickness of metal being secured.

- H. Seams: Fabricate nonmoving seams with flat-lock seams. Tin edges to be seamed, form seams, and solder.
- I. Seams: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use.
- J. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer.
- K. Do not use graphite pencils to mark metal surfaces.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, substrate, and other conditions affecting performance of the Work.
 - 1. Verify compliance with requirements for installation tolerances of substrates.
 - 2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
 - 3. Verify that air- or water-resistant barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners[, **solder**], protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
 - 1. Install sheet metal flashing and trim true to line, levels, and slopes. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.
 - 2. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
 - 3. Space cleats not more than **12 inches (300 mm)** apart. Attach each cleat with at least two fasteners. Bend tabs over fasteners.
 - 4. Install exposed sheet metal flashing and trim with limited oil canning, and free of buckling and tool marks.
 - 5. Torch cutting of sheet metal flashing and trim is not permitted.
 - 6. Do not use graphite pencils to mark metal surfaces.

- B. Metal Protection: Where dissimilar metals contact each other, or where metal contacts pressure-treated wood or other corrosive substrates, protect against galvanic action or corrosion by painting contact surfaces with bituminous coating or by other permanent separation as recommended by sheet metal manufacturer or cited sheet metal standard.
 - 1. Coat concealed side of uncoated-aluminum sheet metal flashing and trim with bituminous coating where flashing and trim contact wood, ferrous metal, or cementitious construction.
- C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at maximum of 10 feet (3 m) with no joints within 24 inches (600 mm) of corner or intersection.
 - 1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with sealant concealed within joints.
 - 2. Use lapped expansion joints only where indicated on Drawings.
- D. Fasteners: Use fastener sizes that penetrate substrate not less than recommended by fastener manufacturer to achieve maximum pull-out resistance
- E. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.
- F. Seal joints as required for watertight construction.
 - 1. Use sealant-filled joints unless otherwise indicated. Embed hooked flanges of joint members not less than 1 inch (25 mm) into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is between 40 and 70 deg F (4 and 21 deg C), set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below 40 deg F (4 deg C).
 - 2. Prepare joints and apply sealants to comply with requirements in Division 07 Section "Architectural Joint Sealants."

3.3 ROOF FLASHING INSTALLATION

- A. General: Install sheet metal flashing and trim to comply with performance requirements, sheet metal manufacturer's written installation instructions, and cited sheet metal standard. Provide concealed fasteners where possible, and set units true to line, levels, and slopes. Install work with laps, joints, and seams that are permanently watertight and weather resistant.
- B. Roof Edge Flashing: Anchor to resist uplift and outward forces according to recommendations in cited sheet metal standard unless otherwise indicated. Interlock bottom edge of roof edge flashing with continuous cleat anchored to substrate at staggered 3-inch (75-mm) centers.

- C. Roof Edge Flashing: Anchor to resist uplift and outward forces according to recommendations in FM Global Property Loss Prevention Data Sheet 1-49 for FM Approvals' listing for required windstorm classification.
- D. Copings: Anchor to resist uplift and outward forces according to recommendations in cited sheet metal standard unless otherwise indicated.
 - 1. Interlock exterior bottom edge of coping with continuous cleat anchored to substrate at 16-inch (400-mm) centers.
 - 2. Anchor interior leg of coping with washers and screw fasteners through slotted holes at 24-inch (600-mm) centers.
- E. Copings: Anchor to resist uplift and outward forces according to recommendations in FM Global Property Loss Prevention Data Sheet 1-49 for specified FM Approvals' listing for required windstorm classification.
- F. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending minimum of **4 inches (100 mm)** over base flashing. Install stainless-steel draw band and tighten.
- G. Counterflashing: Coordinate installation of counterflashing with installation of base flashing. Insert counterflashing in reglets or receivers and fit tightly to base flashing. Extend counterflashing **4 inches (100 mm)** over base flashing. Lap counterflashing joints minimum of **4 inches (100 mm)**. Secure in waterproof manner by means of snap-in installation and sealant or lead wedges and sealant unless otherwise indicated.
- H. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Seal with elastomeric sealant and clamp flashing to pipes that penetrate roof.

3.4 WALL FLASHING INSTALLATION

- A. General: Install sheet metal wall flashing to intercept and exclude penetrating moisture according to cited sheet metal standard unless otherwise indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.
- B. Reglets: Installation of reglets is specified in Division 03 Section "Cast-in-Place Concrete."

3.5 MISCELLANEOUS FLASHING INSTALLATION

- A. Equipment Support Flashing: Coordinate installation of equipment support flashing with installation of roofing and equipment. Weld or seal flashing with elastomeric sealant to equipment support member.

- B. Overhead-Piping Safety Pans: Suspend pans from structure above, independent of other overhead items such as equipment, piping, and conduit, unless otherwise indicated on Drawings. Pipe and install drain line to plumbing waste or drainage system.

3.6 ERECTION TOLERANCES

- A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of **1/4 inch in 20 feet (6 mm in 6 m)** on slope and location lines indicated on Drawings and within **1/8-inch (3-mm)** offset of adjoining faces and of alignment of matching profiles.
- B. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerances specified in MCA's "Guide Specification for Residential Metal Roofing."

3.7 CLEANING AND PROTECTION

- A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
- B. Clean and neutralize flux materials. Clean off excess solder.
- C. Clean off excess sealants.
- D. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of sheet metal flashing and trim installation, remove unused materials and clean finished surfaces as recommended by sheet metal flashing and trim manufacturer. Maintain sheet metal flashing and trim in clean condition during construction.
- E. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 07 62 00

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SECTION 07 72 00 - ROOF ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Roof hatches.
 - 2. Gravity ventilators.
- B. Related Requirements:
 - 1. Division 05, Section "Metal Fabrications" for metal vertical ladders, ships' ladders, and stairs for access to roof hatches.
 - 2. Division 05, Section "Pipe and Tube Railings" for safety railing systems not attached to roof-hatch curbs.

1.3 COORDINATION

- A. Coordinate layout and installation of roof accessories with roofing membrane and base flashing and interfacing and adjoining construction to provide a leakproof, weathertight, secure, and noncorrosive installation.
- B. Coordinate dimensions with rough-in information or Shop Drawings of equipment to be supported.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of roof accessory.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: For roof accessories.
 - 1. Include plans, elevations, keyed details, and attachments to other work. Indicate dimensions, loadings, and special conditions. Distinguish between plant- and field-assembled work.

- C. Samples: For each exposed product and for each color and texture specified, prepared on Samples of size to adequately show color.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Roof plans, drawn to scale, and coordinating penetrations and roof-mounted items. Show the following:
 - 1. Size and location of roof accessories specified in this Section.
 - 2. Method of attaching roof accessories to roof or building structure.
 - 3. Other roof-mounted items including mechanical and electrical equipment, ductwork, piping, and conduit.
 - 4. Required clearances.
- B. Sample Warranties: For manufacturer's special warranties.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For roof accessories to include in operation and maintenance manuals.

1.7 WARRANTY

- A. Special Warranty on Painted Finishes: Manufacturer's standard form in which manufacturer agrees to repair finishes or replace roof accessories that show evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Delta units when tested according to ASTM D2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 - 2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. General Performance: Roof accessories shall withstand exposure to weather and resist thermally induced movement without failure, rattling, leaking, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.
- B. Wind-Restraint Performance: As indicated on Drawings.

2.2 ROOF HATCHES

- A. Roof Hatches: Metal roof-hatch units with lids and insulated single walled curbs, welded or mechanically fastened and sealed corner joints, continuous lid-to-curb counterflashing and weathertight perimeter gasketing, straight sides and integrally formed deck-mounting flange at perimeter bottom.
1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
- a. [Acudor Products, Inc.](#)
 - b. [AES Industries, Inc.](#)
 - c. [Architectural Specialties, Inc.](#)
 - d. [Babcock-Davis.](#)
 - e. [BILCO Company \(The\).](#)
 - f. [Custom Solution Roof and Metal Products.](#)
 - g. [Dur-Red Products.](#)
 - h. [Hi Pro International, Inc.](#)
 - i. [JL Industries, Inc.; a division of the Activar Construction Products Group.](#)
 - j. [KCC International Inc.](#)
 - k. [Kingspan Light + Air, North America.](#)
 - l. [Lexcor; a division of Luxsoco corp.](#)
 - m. [Metallic Products Corp.](#)
 - n. [Milcor; Commercial Products Group of Hart & Cooley, Inc.](#)
 - o. [Nystrom, Inc.](#)
 - p. [O'Keeffe's Inc.](#)
 - q. [Pate Company \(The\).](#)
 - r. [Precision Ladders, LLC.](#)
 - s. [Williams Bros. Corporation of America \(The\).](#)
- B. Type and Size: Single-leaf lid, 30 by 36 inches (750 by 900 mm)
- C. Loads: Minimum 40-lbf/sq. ft. (1.9-kPa) external live load and 20-lbf/sq. ft. (0.95-kPa) internal uplift load.
- D. Hatch Material: Aluminum sheet.
- 1. Thickness: Manufacturer's standard thickness for hatch size indicated
 - 2. Finish: Clear anodic
- E. Construction:
- 1. Insulation: cellulosic-fiber board.
 - a. R-Value: 12.0 according to ASTM C1363.
 - 2. Nailer: Factory-installed wood nailer continuous around hatch perimeter.
 - 3. Hatch Lid: Opaque, insulated, and double walled, with manufacturer's standard metal liner of same material and finish as outer metal lid.
 - 4. Curb Liner: Manufacturer's standard, of same material and finish as metal curb.

5. On ribbed or fluted metal roofs, form flange at perimeter bottom to conform to roof profile.
 6. Fabricate curbs to minimum height of 12 inches (305 mm) above roofing surface unless otherwise indicated.
- F. Hardware: Spring operators, hold-open arm, galvanized steel spring latch with turn handles, galvanized steel butt- or pintle-type hinge system, and padlock hasps inside and outside.
- G. Ladder-Assist Post: Roof-hatch manufacturer's standard device for attachment to roof-access ladder.
1. Operation: Post locks in place on full extension; release mechanism returns post to closed position.
 2. Height: 42 inches (1060 mm) above finished roof deck.
 3. Material: Aluminum.
 4. Post: 1-5/8-inch- (41-mm-) diameter pipe.
 5. Finish: Manufacturer's standard baked enamel or powder coat.
 - a. Color: As selected by Architect from manufacturer's full range.

2.3 GRAVITY VENTILATORS

- A. Low-Profile, Cylindrical-Style Gravity Ventilators: Manufacturer's standard, fabricated as indicated, with manufacturer's standard welded or sealed mechanical joints.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. [Active Ventilation Products, Inc.](#)
 - b. [Air Vent, Inc.; a Gibraltar Industries company.](#)
 - c. [Dur-Red Products.](#)
 - d. [Greenheck Fan Corporation.](#)
 - e. [Loren Cook Company.](#)
 - f. [Metallic Products Corp.](#)
 - g. [Moffitt Corporation Inc.](#)
 - h. [PennBarry.](#)
 - i. [Romlair Ventilator Co.](#)
 - j. [Thaler Metal Industries Ltd.](#)
 - k. [Vent Products Co., Inc.](#)
 2. Construction: Integral base flange, vent cylinder, cylinder bird screen, and rain cap.
 3. Dimensions: As indicated on Drawings.
 4. Configuration: As indicated on Drawings.
 5. Bird Screens: Manufacturer's standard mesh with rewirable frame.
 6. Insect Screens: Manufacturer's standard mesh with rewirable frame.
 7. Vent Cylinder, Base Flange, and Rain-Cap Material: Aluminum sheet, of manufacturer's standard thickness.
 8. Finish: As selected by Architect from manufacturer's full range.

2.4 METAL MATERIALS

- A. Aluminum Sheet: ASTM B209 (ASTM B209M), manufacturer's standard alloy for finish required, with temper to suit forming operations and performance required.
 - 1. Mill Finish: As manufactured.
 - 2. Factory Prime Coating: Where field painting is indicated, apply pretreatment and white or light-colored, factory-applied, baked-on epoxy primer coat, with a minimum dry film thickness of 0.2 mil (0.005 mm).
 - 3. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.
 - 4. Exposed Coil-Coated Finish: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - a. Two-Coat Fluoropolymer Finish: AAMA 2605. System consisting of primer and fluoropolymer color topcoat containing not less than 70 percent PVDF resin by weight.
 - 5. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils (0.04 mm). Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
 - 6. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester-backer finish consisting of prime coat and wash coat, with a minimum total dry film thickness of 0.5 mil (0.013 mm).
- B. Aluminum Extrusions and Tubes: ASTM B221 (ASTM B221M), manufacturer's standard alloy and temper for type of use, finished to match assembly where used; otherwise mill finished.

2.5 GENERAL FINISH REQUIREMENTS

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

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of the Work.
- B. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.

- C. Verify dimensions of roof openings for roof accessories.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install roof accessories according to manufacturer's written instructions.
 - 1. Install roof accessories level; plumb; true to line and elevation; and without warping, jogs in alignment, buckling, or tool marks.
 - 2. Anchor roof accessories securely in place so they are capable of resisting indicated loads.
 - 3. Use fasteners, separators, sealants, and other miscellaneous items as required to complete installation of roof accessories and fit them to substrates.
 - 4. Install roof accessories to resist exposure to weather without failing, rattling, leaking, or loosening of fasteners and seals.
- B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.
 - 1. Coat concealed side of uncoated aluminum roof accessories with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
 - 2. Underlayment: Where installing roof accessories directly on cementitious or wood substrates, install a course of underlayment and cover with manufacturer's recommended slip sheet.
 - 3. Bed flanges in thick coat of asphalt roofing cement where required by manufacturers of roof accessories for waterproof performance.
- C. Roof-Hatch Installation:
 - 1. Verify that roof hatch operates properly. Clean, lubricate, and adjust operating mechanism and hardware.
 - 2. Attach safety railing system to roof-hatch curb.
 - 3. Attach ladder-assist post according to manufacturer's written instructions.
- D. Gravity Ventilator Installation: Verify that gravity ventilators operate properly and have unrestricted airflow. Clean, lubricate, and adjust operating mechanisms.
- E. Seal joints with elastomeric sealant as required by roof accessory manufacturer.

3.3 REPAIR AND CLEANING

- A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing according to ASTM A780/A780M.

- B. Touch up factory-primed surfaces with compatible primer ready for field painting according to Division 09, Section "Exterior Painting."
- C. Clean exposed surfaces according to manufacturer's written instructions.
- D. Clean off excess sealants.
- E. Replace roof accessories that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION 07 72 00

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SECTION 07 84 13 – PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Penetrations in fire-resistance-rated walls.
 - 2. Penetrations in horizontal assemblies.
- B. Related Requirements:
 - 1. Division 07, Section "Joint Firestopping" for joints in or between fire-resistance-rated construction, at exterior curtain-wall/floor intersections, and in smoke barriers.

1.3 PRE-INSTALLATION MEETINGS

- A. Pre-installation Conference: Conduct conference at Project site

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Sustainable Design Submittals:
 - 1. Product Data: For sealants, indicating VOC content.
 - 2. Laboratory Test Reports: For sealants, indicating compliance with requirements for low-emitting materials.
- C. Product Schedule: For each penetration firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing and inspecting agency.
 - 1. Engineering Judgments: Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping system, submit illustration, with modifications marked, approved by penetration firestopping system manufacturer's fire-protection engineer as an

engineering judgment or equivalent fire-resistance-rated assembly. Obtain approval of authorities having jurisdiction prior to submittal.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Test Reports: For each penetration firestopping system, for tests performed by a qualified testing agency.

1.6 CLOSEOUT SUBMITTALS

- A. Installer Certificates: From Installer indicating that penetration firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: A firm that has been approved by FM Global according to FM Global 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with its "Qualified Firestop Contractor Program Requirements."

1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install penetration firestopping system when ambient or substrate temperatures are outside limits permitted by penetration firestopping system manufacturers or when substrates are wet because of rain, frost, condensation, or other causes.
- B. Install and cure penetration firestopping materials per manufacturer's written instructions using natural means of ventilations or, where this is inadequate, forced-air circulation.

1.9 COORDINATION

- A. Coordinate construction of openings and penetrating items to ensure that penetration firestopping systems can be installed according to specified firestopping system design.
- B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration firestopping systems.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics:

1. Perform penetration firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
2. Test per testing standards referenced in "Penetration Firestopping Systems" Article. Provide rated systems complying with the following requirements:
 - a. Penetration firestopping systems shall bear classification marking of a qualified testing agency.
 - 1) UL in its "Fire Resistance Directory."
 - 2) Intertek Group in its "Directory of Listed Building Products."
 - 3) FM Global in its "Building Materials Approval Guide."

2.2 PENETRATION FIRESTOPPING SYSTEMS

- A. Penetration Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. 3M Fire Protection Products.
 - b. A/D Fire Protection Systems Inc.
 - c. Grabber Construction Products.
 - d. Hilti, Inc.
 - e. HOLDRITE.
 - f. NUCO Inc.
 - g. Passive Fire Protection Partners.
 - h. RectorSeal.
 - i. Specified Technologies, Inc.
 - j. Tremco, Inc.
- B. Penetrations in Fire-Resistance-Rated Walls: Penetration firestopping systems with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of **0.01-inch wg (2.49 Pa)**.
 1. F-Rating: Not less than the fire-resistance rating of constructions penetrated.
- C. Penetrations in Horizontal Assemblies: Penetration firestopping systems with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of **0.01-inch wg (2.49 Pa)**.
 1. F-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated.
 2. W-Rating: Provide penetration firestopping systems showing no evidence of water leakage when tested according to UL 1479.

- D. Exposed Penetration Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, per ASTM E 84.
1. Sealant shall have a VOC content of 250 g/L or less.
 2. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- E. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping system manufacturer and approved by qualified testing and inspecting agency for conditions indicated.
1. Permanent forming/damming/backing materials.
 2. Substrate primers.
 3. Collars.
 4. Steel sleeves.

2.3 FILL MATERIALS

- A. Cast-in-Place Firestop Devices: Factory-assembled devices for use in cast-in-place concrete floors and consisting of an outer sleeve lined with an intumescent strip, a flange attached to one end of the sleeve for fastening to concrete formwork, and a neoprene gasket.
- B. Latex Sealants: Single-component latex formulations that do not re-emulsify after cure during exposure to moisture.
- C. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.
- D. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced intumescent elastomeric sheet bonded to galvanized-steel sheet.
- E. Intumescent Putties: Nonhardening, water-resistant, intumescent putties containing no solvents or inorganic fibers.
- F. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.
- G. Mortars: Prepackaged dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.
- H. Pillows/Bags: Reusable heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents, and fire-retardant additives. Where exposed, cover openings with steel-reinforcing wire mesh to protect pillows/bags from being easily removed.

- I. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.
- J. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants.

2.4 MIXING

- A. Penetration Firestopping Materials: For those products requiring mixing before application, comply with penetration firestopping system manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning: Before installing penetration firestopping systems, clean out openings immediately to comply with manufacturer's written instructions and with the following requirements:
 - 1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of penetration firestopping materials.
 - 2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with penetration firestopping materials. Remove loose particles remaining from cleaning operation.
 - 3. Remove laitance and form-release agents from concrete.
- B. Prime substrates where recommended in writing by manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

3.3 INSTALLATION

- A. General: Install penetration firestopping systems to comply with manufacturer's written installation instructions and published drawings for products and applications.
- B. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings.
 - 1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not forming permanent components of firestopping.
- C. Install fill materials by proven techniques to produce the following results:
 - 1. Fill voids and cavities formed by openings, forming materials, accessories and penetrating items to achieve required fire-resistance ratings.
 - 2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
 - 3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 CLEANING AND PROTECTION

- A. Clean off excess fill materials adjacent to openings as the Work progresses by methods and with cleaning materials that are approved in writing by penetration firestopping system manufacturers and that do not damage materials in which openings occur.
- B. Provide final protection and maintain conditions during and after installation that ensure that penetration firestopping systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, immediately cut out and remove damaged or deteriorated penetration firestopping material and install new materials to produce systems complying with specified requirements.

END OF SECTION 07 84 13

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SECTION 07 84 46 – FIRE RESISTIVE JOINT SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Joints in or between fire-resistance-rated constructions.
 - 2. Joints at exterior curtain-wall/floor intersections.
- B. Related Sections:
 - 1. Division 07 Section "Penetration Firestopping" for penetrations in fire-resistance-rated walls, horizontal assemblies, and smoke barriers.
 - 2. Division 07 Section "Expansion Joint Assemblies" for fire-resistive architectural joint systems.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. LEED Submittals:
 - 1. Product Data for Credit IEQ 4.1: For fire-resistive joint system sealants, documentation including printed statement of VOC content.
- C. Product Schedule: For each fire-resistive joint system. Include location and design designation of qualified testing agency.
 - 1. Where Project conditions require modification to a qualified testing agency's illustration for a particular fire-resistive joint system condition, submit illustration, with modifications marked, approved by fire-resistive joint system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.

- B. Installer Certificates: From Installer indicating fire-resistive joint systems have been installed in compliance with requirements and manufacturer's written recommendations.
- C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for fire-resistive joint systems.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: A firm that has been approved by FM Global according to FM Global 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with UL's "Qualified Firestop Contractor Program Requirements."
- B. Fire-Test-Response Characteristics: Fire-resistive joint systems shall comply with the following requirements:
 - 1. Fire-resistive joint system tests are performed by a qualified testing agency acceptable to authorities having jurisdiction.
 - 2. Fire-resistive joint systems are identical to those tested per testing standard referenced in "Fire-Resistive Joint Systems" Article. Provide rated systems complying with the following requirements:
 - a. Fire-resistive joint system products bear classification marking of qualified testing agency.
 - b. Fire-resistive joint systems correspond to those indicated by reference to designations listed by the following:
 - 1) UL in its "Fire Resistance Directory."

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install fire-resistive joint systems when ambient or substrate temperatures are outside limits permitted by fire-resistive joint system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.
- B. Install and cure fire-resistive joint systems per manufacturer's written instructions using natural means of ventilation or, where this is inadequate, forced-air circulation.

1.7 COORDINATION

- A. Coordinate construction of joints to ensure that fire-resistive joint systems are installed according to specified requirements.
- B. Coordinate sizing of joints to accommodate fire-resistive joint systems.

PART 2 - PRODUCTS

2.1 FIRE-RESISTIVE JOINT SYSTEMS

- A. Where required, provide fire-resistive joint systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of assemblies in or between which fire-resistive joint systems are installed. Fire-resistive joint systems shall accommodate building movements without impairing their ability to resist the passage of fire and hot gases.
- B. Joints in or between Fire-Resistance-Rated Construction: Provide fire-resistive joint systems with ratings determined per ASTM E 1966 or UL 2079:
 - 1. Joints include those installed in or between fire-resistance-rated walls floor or floor/ceiling assemblies and roofs or roof/ceiling assemblies.
 - 2. Fire-Resistance Rating: Equal to or exceeding the fire-resistance rating of construction they will join.
 - 3. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. A/D Fire Protection Systems Inc.
 - b. CEMCO.
 - c. Fire Trak Corp.
 - d. Grace Construction Products.
 - e. Hilti, Inc.
 - f. Johns Manville.
 - g. Nelson Firestop Products.
 - h. NUCO Inc.
 - i. Passive Fire Protection Partners.
 - j. RectorSeal Corporation.
 - k. Specified Technologies Inc.
 - l. 3M Fire Protection Products.
 - m. Tremco, Inc.; Tremco Fire Protection Systems Group.
 - n. USG Corporation.
- C. Exposed Fire-Resistive Joint Systems: Provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.
- D. VOC Content: Fire-resistive joint system sealants shall comply with the following limits for VOC content when calculated according to 40 CFR 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.
- E. Low-Emitting Materials: Fire-resistive joint system sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard

Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

- F. Accessories: Provide components of fire-resistive joint systems, including primers and forming materials, that are needed to install fill materials and to maintain ratings required. Use only components specified by fire-resistive joint system manufacturer and approved by the qualified testing agency for systems indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for joint configurations, substrates, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning: Clean joints immediately before installing fire-resistive joint systems to comply with fire-resistive joint system manufacturer's written instructions and the following requirements:
 - 1. Remove from surfaces of joint substrates foreign materials that could interfere with adhesion of fill materials.
 - 2. Clean joint substrates to produce clean, sound surfaces capable of developing optimum bond with fill materials. Remove loose particles remaining from cleaning operation.
 - 3. Remove laitance and form-release agents from concrete.
- B. Priming: Prime substrates where recommended in writing by fire-resistive joint system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.
- C. Masking Tape: Use masking tape to prevent fill materials of fire-resistive joint system from contacting adjoining surfaces that will remain exposed on completion of the Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove stains. Remove tape as soon as possible without disturbing fire-resistive joint system's seal with substrates.

3.3 INSTALLATION

- A. General: Install fire-resistive joint systems to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.

- B. Install forming materials and other accessories of types required to support fill materials during their application and in position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
 - 1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of fire-resistive joint system.
- C. Install fill materials for fire-resistive joint systems by proven techniques to produce the following results:
 - 1. Fill voids and cavities formed by joints and forming materials as required to achieve fire-resistance ratings indicated.
 - 2. Apply fill materials so they contact and adhere to substrates formed by joints.
 - 3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 CLEANING AND PROTECTING

- A. Clean off excess fill materials adjacent to joints as the Work progresses by methods and with cleaning materials that are approved in writing by fire-resistive joint system manufacturers and that do not damage materials in which joints occur.
- B. Provide final protection and maintain conditions during and after installation that ensure fire-resistive joint systems are without damage or deterioration at time of Substantial Completion. If damage or deterioration occurs despite such protection, cut out and remove damaged or deteriorated fire-resistive joint systems immediately and install new materials to produce fire-resistive joint systems complying with specified requirements.

END OF SECTION 07 84 46

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SECTION 07 92 33 –CONCRETE JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. A single installer shall be responsible for providing complete water proofing system including all products specified in the following Sections:
 - 1. Division 07 Section, "Traffic Coatings"
 - 2. Division 07 Section, "Water Repellents"
 - 3. Division 07 Section, "Concrete Joint Sealants"
 - 4. Division 07 Section, "Expansion Joint Assemblies"
- B. This Section includes the following:
 - 1. Exterior joints in the following horizontal traffic bearing surfaces:
 - a. Construction joints in cast-in-place concrete.
 - b. Control joints in slab-on-grade, pour strips, slabs, and topping slabs.
 - c. Joints between precast concrete units.
 - d. Perimeter of all floor drains.
 - e. Perimeter of floor penetrations.
 - f. Other joints as indicated on the Drawings.
 - 2. Exterior joints in the following vertical and horizontal non-traffic surfaces:
 - a. Construction joints in cast-in-place concrete.
 - b. Joints between precast concrete units.
 - c. Cove joints at intersection of horizontal and vertical concrete.
 - d. Exterior horizontal joints between precast and cast-in-place concrete. Color to match precast concrete.
 - e. Vertical and horizontal joints between precast beams and columns at tiers exposed directly to weather.
 - f. Other joints as indicated on the Drawings.
- C. Related Sections: Following Sections contain requirements that relate to this Section.
 - 1. Division 03 Section, "Precast Architectural Concrete."
 - 2. Division 03 Section, "Precast Structural Concrete."
 - 3. Division 07 Section, "Traffic Coatings."
 - 4. Division 07 Section, "Water Repellents."
 - 5. Division 07 Section, "Expansion Joint Assemblies."

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Materials shall be compatible with materials or related Work with which they come into contact, and with materials covered by this Section.
 - 2. Distribute reviewed submittals to all others whose Work is related.
 - 3. Coordinate layout of joint system and approve methods for providing joints with precast concrete and concrete contractors.
 - 4. Inspect site and precast plant before precast production to insure proper joint configuration.
- B. Make submittals in accordance with requirements of Division 01 Section, "Submittal Procedures."
- C. Submittals and Resubmittals: Engineer will review each of Contractor's shop drawings and/or submittal data the initial time and, should resubmittal be required, one additional time to verify that reasons for resubmittal have been addressed by Contractor and corrections made. Resubmittal changes/revisions/corrections shall be circled. Engineer will review only circled items and will not be responsible for non-circled changes/revisions/corrections and additions. Should additional resubmittals be required, Contractor shall reimburse City for all costs incurred, including the cost of Engineer's services made necessary to review such additional resubmittals. City shall in turn reimburse Engineer.
- D. Requests for Information
 - 1. Engineer reserves the right to reject, unprocessed, any Request for Information (RFI) that the Engineer, at its sole discretion, deems frivolous.
 - 2. Engineer reserves the right to reject, unprocessed, any RFI that the Engineer, at its sole discretion, deems already answered in the Contract Documents.
 - 3. RFI process shall not be used for requesting substitutions. Procedures for substitutions are clearly specified elsewhere in the contract documents.

1.4 ACTION SUBMITTALS

- A. Product Data: For each system indicated at least 60 days prior to application.
 - 1. Product description, technical data, appropriate applications, and limitations.
 - 2. Primer type and application rate
- B. Samples:
 - 1. One for each system indicated.
- C. Sample Warranty: For each system indicated.

1.5 INFORMATION SUBMITTALS

- A. Certificates:
 - 1. Evidence of installer's being certified by manufacturer. Evidence shall include complete copy of manufacturer's licensing/certification document, spelling out repair responsibility for warranty claims.
 - 2. Certification from the Manufacturer that joint details as specified are acceptable for system to be installed at least 1 month before placement of any concrete which will receive joint sealant.

- B. Field Quality Control:
 - 1. Two copies each of manufacturer's technical representative's log for each visit.
 - 2. Testing agency field and test reports.
- C. Qualification Statements:
 - 1. Manufacturer's qualifications as defined in the "Quality Assurance" article.
 - 2. Installer's qualifications as defined in the "Quality Assurance" article.
 - 3. Signed statement from this Section applicator certifying that applicator has read, understood, and shall comply with all requirements of this Section.

1.6 CLOSEOUT SUBMITTALS

- A. Final executed Warranty.
- B. Three copies of System Maintenance Manual.
- C. Five copies of Snow Removal Guidelines for areas covered by warranty.

1.7 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: City retains right to reject any manufacturer.
 - 1. Evidence of acceptable previous work on WALKER-designed projects. If none, so state.
 - 2. Evidence of financial stability acceptable to Engineer/Architect.
 - 3. Listing of 20 or more projects completed with submitted sealant, to include:
 - a. Name and location of project.
 - b. Type of sealant applied.
 - c. On-Site contact with phone number.
- B. Manufacturer's technical representative, acceptable to Engineer/Architect, shall be on site during surface preparation and initial stages of installation.
- C. Installer's Qualifications: City retains right to reject any installer or subcontractor.
 - 1. Installer shall be legally licensed to perform work in the state of New York. Evidence of compliance with Summary article paragraph "A single installer. . ."
 - 2. Evidence that installer has successfully performed or has qualified staff who have successfully performed at least 5 verifiable years of installations similar to those involved in this Contract, and minimum 10 projects with submitted sealant.
 - 3. Listing of 5 or more installations in climate and size similar to this Project performed by installer's superintendent.
- D. Testing Agency: Independent testing laboratory employed by **City** and acceptable to Engineer/Architect.
- E. Certifications:
 - 1. Licensing/certification document from system manufacturer that confirms sealant installer is a licensed/certified applicator for the manufacturer and is legally licensed to perform work in the state of New York.
 - 2. Licensing/certification agreement shall include following information:
 - a. Applicator's financial responsibility for warranty burden under agreement terms.
 - b. Manufacturer's financial responsibility for warranty burden under agreement terms.

- c. Process for dispute settlement between manufacturer and applicator in case of system failures where cause is not evident or cannot be assigned.
- d. Authorized signatures for both Applicator Company and Manufacturer.
- e. Commencement date of agreement and expiration date (if applicable).

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver all materials to site in original, unopened containers, bearing following information:
 - 1. Name of product.
 - 2. Name of manufacturer.
 - 3. Date of preparation.
 - 4. Lot or batch number.
- B. Store materials under cover and protect from weather. Replace packages or materials showing any signs of damage with new material at no additional cost to City.

1.9 FIELD CONDITIONS

- A. Weather and Substrate Conditions: Proceed with work only when existing and forecast weather and temperature of concrete substrate will permit work in accordance with manufacturer's recommendations.

1.10 WARRANTY

- A. Manufacturer: Furnish City with written total responsibility Joint and Several Warranty, detailing responsibilities of manufacturer and installer with regard to warranty requirements (Joint and Several). The warranty shall provide that sealant will be free of defects, water penetration and chemical damage related to system design, workmanship or material deficiency, consisting of:
 - 1. Any adhesive or cohesive failures.
 - 2. Weathering.
 - 3. Abrasion or tear failure resulting from normal traffic use.
- B. If material surface shows any of defects listed above, supply labor and material to repair all defective areas and to repaint all damaged line stripes.
- C. Warranty period shall be a 5 year Joint and Several Warranty commencing with date of acceptance of work.
- D. Perform any repair under this warranty at no cost to City.
- E. Address the following in the terms of the Warranty: length of warranty, change in value of warranty – if any- based on length of remaining warranty period, transferability of warranty, responsibilities of each party, notification procedures, dispute resolution procedures, and limitations of liability for direct and consequential damages.
- F. Snowplows, vandalism, and abnormally abrasive maintenance equipment are not normal traffic use and are exempted from warranty.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturer: Subject to compliance with requirements, provide products of 1 of following, only where specifically named in product category:
1. BASF Building Systems (BASF), Shakopee, MN.
 2. Dow Corning Corp. (Dow Corning), Midland, MI.
 3. Lymtal International Inc. (Lymtal), Lake Orion, MI.
 4. Pecora Corporation (Pecora), Harleysville, PA.
 5. Sika Corporation (Sika), Lyndhurst, NJ.
 6. Tremco (Tremco), Cleveland, OH.

2.2 MATERIALS, JOINT SEALANT SYSTEM

- A. Provide complete system of compatible materials designed by manufacturer to produce waterproof, traffic-bearing control joints as detailed on Drawings.
- B. Compounds used for sealants shall not stain masonry or concrete. Aluminum pigmented compounds not acceptable.
- C. Color of sealants shall match adjacent surfaces.
- D. Closed cell or reticulated backer rods: Acceptable products:
1. "Sof Rod," Nomaco Inc., 501 NMC Drive, Zebulon, NC 27597. (800) 345-7279 ext. 341.
 2. "ITP Soft Type Backer Rod," Industrial Thermo Polymers Limited, 2316 Delaware Ave., Suite 216, Buffalo, NY 14216. (800) 387-3847.
 3. "MasterSeal 921 Backer Rod," BASF.
- E. Bond breakers and fillers: as recommended by system manufacturer.
- F. Primers: as recommended by sealant manufacturer.
- G. Acceptable sealants are listed below. Sealants shall be compatible with all other materials in this Section and related work.
- H. Acceptable polyurethane control joint sealants (traffic bearing):
1. MasterSeal SL-2 or MasterSeal SL-2 SG, BASF.
 2. Iso-flex 880 GB or Iso-flex 881, Lymtal.
 3. Dynatrol II-SG or Urexpan NR 200, Pecora.
 4. Sikaflex-2c SL or Sikaflex-2c NS TG, Sika.
 5. THC-901, Vulkem 45SSL, Dymetric 240 FC or Dymonic 100, Tremco.
- I. Acceptable silicone control joint sealants (traffic bearing):
1. Spectrem 800 or Spectrem 900SL, Tremco.
 2. 310-SL or 311-NS, Pecora.
 3. Dow Corning SL, FC or NS Parking Structure Sealant, Dow Corning.
- J. Acceptable polyurethane vertical and cove joints sealants (non-traffic bearing):
1. Sikaflex-2c NS EZ, Sika.
 2. MasterSeal NP-2, BASF.
 3. Dymetric 240FC, Dymonic 100 or THC 901 (cove only), Tremco.

4. Dynatred, Pecora.
 5. Iso-flex 881, Lymtal.
- K. Acceptable silicone vertical and cove joint sealants (non-traffic bearing):
1. Spectrem 1 or Spectrem 4-TS, Tremco.
 2. 311-NS, Pecora.
 3. Dow Corning NS Parking Structure Sealant, Dow Corning.
- L. Proposed Substitutions: None for this project. Contact Engineer/Architect for consideration for future projects.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces to receive Work and report immediately in writing to Engineer/Architect any deficiencies in surface which render it unsuitable for proper execution of Work.
- B. Coordinate and verify that related Work meets following requirements before beginning installation
1. Concrete surfaces are finished as acceptable for system to be installed.
 2. Curing compounds used on concrete surfaces are compatible with system to be installed.
 3. Concrete surfaces have completed proper curing period for system selected.

3.2 PREPARATION

- A. Seal all openings to occupied space to prevent cleaning materials, solvents and fumes from infiltration. All protective measures and/or ventilating systems required to prevent infiltration are incidental to this Work.
- B. Correct unsatisfactory conditions before installing sealant system.
- C. Acid etching is prohibited.
- D. Grind joint edges smooth and straight with beveled grinding wheel before sealing. All surfaces to receive sealant shall be dry and thoroughly cleaned of all loose particles, laitance, dirt, dust, oil, grease or other foreign matter. Obtain written approval of method from system manufacturer before beginning cleaning.
- E. Final preparation of joints shall be a sandblast with medium that removes dust and ground material from surfaces to receive sealant.
- F. Check preparation of substrate for adhesion of sealant.
- G. Prime and seal joints and protect as required until sealant is fully cured. A primer coat is required for all systems.

3.3 INSTALLATION/APPLICATION

- A. Do all Work in strict accordance with manufacturer's written instructions and specifications including, but not limited to, moisture content of substrate, atmospheric conditions (including relative humidity and temperature), thicknesses and texture, and as shown on Drawings.

- B. Completely fill joint without sagging or smearing onto adjacent surfaces.
- C. Self-Leveling Sealants: Fill horizontal joints slightly recessed to avoid direct contact with wheel traffic.
- D. Non-Sag Sealants: Tool joints concave: Wet tooling not permitted.
- E. Clean off excess material and material smears adjacent to joints as work progresses using methods and materials approved by manufacturers.
- F. Cease material installation under adverse weather conditions, or when temperatures are outside manufacturer's recommended limitations for installation, or when temperature of work area or substrate are below 40°F.

3.4 FIELD QUALITY CONTROL

- A. Contractor and Engineer/Architect will jointly determine which one of following 2 methods of sealant testing to verify sealant profile:
 - 1. Contractor, at Engineer/Architect's direction, shall cut out lesser of 1% of total lineal footage placed or total of 100 lineal ft of joint sealant at isolated/random locations (varying from in. to ft of material) for Engineer/Architect and Manufacturer's Representative inspection of sealant profile.
 - 2. Contractor, at Engineer/Architect's direction, shall install 3 trial joint sections of 20 ft each. Contractor shall cut out joint sections, as selected by Engineer/Architect, for Engineer/Architect and Manufacturer's Representative inspection. Additional isolated/random removals may be required where sealant appears deficient. Total cut out sealant shall not exceed lesser of 1% of total lineal footage placed or total of 100 lineal ft of joint sealant at isolated/random locations (varying from in. to ft of material) for Engineer/Architect and Manufacturer's Representative inspection of sealant profile.
- B. Repair all random joint sealant "cut out" sections at no cost to City.
- C. Testing Agency:
 - 1. Check shore hardness per ASTM standard specified in sealant manufacturer's printed data.
 - 2. If flood test of joints required by this Section, report results to Engineer/Architect.

END OF SECTION 07 92 33

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SECTION 07 92 36 – ARCHITECTURAL JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal non-traffic surfaces.
 - 1. Joint locations provided by precaster (urethane joint sealants)
 - a. Joints between plant precast pieces
 - b. Joints between plant-precast architectural concrete units.
 - 2. Joint locations provided by others (Silicon):
 - a. Construction joints in cast-in-place concrete.
 - b. Control and expansion joints in unit masonry.
 - c. Joints in glass unit masonry assemblies.
 - d. Joints in exterior insulation and finish systems.
 - e. Joints between metal panels.
 - f. Joints between different materials listed above.
 - g. Perimeter joints between materials listed above and frames of doors windows and louvers.
 - h. Control and expansion joints in ceilings and other overhead surfaces.
 - i. Other joints as indicated on Drawings.
- B. Related Requirements:
 - 1. Division 07, Section "Concrete Joint Sealants" for sealing joints in horizontal traffic-bearing areas and vertical joints in concrete.

1.3 ACTION SUBMITTALS

- A. Product Data: For each joint-sealant product.
- B. Sustainable Design Submittals:
 - 1. Product Data: For sealants, indicating VOC content.
 - 2. Laboratory Test Reports: For sealants, indicating compliance with requirements for low-emitting materials.
- C. 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.
- D. 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.

E. 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.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified testing agency.
- B. Product Test Reports: For each kind of joint sealant, for tests performed by manufacturer and witnessed by a qualified testing agency or by a qualified testing agency.
- C. Preconstruction Laboratory Test Schedule: Include the following information for each joint sealant and substrate material to be tested:
1. Joint-sealant location and designation.
 2. Manufacturer and product name.
 3. Type of substrate material.
 4. Proposed test.
 5. Number of samples required.
- D. 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.
- E. Field-Adhesion-Test Reports: For each sealant application tested.
- F. Sample Warranties: For special warranties.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.
- B. Product Testing: Test joint sealants using a qualified testing agency.
1. Testing Agency Qualifications: Qualified according to ASTM C 1021 to conduct the testing indicated.
- C. 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.

1.6 PRECONSTRUCTION TESTING

- A. Preconstruction Laboratory Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.
1. Adhesion Testing: Use ASTM C 794 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
 2. Compatibility Testing: Use ASTM C 1087 to determine sealant compatibility when in contact with glazing and gasket materials.
 3. Stain Testing: Use ASTM C 1248 to determine stain potential of sealant when in contact with masonry substrates.
 4. Submit manufacturer's recommended number of pieces of each type of material, including joint substrates, joint-sealant backings, and miscellaneous materials.

5. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
6. For materials failing tests, obtain joint-sealant manufacturer's written instructions for corrective measures, including use of specially formulated primers.
7. Testing will not be required if joint-sealant manufacturers submit data that are based on previous testing, not older than 24 months, of sealant products for adhesion to, staining of, and compatibility with joint substrates and other materials matching those submitted.

1.7 FIELD 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.

1.8 WARRANTY

- A. Special Installer's Warranty: Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 1. Warranty Period: Five years from date of Substantial Completion.
- B. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:
 1. Movement of the structure caused by stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
 2. Disintegration of joint substrates from 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 JOINT SEALANTS, 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. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.2 SILICONE JOINT SEALANTS

- A. Silicone, S, NS, 100/50, NT: Single-component, non-sag, plus 100 percent and minus 50 percent movement capability, non-traffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 100/50, Use NT.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. GE Construction Sealants; Momentive Performance Materials Inc.
 - b. Sika Corporation.
- B. Silicone, S, NS, 50, NT: Single-component, non-sag, plus 50 percent and minus 50 percent movement capability, non-traffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 50, Use NT.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Dow Corning Corporation.
 - b. GE Construction Sealants; Momentive Performance Materials Inc.
 - c. Pecora Corporation.
 - d. Sika Corporation.
- C. Silicone, S, NS, 35, NT: Single-component, non-sag, plus 35 percent and minus 35 percent movement capability. Non-traffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 35, Use NT.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. GE Construction Sealants; Momentive Performance Materials Inc.
- D. Silicone, S, NS, 25, NT: Single-component, non-sag, plus 25 percent and minus 25 percent movement capability, non-traffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 25, Use NT.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Dow Corning Corporation.
 - b. GE Construction Sealants; Momentive Performance Materials Inc.
 - c. Polymeric Systems, Inc.
 - d. Schnee-Morehead, Inc., an ITW company.
 - e. Sherwin-Williams Company (The).
- E. Silicone, Acid Curing, S, NS, 25, NT: Single-component, non-sag, plus 25 percent and minus 25 percent movement capability, non-traffic-use, acid-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 25, Use NT.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Bostik, Inc.
 - b. Dow Corning Corporation.
 - c. Pecora Corporation.
 - d. Polymeric Systems, Inc.
 - e. Sika Corporation.
- F. Silicone, S, NS, 100/50, T, NT: Single-component, non-sag, plus 100 percent and minus 50 percent movement capability, traffic- and non-traffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 100/50, Uses T and NT.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Dow Corning Corporation.
- G. Silicone, S, NS, 50, T, NT: Single-component, non-sag, plus 50 percent and minus 50 percent movement capability, traffic- and non-traffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 50, Uses T and NT.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Dow Corning Corporation.
 - b. Soudal USA.
- H. Silicone, S, NS, 25, T, NT: Single-component, non-sag, plus 25 percent and minus 25 percent movement capability, traffic- and non-traffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 25, Uses T and NT.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Sika Corporation.
- I. Silicone, S, P, 100/50, T, NT: Single-component, pourable, plus 100 percent and minus 50 percent movement capability traffic- and non-traffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade P, Class 100/50, Uses T and NT.
 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Sika Corporation.
- J. Silicone, S, P, 25, T, NT: Single-component, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and non-traffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade P, Class 25, Uses T and NT.
 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Sika Corporation.

- K. Silicone, M, P, 100/50, T, NT: Multicomponent, pourable, plus 100 percent and minus 50 percent movement capability, traffic- and non-traffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type M, Grade P, Class 100/50, Uses T and NT.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. May National Associates, Inc.; a subsidiary of Sika Corporation.

2.3 URETHANE JOINT SEALANTS

- A. Urethane, S, NS, 25, NT: Single-component, non-sag, non-traffic-use, plus 25 percent and minus 25 percent movement capability, urethane joint sealant; ASTM C 920, Type S, Grade NS, Class 25, Use NT.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. BASF Corporation-Construction Systems.
 - b. Bostik, Inc.
 - c. ER Systems; an ITW Company.
 - d. Pecora Corporation.
 - e. Polymeric Systems, Inc.
 - f. Schnee-Morehead, Inc., an ITW company.
 - g. Sherwin-Williams Company (The).
 - h. Sika Corporation.
 - i. Tremco Incorporated.

- B. Urethane, S, NS, 100/50, T, NT: Single-component, non-sag, plus 100 percent and minus 50 percent movement capability, traffic- and non-traffic-use, urethane joint sealant; ASTM C 920, Type S, Grade NS, Class 100/50, Uses T and NT.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Sika Corporation.

- C. Urethane, S, NS, 25, T, NT: Single-component, non-sag, plus 25 percent and minus 25 percent movement capability, traffic- and non-traffic-use, urethane joint sealant; ASTM C 920, Type S, Grade NS, Class 25, Uses T and NT.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. BASF Corporation-Construction Systems.
 - b. LymTal International Inc.

- D. Urethane, S, P, 35, T, NT: Single-component, pourable, plus 35 percent and minus 35 percent movement capability, traffic- and non-traffic-use, urethane joint sealant; ASTM C 920, Type S, Grade P, Class 35, Uses T and NT.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Bostik, Inc.

- E. Urethane, S, P, 25, T, NT: Single-component, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and non-traffic-use, urethane joint sealant; ASTM C 920, Type S, Grade P, Class 25, Uses T and NT.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. BASF Corporation-Construction Systems.
 - b. Pecora Corporation.
 - c. Polymeric Systems, Inc.
 - d. Schnee-Morehead, Inc., an ITW company.
 - e. Sherwin-Williams Company (The).
 - f. Sika Corporation
- F. Urethane, M, NS, 50, NT: Multicomponent, non-sag, plus 50 percent and minus 50 percent movement capability non-traffic-use, urethane joint sealant; ASTM C 920, Type M, Grade NS, Class 50, Use NT.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Pecora Corporation.
- G. Urethane, M, NS, 25, NT: Multicomponent, non-sag, plus 25 percent and minus 25 percent movement capability, non-traffic-use, urethane joint sealant; ASTM C 920, Type M, Grade NS, Class 25, Use NT.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. BASF Corporation-Construction Systems.
 - b. Sherwin-Williams Company (The).
 - c. Sika Corporation
- H. Urethane, M, NS, 50, T, NT: Multicomponent, non-sag, plus 50 percent and minus 50 percent movement capability, traffic- and non-traffic-use, urethane joint sealant; ASTM C 920, Type M, Grade NS, Class 50, Uses T and NT.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Tremco Incorporated.
- I. Urethane, M, NS, 25, T, NT: Multicomponent, non-sag, plus 25 percent and minus 25 percent movement capability, traffic- and non-traffic-use, urethane joint sealant; ASTM C 920, Type M, Grade NS, Class 25, Uses T and NT.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. BASF Corporation-Construction Systems.
 - b. Bostik, Inc.
 - c. LymTal International Inc.
 - d. Sika Corporation.

- J. Urethane, M, P, 50, T, NT: Multicomponent, pourable, plus 50 percent and minus 50 percent movement capability, traffic- and non-traffic-use, urethane joint sealant; ASTM C 920, Type M, Grade P, Class 50, Uses T and NT.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. LymTal International Inc.
- K. Urethane, M, P, 25, T, NT: Multicomponent, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and non-traffic-use, urethane joint sealant; ASTM C 920, Type M, Grade P, Class 25, Uses T and NT.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. BASF Corporation-Construction Systems.
 - b. Bostik, Inc.
 - c. LymTal International Inc.
 - d. Pecora Corporation.
 - e. Sherwin-Williams Company (The).
 - f. Sika Corporation
 - g. Tremco Incorporated.

2.4 JOINT-SEALANT BACKING

- A. Sealant Backing Material, General: Non-staining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. BASF Corporation-Construction Systems.
 - b. Construction Foam Products; a division of Nomaco, Inc.
- 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.

2.5 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: Non-staining, 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 performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

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. Exterior insulation and finish systems.
 - 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.
- 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 Non-sag 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 at locations indicated on Drawings according to Figure 8B in ASTM C 1193.
 - 5. Provide recessed joint configuration of recess depth and at locations indicated on Drawings according to 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 one test for each 1000 feet (300 m)> of joint length thereafter or one 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 complies with 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 material, 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 manufacturers of 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, remove, and repair damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

END OF SECTION 07 92 36

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SECTION 07 95 00 – EXPANSION JOINT ASSEMBLIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. A single installer shall be responsible for providing complete water proofing system including all products specified in the following Sections:
 - 1. Division 07 Section, "Traffic Coatings"
 - 2. Division 07 Section, "Water Repellents"
 - 3. Division 07 Section, "Concrete Joint Sealants"
 - 4. Division 07 Section, "Expansion Joint Assemblies"
- B. This Section includes the following: Standard expansion joint systems:
 - a. Elastomeric concrete edged, extruded rubber joint system
 - 2. Vertical expansion joint systems
 - 3. Pedestrian rated hinged cover plate system
- C. Related Sections: The following Sections contain requirements that relate to this section:
 - 1. Division 03 Section "Cast-in-Place Concrete".
 - 2. Division 03 Section "Precast Structural Concrete".
 - 3. Division 03 Section "Precast Architectural Concrete".
 - 4. Division 04 Section "Unit Masonry" for masonry wall joint systems.
 - 5. Division 07 Section "Fire-Resistive Joint Systems" or "Firestopping".
 - 6. Division 07 Section "Concrete Joint Sealants" for liquid-applied joint sealants.
 - 7. Division 09 Section "Pavement Markings".

1.3 DEFINITIONS

- A. Maximum Joint Width: Widest linear gap a joint system tolerates and in which it performs its designed function without damaging its functional capabilities.
- B. Minimum Joint Width: Narrowest linear gap a joint system tolerates and in which it performs its designed function without damaging its functional capabilities.
- C. Movement Capability: Value obtained from the difference between widest and narrowest widths of a joint opening typically expressed in numerical values (mm or inches) or a percentage (plus or minus) of nominal value of joint width. Movement capability is to include anticipated movements from concrete shrinkage, concrete shortening and creep from post-tensioning or prestressing, cyclic thermal movements, and seismic movements.
- D. Nominal Joint Width: Width of linear opening specified in practice and in which joint system is installed.

- E. Nominal Form Width: Linear gap in joint system at time of forming or erection of structural elements bounding the expansion joint.
- F. Service Load Level: Defined level of load under which joint assembly remains elastic and fully functional.
- G. Fatigue Load Level: Defined level of load under which joint assembly remains elastic and fully functional, including all noise mitigation components, for the stated number of cycles.
- H. Collapse Load Level: Defined level of load under which joint assembly remains capable of bridging the gap, although plates may yield and components may break.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. General:
 - a. Coordinate and furnish anchorages, setting drawings, and instructions for installing joint systems. Provide fasteners of metal, type, and size to suit type of construction indicated and to provide for secure attachment of joint systems.
 - b. Coordinate requirements for transitions, tolerances, levelness, and plumbness to ensure the installed expansion joint system can perform with expected movement capabilities.
 - c. Coordinate and assign responsibility for preparation of concrete surfaces adjacent to expansion joints.
 - d. Expansion joint surface areas each side of joint gap shall have a vertical differential less than $\frac{1}{4}$ " and meet requirements of expansion joint manufacturer.
 - e. Minor surface defects shall be repaired according to manufacturer's recommendations. Repair materials shall be compatible with intended system materials and shall be approved by the Engineer prior to surface preparation and installation.
 - f. Submit for approval repair products and procedures for all major defects. Repair description shall indicate materials, manufacturer's requirements, expected service life, and maintenance requirements. Take all precautions necessary to avoid damaging adjacent surfaces and embedded reinforcement or post tensioned anchors and tendons. Contractor is responsible for any damages. Concrete repairs shall be of rectangular configuration, with no feather-edged surfaces. Final surface preparation of all repairs shall be sandblasting, or approved equivalent.
 - g. Coordinate layout of joint system and approval of methods for providing joints.
 - 2. Joint Opening Width:
 - a. Use temperature adjustment table to properly size joint gap at time of concrete pour and show that proposed joint system is capable of equal individual and combined movements in each direction when installed at designated temperature shown on drawings.
 - b. Where installation temperature is other than specified temperature, perform calculations showing joint is capable of movement within design temperature

- range (Criteria on Drawings) for “other” temperature, and that design and installation follow manufacturer’s recommendations.
- c. Expansion joint movement capability and the actual joint gap movement may not coincide. Construct actual joint gap in accordance with expansion design criteria.
 - d. Float expansion joint blockouts to remove all air pockets, voids and spalls caused by form work.
 - e. Blockouts shall be plumb with maximum tolerance per Manufacturer or not more than 0.125 inches deviation in 12 inches. Noncompliant blockouts shall be considered major defects.
 - f. Blockouts shall be straight and true with maximum tolerance per Manufacturer or not more than 0.250 inches deviation in 10 lineal feet. Noncompliant blockouts shall be considered major defects.
- B. Preinstallation Meetings: Meet at project site well in advance of time scheduled for Work to proceed to review requirements for Work and conditions that could interfere with successful expansion joint system performance. Require every party concerned with concrete formwork, blockout, concrete placement, or others required to coordinate or protect the Work thereafter, to attend. Include Engineer of Record and manufacturer’s technical representative and warranty officer.
- C. Submittals and Resubmittals: Engineer will review each of Contractor’s shop drawings and/or submittal data the initial time and, should resubmittal be required, one additional time to verify that reasons for resubmittal have been addressed by Contractor and corrections made. Resubmittal changes/revisions/corrections shall be circled. Engineer will review only circled items and will not be responsible for non-circled changes/revisions/corrections and additions. Should additional resubmittals be required, Contractor shall reimburse **City** for all costs incurred, including the cost of Engineer’s services made necessary to review such additional resubmittals. **City** shall in turn reimburse Engineer.
- D. Requests for Information
- 1. Engineer reserves the right to reject, unprocessed, any Request for Information (RFI) that the Engineer, at its sole discretion, deems frivolous.
 - 2. Engineer reserves the right to reject, unprocessed, any RFI that the Engineer, at its sole discretion, deems already answered in the Contract Documents.
 - 3. RFI process shall not be used for requesting substitutions. Procedures for substitutions are clearly specified elsewhere in the contract documents.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated:
- 1. Construction details, material descriptions, dimensions, and finishes.
 - 2. Proposed method of preparation of concrete surface to receive expansion joint systems.
 - 3. Proposed method and details for treatment of cracks, bugholes, or other potential concrete surface defects in areas to receive expansion joint systems.
 - 4. Horizontal spacing between embedded metals and plates to allow for volume change due to thermal conditions.

5. Temperature adjustment table showing formed gap at the time of concrete placement calculated at 10°F increments and a calculation showing joint system is capable of movement within the design temperature range.
- B. Shop Drawings: For each type of product indicated:
 1. Placement Drawings: Show project conditions including, but not limited to, line diagrams showing plans, elevations, sections, details, splices, blockout requirement, and terminations. Provide isometric or clearly detailed drawings depicting how components interconnect. Include reviewed and approved details from others whose work is related. Other information required to define joint placement or installation.
 2. Components and systems required to be designed by a professional engineer, shall bear such professional's written approval when submitted.
- C. Samples: Samples for each type of joint system indicated.
 - a. Submit **2** samples for each type. Full width by 6 inches (150 mm) long, for each system required.
- D. Delegated Design Submittals:
 1. Analysis indicating expansion joint system complies with expansion joint performance and design criteria of this specification and is suitable for use in conditions of this project. Provide a summary of design criteria used in design.
- E. Test and Evaluation Reports: Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for current products.

1.6 INFORMATIONAL SUBMITTALS

- A. Certificates
 1. Certification that products and installation comply with applicable federal, state of New York, and local EPA, OSHA and VOC requirements regarding health and safety hazards.
 2. ADA Certification: Prior to installation, submit written certification from manufacturer indicating that expansion joints conform to Americans with Disabilities Accessibility Guidelines for Buildings and Facilities, as published by U.S. Architectural & Transportation Barriers Compliance Board, 1331 F Street, N.W., Suite 1000, Washington, DC 20004-1111. 1-800-872-2253.
 - a. Submit test reports from accredited laboratory attesting to joint systems' movement capability and ADA compliance.
 - b. Static coefficient of friction shall meet minimum requirements of Americans with Disabilities Act (ADA).
 3. Signed statement from installer/applicator certifying that installer/applicator has read, understood, and shall comply with all requirements of this Section.
 4. Signed statement from manufacturer's representative that they have read, understood, and shall comply with all requirements of this section.
- B. Field Quality Control
 1. Two copies each of manufacturer's technical representative's log for each visit.
- C. Qualification Statements

1. Manufacturer's qualifications as defined in the "Quality Assurance" article within 60 days of project award.
2. Installer's qualifications as defined in the "Quality Assurance" article.
3. Evidence of manufacturer's certification of installer/applicator. Evidence shall include complete copy of manufacturer's licensing/certification document, spelling out repair responsibility for warranty claims.

1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Contracts: 2 copies of Maintenance Program contracts.
- B. Operation and Maintenance Data
 1. Maintenance Manual: 3 copies of System Maintenance Manual.
 2. Five copies of snow removal guidelines for areas covered by warranty.
- C. Warranty Documentation: 2 executed copies of Labor and Material Warranty including all terms, conditions and maintenance requirements.

1.8 QUALITY ASSURANCE

- A. Manufacturer Qualifications: **City** retains right to reject any manufacturer.
 1. Evidence of acceptable previous work on WALKER-designed projects. If none, so state.
 2. Copy of sample warranty that meets the requirements of the "Warranty" article in Section 1.
 3. Evidence of financial stability acceptable to **City** or Engineer/Architect.
 4. Evidence of compliance with "Single Installer" requirement.
- B. Installer Qualifications: An employer of workers, including superintendent for this project, trained and approved by manufacturer.
- C. Testing Agency: Independent testing laboratory employed by **City** and acceptable to Engineer/Architect.

1.9 DELIVERY, STORAGE AND HANDLING

- A. Deliver all materials to site in original, unopened containers, bearing following information:
 1. Name of product.
 2. Name of manufacturer.
 3. Date of preparation.
 4. Lot or batch number.
- B. Store materials under cover and protect from weather. Replace packages or materials showing any signs of damage with new material at no additional cost to **City**.

1.10 WARRANTY

- A. Warranty period shall be a 5 year Joint and Several Warranty commencing with date of acceptance of work.
- B. Installation Requirements: Include a written plan of construction and coordination requirements, to allow joint system installation to proceed with specified warranty, that specifically addresses the following:

1. Block out acceptance criteria.
 2. Surface preparation acceptance criteria.
 3. Crack, surface defect, and detailing recommendations.
 4. Method of protection of surrounding surfaces.
 5. Method of expansion joint system installation description.
 6. Primer type and application rate.
 7. Method of preparation of all glands and reinforced membranes.
 8. Temperature, humidity and other weather constraints. Specify substrate moisture testing criteria, if any.
 9. Final cure time before removal of protection, resumption of traffic, and/or paint striping.
 10. Any other special instructions required to ensure proper installation.
- C. Quality Service Requirements: Show evidence of licensed/approved installer. List of names, addresses and phone numbers, with copies of certification/approval agreement with each, satisfies requirement. Licensing/certification agreement shall include following information:
1. Installer's financial responsibility for warranty burden under agreement terms.
 2. Manufacturer's financial responsibility for warranty burden under agreement terms.
 3. Process for dispute settlement between manufacturer and installer in case of system failures where cause is not evident or cannot be assigned.
 4. Authorized signatures for both Installer Company and Manufacturer.
 5. Commencement date of agreement and expiration date (if applicable).
 6. Provide copy of contractor's field application quality control procedures.
- D. Manufacturer: Furnish **City** with written total responsibility Joint and Several Warranty, detailing responsibilities of manufacturer and installer with regard to warranty requirements (Joint and Several). The warranty shall provide that expansion joints will be free of defects, water penetration and chemical damage related to system design, workmanship or material deficiency, consisting of: Warranty shall provide that system shall be free of defects, water penetration and chemical damage related to system design, workmanship or material deficiency, consisting of:
1. Any water leakage through expansion joint system or leaking conditions of reinforced membrane, other waterproofing components, or glands.
 2. Any adhesive or cohesive failures of the system.
 3. Shifting of plates out of alignment due to system failure.
 4. Loose plates, anchor blocks, bolts.
 5. Metal to metal vibration causing noises during use.
 6. Metal to non-metal vibration causing noises during use.
 7. Tears, weathering, or degradation in gland from normal use.
 8. Expansion joint glands are considered defective if they buckle upwards beyond the level of the floor surface after installation or downward in excess of ½ inch below the floor surface.
- E. If expansion joint systems or components show any of defects listed above, supply labor and material to repair all defects at no cost to **City**.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. A single Installer shall be responsible for providing complete expansion joint system. Obtain all joint systems through one source from a single manufacturer.
- B. Drawings indicate size, profiles, and dimensional requirements of joint systems and are schematic for systems indicated.
- C. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.

2.2 PERFORMANCE REQUIREMENTS

- A. Intent of this section is to insure that installed expansion joints allow pedestrian and vehicular traffic to pass in a smooth, quiet fashion with minimal maintenance required over a period of not less than 10 years. Expansion joints shall not only function as structural bridging elements, but must also accommodate structural expansions/contractions and minimize water leakage.
- B. Provide design of expansion joint for preparation of final details for fabrication and construction of all concrete openings, expansion joint elements and required accessories. An integral part of this project is engineering for the following:
 - 1. Include calculations for the size and forming of concrete openings to provide nominal joint width as indicated on drawings. Provide a summary of the design criteria used in the design.
 - 2. Include calculations for the appropriate size of expansion joint elements in accordance with the expansion joint assembly performance criteria. Include installation requirements of expansion joint assembly for specific project conditions and scheduling. Provide a summary of design criteria used in design.
- C. Expansion joint design shall meet or exceed all expected movements shown on drawings.
- D. Installation temperature range and estimated volume change movements are shown on drawings. Nominal form width shown on the drawings shall be adjusted for the ambient temperature at time of concrete placement and designer shall verify that width of joint at installation shall meet minimum installation requirements.
- E. Expansion joint systems shall be capable of resisting a differential vertical movement of ½ inch.
- F. Materials shall be supplied in lengths to minimize or eliminate the need to splice waterproofing components.
 - 1. Waterproofing materials directly exposed to vehicular traffic shall be supplied with no joints in vehicle drive aisles.
 - 2. All mitered splices shall be performed at the factory and provide sufficient gland length for butt splicing with field splicing equipment.
 - 3. All Santoprene butt to butt splices shall be heat welded.
 - 4. Butt to butt splices with other materials shall be per manufacturer's recommendations.
- G. Design system for passenger vehicles traveling at speeds normally expected within a parking structure.

- H. Walking Surfaces: Expansion joint assemblies at walking areas subject to pedestrian traffic shall provide a smooth, slip resistant walking surface for pedestrians with these minimum requirements:
1. Shall provide walking surfaces in accordance with ASTM – F 1637 Standard Practice for Safe Walking Surfaces.
 2. Shall be designed to comply with “Americans with Disabilities Act (ADA), Accessibility Guidelines (ADAAG)” [and] [ICC A117.1]. Americans with Disabilities Accessibility Guidelines for Buildings and Facilities, as published by U.S. Architectural & Transportation Barriers Compliance Board, 1331 F Street, N.W., Suite 1000, Washington, DC 20004-1111. 1–800-872-2253.
 3. Adjoining walkway surfaces shall be flush and meet the following minimum requirements:
 - a. Changes in level of less than ¼ inch in height may be without edge treatment as shown in ADA Figure 303.2 and on the Drawings.
 - b. Changes in Level between ¼ inch and ½ inch in height shall be beveled with a slope no greater than 1:2 as shown in ADA Figure 303.3 and on the Drawings.
 - c. Changes in level greater than ½ inch in height are not permitted unless they can be transitioned by means of a ramp as shown on Drawings.
 - d. Openings in floor or ground surfaces shall not allow passage of a sphere more than ½ inch diameter except as allowed for elevators and platform lifts as shown in ADA Figure 302.3 and on the Drawings.

2.3 MANUFACTURERS

- A. Subject to compliance with requirements, provide products from one of following manufacturers (listed in alphabetical order), only where specifically named in product categories:
1. Balco Inc., Wichita, KS (Balco).
 2. Construction Specialties, Inc., Muncy, PA (C/S).
 3. Dow Corning Corp., Midland, MI (Dow Corning).
 4. Emseal Joint Systems, Westborough, MA (Emseal).
 5. Erie Metal Specialties, Inc., Akron, NY (EMS).
 6. Inpro Jointmaster, Muskego, WI (Jointmaster)
 7. Lymtal International Inc. Lake Orion, MI (Lymtal).
 8. MM Systems Corporation, Atlanta, GA (MM).
 9. TechStar, Inc., Findlay, OH (TechStar).
 10. Tremco, Cleveland, OH (Tremco).
 11. Watson Bowman Acme Corporation, a Division of BASF Construction Chemicals NA, Amherst, NY (WBA).

2.4 PRODUCTS, STANDARD EXPANSION JOINT SYSTEMS

- A. Elastomeric concrete edged, extruded rubber expansion joint system.
1. CR Series System, Jointmaster.
 2. DuraFlex Chambered Wing Seal CS and DCS Series, Balco.
 3. Iso-Flex Winged Joint System J Series, LymTal.
 4. Lokcrete Membrane System (LMS) Series, MM.
 5. Polycrete/Membrane System, Type CR Series, EMS.

6. Thermaflex Membrane/Nosing System, Type TM and TCR Series, Emseal.
 7. Vulkem WF series Vehicular Expansion Joint System, Tremco.
 8. Wabo®Crete Membrane System ME Series, WBA.
 9. ZB 200/400 Series, C/S.
- B. Substitutions: **None** for this project. Contact Engineer/Architect for consideration for future projects.
- C. Substitutions: None for this project. Contact Engineer/Architect for consideration for future projects.
- D. Substitutions: Products meeting the Experience Record and Qualifications section will be considered.

2.5 PRODUCTS, OTHER

- A. Neoprene foam rubber vertical expansion joint sealants:
1. Wabo®InverSeal, WBA.
 2. Iso-Flex Foamflux, LymTal.
 3. Expanded Rubber Sealing System, ERS Series, MM.
- B. Vertical compression joint sealants:
1. AR Series Compression Seal, Jointmaster.
 2. Elastoprene Compression Seals, ECS & VCS Series, MM.
 3. Iso-Flex Compression Seal, LymTal.
 4. Wabo®CompressionSeal, WBA.
- C. Expanding foam sealants:
1. 1200 Series Foam Seal, Jointmaster.
 2. ColorJoint Silicone Sealing System, ESS Series, MM.
 3. Seismic Colorseal, Emseal.
 4. Iso-Flex Precom "C", LymTal.
 5. Wabo Seismic WeatherSeal, WBA.
- D. Pedestrian Rated Hinged Cover Plate System, aluminum and stainless steel plates that provide flexible cover plate across stair and elevator tower expansion joint openings:
1. 806SD Series Hinged Cover Plate System, Jointmaster.
 2. Iso-Flex Hinged Cover Plate PD Series, LymTal.
 3. C/S Hinged Cover System, Model PD, PDW, C/S.
 4. Hinged Safety Cover System, HSC Series, MM.
 5. Wabo Hingemount, HDH Series, WBA.
 6. Wabo Safety Flex, SFP, with Elastomeric Cover, WBA.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces and blockouts where expansion joint systems will be installed for installation tolerances and other conditions affecting performance of Work.
- B. Check elevations on each side of expansion joint gap to ensure flush slab-to-slab transition.
- C. Check anticipated or actual minimum and maximum joint openings. Compare to manufacturer's movement specifications and make joint sizing recommendations.
- D. Coordinate and verify that related Work meets following requirements:
 - 1. Check adhesion to substrates and recommend appropriate preparatory measures.
 - 2. Curing compounds used on concrete surfaces are compatible with Work to be installed.
 - 3. Concrete surfaces have completed proper curing period for system selected.
 - 4. Coordinate expansion joint system with other related Work before installation of expansion joint.
 - 5. Verify expansion joints are compatible with Joint Sealants and traffic toppings.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.
- F. Cease installation if expansion joint blockouts and/or openings exhibit cracked edges, voids or spalls. Repair with approved material prior to installation of expansion joint.
- G. Correct unsatisfactory conditions in manner acceptable to Manufacturer and Engineer before installing joint system.

3.2 PREPARATION

- A. Prepare for installation of expansion joint systems in accordance with manufacturer's recommendations
- B. Surface Preparation:
 - 1. Acid etching: Prohibited.
 - 2. Prepare substrates according to joint system manufacturer's written instructions.
 - 3. Clean joints thoroughly in accordance with manufacturer's instructions to remove all laitance, unsound concrete and curing compounds which may interfere with adhesion.

3.3 INSTALLATION

- A. Comply with manufacturer's written instructions for storing, handling, and installing joint assemblies and materials unless more stringent requirements are indicated.
- B. Proceed with work only when existing and forecast weather and temperature of concrete substrate will permit work in accordance with manufacturer's recommendations.
- C. Cease material installation under adverse weather conditions, or when temperatures are outside manufacturers recommended limitations for installation, or when temperature of work area or substrate are below 40°F.
- D. Terminate exposed ends of joint assemblies with field- or factory-fabricated termination devices.

- E. Seal all openings to occupied spaces to prevent cleaning materials, solvents and fumes from infiltration. All protective measures and/or ventilating systems required to prevent infiltration are incidental to this Work.
- F. Clean off excess material and material smears adjacent to joints as work progresses using methods and materials approved by manufacturer.

3.4 FIELD QUALITY CONTROL

- A. Field Tests and Inspections: Prior to opening to traffic, test joint seal for leaks by maintaining continuously wet for 12 hours. Repair leaks revealed by examination of seal underside. Repeat test and repairs until all leaks stopped for full 12 hours.
- B. Manufacturer Services: Provide qualified manufacturer's technical representative for periodic inspection of Work at critical time of the installation, including but not limited to pre-concrete formwork and placement site meetings, block out inspection, surface defect repair, surface preparation, metal work, expansion gland installation and waterproofing system installation.

3.5 PROTECTION

- A. Do not remove protective covering until finish work in adjacent areas is complete. When protective covering is removed, clean exposed metal surfaces to comply with manufacturer's written instructions.
- B. Protect installation from damage by work of other Sections. Where necessary due to heavy construction traffic, remove and properly store cover plates or seals and install temporary protection over joints. Reinstall cover plates or seals prior to Substantial Completion of Work.

3.6 MAINTENANCE

- A. Provide separate line item bid price for 5 year maintenance program for vehicle rated seismic expansion joint system. The Maintenance Program includes observations, reports, and maintenance of all components for seismic expansion joint system.

END OF SECTION 07 95 00

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SECTION 08 11 13 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes hollow-metal work.
 - 1. Exterior standard steel doors and frames.
- B. Related Requirements:
 - 1. Division 08, Section "Door Hardware" for door hardware for hollow-metal doors.

1.3 DEFINITIONS

- A. Minimum Thickness: Minimum thickness of base metal without coatings according to NAAMM-HMMA 803 or SDI A250.8.

1.4 COORDINATION

- A. Coordinate anchorage installation for hollow-metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

1.5 PRE-INSTALLATION MEETINGS

- A. Pre-installation Conference: Conduct conference at Project site.

1.6 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, core descriptions, fire-resistance ratings, and finishes.

B. Sustainable Design Submittals:

1. **Product Data:** For recycled content, indicating postconsumer and pre-consumer recycled content and cost.

C. Schedule: Provide a schedule of hollow-metal work prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final Door Hardware Schedule.

1.7 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each type of hollow-metal door and frame assembly, for tests performed by a qualified testing agency.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver hollow-metal work palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use non-vented plastic.
1. Provide additional protection to prevent damage to factory-finished units.
- B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
- C. Store hollow-metal work vertically under cover at Project site with head up. Place on minimum **4-inch- (102-mm-)** high wood blocking. Provide minimum **1/4-inch (6-mm)** space between each stacked door to permit air circulation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
1. Amweld International, LLC.
 2. Apex Industries, Inc.
 3. Ceco Door; ASSA ABLOY.
 4. Commercial Door & Hardware Inc.
 5. Concept Frames, Inc.
 6. Curries Company; ASSA ABLOY.
 7. Custom Metal Products.
 8. Daybar Industries, Ltd.
 9. DE LA FONTAINE.
 10. Deansteel Manufacturing Company, Inc.
 11. DKS Steel Door & Frame Systems, Inc.

12. [Door Components, Inc.](#)
13. [Fleming Door Products Ltd.; Assa Abloy Group Company.](#)
14. [Gensteel Doors, Inc.](#)
15. [Greensteel Industries, Ltd.](#)
16. [HMF Express, LLC.](#)
17. [Hollow Metal Inc.](#)
18. [Hollow Metal Xpress.](#)
19. [J/R Metal Frames Manufacturing, Inc.](#)
20. [Karpen Steel Custom Doors & Frames.](#)
21. [L.I.F. Industries, Inc.](#)
22. [LaForce, Inc.](#)
23. [Megamet Industries, Inc.](#)
24. [Mesker Door Inc.](#)
25. [Michbi Doors Inc.](#)
26. [MPI Group, LLC \(The\).](#)

- B. Source Limitations: Obtain hollow-metal work from single source from single manufacturer.

2.2 REGULATORY REQUIREMENTS

- A. Fire-Rated Assemblies: Complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings and temperature-rise limits indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.
- B. Fire-Rated, Borrowed-Lite Assemblies: Complying with NFPA 80 and listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction for fire-protection ratings indicated, based on testing according to NFPA 257 or UL 9.

2.3 EXTERIOR HOLLOW-METAL DOORS AND FRAMES

- A. Construct exterior doors and frames to comply with the standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- B. Hollow-Metal Doors and Frames: NAAMM-HMMA 860. At locations indicated in the Door and Frame Schedule.
1. Physical Performance: Level A according to SDI A250.4.
 2. Doors:
 - a. Type: As indicated in the Door and Frame Schedule.
 - b. Thickness: 1-3/4 inches (44.5 mm.)
 - c. Face: Metallic-coated steel sheet, minimum thickness of 0.042 inch (1.0 mm), with minimum G60 ((Z180) or)A60 (ZF180) coating.
 - d. Edge Construction: model 2, seamless.
 - e. Core: Steel stiffened.

3. Frames:
 - a. Materials: Metallic-coated steel sheet, minimum thickness of **0.053 inch (1.3 mm)**, with minimum **G60 ((Z180) or)A60 (ZF180)** coating.
 - b. Construction: Full profile welded.
4. Prime.

2.4 FRAME ANCHORS

- A. Jamb Anchors:
 1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than **0.042 inch (1.0 mm)** thick, with corrugated or perforated straps not less than **2 inches (51 mm)** wide by **10 inches (254 mm)** long; or wire anchors not less than **0.177 inch (4.5 mm)** thick.
 2. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than **0.042 inch (1.0 mm)** thick.
 3. Compression Type for Drywall Slip-on Frames: Adjustable compression anchors.
 4. Post-installed Expansion Type for In-Place Concrete or Masonry: Minimum **3/8-inch- (9.5-mm-)** diameter bolts with expansion shields or inserts. Provide pipe spacer from frame to wall, with throat reinforcement plate, welded to frame at each anchor location.
- B. Floor Anchors: Formed from same material as frames, minimum thickness of **0.042 inch (1.0 mm)**, and as follows:
 1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.
 2. Separate Topping Concrete Slabs: Adjustable-type anchors with extension clips, allowing not less than **2-inch (51-mm)** height adjustment. Terminate bottom of frames at finish floor surface.

2.5 MATERIALS

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of pre-consumer recycled content not less than 25 percent.
- B. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- C. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- D. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B.
- E. Frame Anchors: ASTM A 879/A 879M, Commercial Steel (CS), **04Z (12G)** coating designation; mill phosphatized.

1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.
- F. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.
- G. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.
- H. Grout: ASTM C 476, except with a maximum slump of 4 inches (102 mm), as measured according to ASTM C 143/C 143M.
- I. Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.
- J. Glazing: Comply with requirements in Division 08, Section "Glazing."
- K. Bituminous Coating: Cold-applied asphalt mastic, compounded for 15-mil (0.4-mm) dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.6 FABRICATION

- A. Fabricate hollow-metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for metal thickness. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.
- B. Hollow-Metal Doors:
 1. Steel-Stiffened Door Cores: Provide minimum thickness 0.026 inch (0.66 mm), steel vertical stiffeners of same material as face sheets extending full-door height, with vertical webs spaced not more than 6 inches (152 mm) apart. Spot weld to face sheets no more than 5 inches (127 mm) o.c. Fill spaces between stiffeners with glass- or mineral-fiber insulation.
 2. Fire Door Cores: As required to provide fire-protection and temperature-rise ratings indicated.
 3. Vertical Edges for Single-Acting Doors: Bevel edges 1/8 inch in 2 inches (3.2 mm in 51 mm)
 4. Top Edge Closures: Close top edges of doors with flush closures of same material as face sheets.
 5. Bottom Edge Closures: Close bottom edges of doors with end closures or channels of same material as face sheets.
 6. Exterior Doors: Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.

7. Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum **3/4 inch (19 mm)** beyond edge of door on which astragal is mounted or as required to comply with published listing of qualified testing agency.
8. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.
 - a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
 - b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.
- C. Fabricate concealed stiffeners and edge channels from either cold- or hot-rolled steel sheet.
- D. Hardware Preparation: Factory prepare hollow-metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the Door Hardware Schedule, and templates.
 1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
 2. Comply with applicable requirements in SDI A250.6 and BHMA A156.115 for preparation of hollow-metal work for hardware.
- E. Stops and Moldings: Provide stops and moldings around glazed lites and louvers where indicated. Form corners of stops and moldings with mitered hairline joints.
 1. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of hollow-metal work.
 2. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
 3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
 4. Provide loose stops and moldings on inside of hollow-metal work.
 5. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.

2.7 STEEL FINISHES

- A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.
 1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

2.8 ACCESSORIES

- A. Grout Guards: Formed from same material as frames, not less than **0.016 inch (0.4 mm)** thick.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.
- B. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.3 INSTALLATION

- A. General: Install hollow-metal work plumb, rigid, properly aligned, and securely fastened in place. Comply with Drawings and manufacturer's written instructions.
- B. Hollow-Metal Frames: Install hollow-metal frames for doors, transoms, sidelites, borrowed lites, and other openings, of size and profile indicated. Comply with SDI A250.11 or NAAMM-HMMA 840 as required by standards specified.
 - 1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
 - a. At fire-rated openings, install frames according to NFPA 80.
 - b. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
 - c. Install frames with removable stops located on secure side of opening.
 - d. Install door silencers in frames before grouting.
 - e. Remove temporary braces necessary for installation only after frames have been properly set and secured.
 - f. Check plumb, square, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.

- g. Field apply bituminous coating to backs of frames that will be filled with grout containing antifreezing agents.
 2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with post-installed expansion anchors.
 - a. Floor anchors may be set with power-actuated fasteners instead of post-installed expansion anchors if so indicated and approved on Shop Drawings.
 3. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout.
 4. Concrete Walls: Solidly fill space between frames and concrete with mineral-fiber insulation.
 5. In-Place Concrete or Masonry Construction: Secure frames in place with post-installed expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
 6. Installation Tolerances: Adjust hollow-metal door frames for squareness, alignment, twist, and plumb to the following tolerances:
 - a. Squareness: Plus or minus **1/16 inch (1.6 mm)**, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - b. Alignment: Plus or minus **1/16 inch (1.6 mm)**, measured at jambs on a horizontal line parallel to plane of wall.
 - c. Twist: Plus or minus **1/16 inch (1.6 mm)**, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - d. Plumbness: Plus or minus **1/16 inch (1.6 mm)**, measured at jambs at floor.
- C. Hollow-Metal Doors: Fit hollow-metal doors accurately in frames, within clearances specified below. Shim as necessary.
 1. Non-Fire-Rated Steel Doors:
 - a. Between Door and Frame Jambs and Head: **1/8 inch (3.2 mm)** plus or minus **1/32 inch (0.8 mm)**.
 - b. Between Edges of Pairs of Doors: **1/8 inch (3.2 mm)** to **1/4 inch (6.3 mm)** plus or minus **1/32 inch (0.8 mm)**.
 - c. At Bottom of Door: [**3/4 inch (19.1 mm)**] [**5/8 inch (15.8 mm)**] plus or minus **1/32 inch (0.8 mm)**.
 - d. Between Door Face and Stop: **1/16 inch (1.6 mm)** to **1/8 inch (3.2 mm)** plus or minus **1/32 inch (0.8 mm)**.
 2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
- D. Glazing: Comply with installation requirements in Division 08, Section "Glazing" and with hollow-metal manufacturer's written instructions.
 1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than **9 inches (230 mm)** o.c. and not more than **2 inches (51 mm)** o.c. from each corner.

3.4 ADJUSTING AND CLEANING

- A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow-metal work that is warped, bowed, or otherwise unacceptable.
- B. Remove grout and other bonding material from hollow-metal work immediately after installation.
- C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.
- D. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.
- E. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

END OF SECTION 08 11 13

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SECTION 08 31 13 - ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes access doors and frames for walls and ceilings.
- B. Related Requirements:
 - 1. Section 07 72 00 "Roof Accessories" for roof hatches.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, fire ratings, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Samples: For each type of access door and frame and for each finish specified, complete assembly minimum 6 by 6 inches (150 by 150 mm) in size.
- C. Product Schedule: For access doors and frames. Use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing and inspecting agency.
 - 1. Fire-Rated Door Inspector: Submit documentation of compliance with NFPA 80, section 5.2.3.1.

1.5 CLOSEOUT SUBMITTALS

- A. Record Documents: For fire-rated doors, list of applicable room name and number in which access door is located.

1.6 QUALITY ASSURANCE

- A. Fire-Rated Door Inspector Qualifications: Inspector for field quality control inspections of fire-rated door assemblies shall meet the qualifications set forth in NFPA 80, section 5.2.3.1 and the following:

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Access Doors and Frames: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, according to NFPA 252 or UL 10B.

2.2 ACCESS DOORS AND FRAMES

- A. Flush Access Doors with Exposed Flanges
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Acudor Products, Inc.
 - b. Babcock-Davis.
 - c. Cendrex Inc.
 - d. Elmdor/Stoneman Manufacturing Company; a division of Acorn Engineering Company.
 - e. JL Industries, Inc.; a division of the Activar Construction Products Group.
 - f. Karp Associates, Inc.
 - g. Lane-Aire Manufacturing Corp.
 - h. Larsens Manufacturing Company.
 - i. Maxam Metal Products Limited.
 - j. Metropolitan Door Industries Corp.
 - k. MIFAB, Inc.
 - l. Milcor; Commercial Products Group of Hart & Cooley, Inc.
 - m. Nystrom, Inc.
 - n. Williams Bros. Corporation of America (The).
 2. Description: Face of door flush with frame, with exposed flange and concealed hinge.
 3. Locations: Wall and ceiling.
 4. Door Size: As indicated on drawings.
 5. Metallic-Coated Steel Sheet for Door: Nominal **0.064 inch (1.63 mm)**, 16 gage , factory primed.
 6. Frame Material: Same material, thickness, and finish as door .
 7. Latch and Lock: Cam latch, key operated with interior release.

2.3 FIRE-RATED ACCESS DOORS AND FRAMES

A. Fire-Rated, Flush Access Doors with Exposed Flanges.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Acudor Products, Inc.
 - b. Babcock-Davis.
 - c. Cendrex Inc.
 - d. Elmdor/Stoneman Manufacturing Company; a division of Acorn Engineering Company.
 - e. JL Industries, Inc.; a division of the Activar Construction Products Group.
 - f. Karp Associates, Inc.
 - g. Lane-Aire Manufacturing Corp.
 - h. Larsens Manufacturing Company.
 - i. Maxam Metal Products Limited.
 - j. Metropolitan Door Industries Corp.
 - k. MIFAB, Inc.
 - l. Milcor; Commercial Products Group of Hart & Cooley, Inc.
 - m. Nystrom, Inc.
 - n. Williams Bros. Corporation of America (The).
2. Description: Door face flush with frame, with a core of mineral-fiber insulation enclosed in sheet metal ; with exposed flange, self-closing door, and concealed hinge.
3. Locations: Wall and ceiling.
4. Door Size: As indicated on drawings.
5. Fire-Resistance Rating: Not less than that indicated.
6. Metallic-Coated Steel Sheet for Door: Nominal **0.040 inch (1.02 mm)**, 20 gage, factory primed.
7. Frame Material: Same material, thickness, and finish as door
8. Latch and Lock: Self-latching door hardware, operated by key with interior release.

2.4 MATERIALS

- A. Steel Plates, Shapes, and Bars: ASTM A36/A36M.
- B. Steel Sheet: Uncoated or electrolytic zinc coated, ASTM A879/A879M, with cold-rolled steel sheet substrate complying with ASTM A1008/A1008M, Commercial Steel (CS), exposed.
- C. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B; with minimum **G60 (Z180)** or **A60 (ZF180)** metallic coating.
- D. Aluminum Extrusions: **ASTM B221 (ASTM B221M)**, Alloy 6063.
- E. Aluminum Sheet: **ASTM B209 (ASTM B209M)**, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.

- F. Frame Anchors: Same material as door face.
- G. Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel according to ASTM A153/A153M or ASTM F2329.

2.5 FABRICATION

- A. General: Provide access door and frame assemblies manufactured as integral units ready for installation.
- B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.
- C. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish mounting holes, attachment devices and fasteners of type required to secure access doors to types of supports indicated.
 - 1. For concealed flanges with plaster bead for full-bed plaster applications, provide zinc-coated expanded-metal lath and exposed casing bead welded to perimeter of frames.
- D. Recessed Access Doors: Form face of panel to provide recess for application of applied finish. Reinforce panel as required to prevent buckling. Provide access sleeves for each latch operator and install in holes cut through finish.
- E. Latch and Lock Hardware:
 - 1. Quantity: Furnish number of latches and locks required to hold doors tightly closed.
 - 2. Keys: Furnish two keys per lock and key all locks alike.

2.6 FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- D. Painted Finishes: Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
 - 1. Factory Primed: Apply manufacturer's standard, lead- and chromate-free, universal primer immediately after surface preparation and pretreatment.

2. Factory Finished: Apply manufacturer's standard baked-enamel or powder-coat finish immediately after cleaning and pretreating, with minimum dry-film thickness of 1 mil (0.025 mm) for topcoat.
 - a. Color: As selected by Architect from full range of industry colors.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with manufacturer's written instructions for installing access doors and frames.

3.3 FIELD QUALITY CONTROL

- A. Inspection Agency: Engage a qualified inspector to perform inspections and to furnish reports to Architect.
- B. Inspections:
 1. Fire-Rated Door Inspections: Inspect each fire-rated access door in accordance with NFPA 80, section 5.2.
- C. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.
- D. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.
- E. Prepare and submit separate inspection report for each fire-rated access door indicating compliance with each item listed in NFPA 101.

3.4 ADJUSTING

- A. Adjust doors and hardware, after installation, for proper operation.

END OF SECTION 08 31 13

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SECTION 08 41 13 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Storefront framing.
 - 2. Manual-swing entrance doors.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: For aluminum-framed entrances and storefronts. Include plans, elevations, sections, full-size details, and attachments to other work.
 - 1. Include details of provisions for assembly expansion and contraction and for draining moisture occurring within the assembly to the exterior.
 - 2. Include full-size isometric details of each type of vertical-to-horizontal intersection of aluminum-framed entrances and storefronts, showing the following:
 - a. Joinery, including concealed welds.
 - b. Anchorage.
 - c. Expansion provisions.
 - d. Glazing.
 - e. Flashing and drainage.
 - 3. Show connection to and continuity with adjacent thermal, weather, air, and vapor barriers.
- C. Samples for Initial Selection: For units with factory-applied color finishes.
- D. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.
- E. Fabrication Sample: Of each vertical-to-horizontal intersection of assemblies, made from 12-inch (300-mm) lengths of full-size components and showing details of the following:

1. Joinery, including concealed welds.
 2. Anchorage.
 3. Expansion provisions.
 4. Glazing.
 5. Flashing and drainage.
- F. Entrance Door Hardware Schedule: Prepared by or under supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams. Coordinate final entrance door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of entrance door hardware.
- G. Delegated-Design Submittal: For aluminum-framed entrances and storefronts indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer
- B. Energy Performance Certificates: For aluminum-framed entrances and storefronts, accessories, and components, from manufacturer.
1. Basis for Certification: NFRC-certified energy performance values for each aluminum-framed entrance and storefront.
- C. Product Test Reports: For aluminum-framed entrances and storefronts, for tests performed by a qualified testing agency.
- D. Quality-Control Program: Developed specifically for Project, including fabrication and installation, according to recommendations in ASTM C 1401. Include periodic quality-control reports.
- E. Source quality-control reports.
- F. Field quality-control reports.
- G. Sample Warranties: For special warranties.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For aluminum-framed entrances and storefronts to include in maintenance manuals.
- B. Maintenance Data for Structural Sealant: For structural-sealant-glazed storefront to include in maintenance manuals. Include ASTM C 1401 recommendations for post-installation-phase quality-control program.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
- B. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.
 - 1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

1.7 MOCKUPS

- A. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
 - 1. Build mockup of typical wall area as shown on Drawings.
 - 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of aluminum-framed entrances and storefronts that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures, including, but not limited to, excessive deflection.
 - b. Noise or vibration created by wind and thermal and structural movements.
 - c. Water penetration through fixed glazing and framing areas.
 - d. Failure of operating components.
 - 2. Warranty Period: Five years from date of Substantial Completion.
- B. Special Finish Warranty: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.

- c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
2. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain all components of aluminum-framed entrance and storefront system, including framing spandrel panels and accessories, from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Division 01, Section "Quality Control," to design aluminum-framed entrances and storefronts.
- B. General Performance: Comply with performance requirements specified, as determined by testing of aluminum-framed entrances and storefronts representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.
 1. Aluminum-framed entrances and storefronts shall withstand movements of supporting structure, including, but not limited to, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
 2. Failure also includes the following:
 - a. Thermal stresses transferring to building structure.
 - b. Glass breakage.
 - c. Noise or vibration created by wind and thermal and structural movements.
 - d. Loosening or weakening of fasteners, attachments, and other components.
 - e. Failure of operating units.
- C. Structural Loads:
 1. Wind Loads: As indicated on Drawings.
 2. Other Design Loads: As indicated on Drawings.
- D. Deflection of Framing Members: At design wind pressure, as follows:
 1. Deflection Normal to Wall Plane: Limited to 1/175 of clear span for spans of up to 13 feet 6 inches (4.1 m) and to 1/240 of clear span plus 1/4 inch (6.35 mm) for spans greater than 13 feet 6 inches (4.1 m) or an amount that restricts edge deflection of individual glazing lites to **3/4 inch (19.1 mm)**, whichever is less.
 2. Deflection Parallel to Glazing Plane: Limited to 1/360 of clear span or 1/8 inch (3.2 mm), whichever is smaller
- E. Structural: Test according to ASTM E 330/E 330M as follows:

1. When tested at positive and negative wind-load design pressures, storefront assemblies, including entrance doors, do not evidence deflection exceeding specified limits.
 2. When tested at 150 percent of positive and negative wind-load design pressures, storefront assemblies, including entrance doors and anchorage, do not evidence material failures, structural distress, or permanent deformation of main framing members exceeding 0.2 percent of span.
 3. Test Durations: As required by design wind velocity, but not less than 10 seconds.
- F. Air Infiltration: Test according to ASTM E 283 for infiltration as follows:
1. Fixed Framing and Glass Area:
 - a. Maximum air leakage of 0.06 cfm/sq. ft. (0.30 L/s per sq. m) at a static-air-pressure differential of 1.57 lbf/sq. ft. (75 Pa).
 2. Entrance Doors:
 - a. Single Doors: Maximum air leakage of 0.5 cfm/sq. ft. (2.54 L/s per sq. m) at a static-air-pressure differential of 1.57 lbf/sq. ft. (75 Pa).
- G. Water Penetration under Static Pressure: Test according to ASTM E 331 as follows:
1. No evidence of water penetration through fixed glazing and framing areas, including entrance doors, when tested according to a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft. (300 Pa)
- H. Water Penetration under Dynamic Pressure: Test according to AAMA 501.1 as follows:
1. No evidence of water penetration through fixed glazing and framing areas when tested at dynamic pressure equal to 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft. (300 Pa)
- I. Seismic Performance: Aluminum-framed entrances and storefronts shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
1. Seismic Drift Causing Glass Fallout: Complying with criteria for passing based on building occupancy type when tested according to AAMA 501.6 at design displacement.
- J. Windborne-Debris Impact Resistance: Pass missile-impact and cyclic-pressure tests according to ASTM E 1996 for Wind Zone 1
1. Large-Missile Test: For glazed openings located within 30 feet (9.1 m) of grade.
 2. Small-Missile Test: For glazed openings located more than 30 feet (9.1 m) above grade.
- K. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes.

1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
2. Thermal Cycling: No buckling; stress on glass; sealant failure; excess stress on framing, anchors, and fasteners; or reduction of performance when tested according to AAMA 501.5.
 - a. High Exterior Ambient-Air Temperature: That which produces an exterior metal-surface temperature of 180 deg F (82 deg C)
 - b. Low Exterior Ambient-Air Temperature: 0 deg F (minus 18 deg C)
 - c. Interior Ambient-Air Temperature: 75 deg F (24 deg C)

2.3 STOREFRONT SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Arcadia, Inc.
 2. CMI Architectural.
 3. Commercial Architectural Products, Inc.
 4. Coral Industries, Inc.
 5. EFCO Corporation.
 6. Kawneer North America; an Alcoa company.
 7. Leed Himmel Industries, Inc.
 8. Manko Window Systems, Inc.
 9. Oldcastle BuildingEnvelope™.
 10. Pittco Architectural Metals, Inc.
 11. SAFTI FIRST Fire Rated Glazing Solutions.
 12. Trulite Glass & Aluminum Solutions, LLC.
 13. Tubelite Inc.
 14. U.S. Aluminum; a brand of C.R. Laurence.
 15. YKK AP America Inc.
- B. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.
 1. Exterior Framing Construction: Thermally broken.
 2. Interior Vestibule Framing Construction: Nonthermal
 3. Glazing System: Retained mechanically with gaskets on four sides.
 4. Glazing Plane: Front.
 5. Finish: Color anodic finish.
 6. Fabrication Method: Field-fabricated stick system.
 7. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
 8. Steel Reinforcement: As required by manufacturer.
- C. Backer Plates: Manufacturer's standard, continuous backer plates for framing members, if not integral, where framing abuts adjacent construction.

- D. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

2.4 ENTRANCE DOOR SYSTEMS

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

1. Arcadia, Inc.
2. CMI Architectural.
3. Commercial Architectural Products, Inc.
4. Coral Industries, Inc.
5. EFCO Corporation.
6. Kawneer North America; an Alcoa company.
7. Leed Himmel Industries, Inc.
8. Manko Window Systems, Inc.
9. Nana Wall Systems, Inc.
10. Oldcastle BuildingEnvelope™.
11. Pittco Architectural Metals, Inc.
12. SAFTI FIRST Fire Rated Glazing Solutions.
13. Trulite Glass & Aluminum Solutions, LLC.
14. Tubelite Inc.
15. U.S. Aluminum; a brand of C.R. Laurence.
16. YKK AP America Inc.

- B. Entrance Doors: Manufacturer's standard glazed entrance doors for manual-swing or automatic operation.

1. Door Construction: 1-3/4-inch (44.5-mm) overall thickness, with minimum 0.125-inch- (3.2-mm-) thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods.
2. Door Design: As indicated.
3. Glazing Stops and Gaskets: Beveled, snap-on, extruded-aluminum stops and preformed gaskets.
 - a. Provide nonremovable glazing stops on outside of door.

2.5 GLAZING

- A. Glazing: Comply with Division 08, Section "Glazing."
- B. Glazing Gaskets: Manufacturer's standard sealed-corner pressure-glazing system of black, resilient elastomeric glazing gaskets, setting blocks, and shims or spacers.
- C. Glazing Sealants: As recommended by manufacturer.

- D. Weatherseal Sealants: ASTM C 920 for Type S; Grade NS; Class 25; Uses NT, G, A, and O; chemically curing silicone formulation that is compatible with structural sealant and other system components with which it comes in contact; recommended by structural-sealant, weatherseal-sealant, and structural-sealant-glazed storefront manufacturers for this use.

1. Color: Match structural sealant.

2.6 MATERIALS

- A. Sheet and Plate: **ASTM B 209** (**ASTM B 209M**).
- B. Extruded Bars, Rods, Profiles, and Tubes: **ASTM B 221** (**ASTM B 221M**).
- C. Extruded Structural Pipe and Tubes: ASTM B 429/B 429M.
- D. Structural Profiles: ASTM B 308/B 308M.
- E. Steel Reinforcement:
1. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
 2. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.
 3. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M.
 4. Primer: Manufacturer's standard zinc-rich, corrosion-resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM, and prepare surfaces according to applicable SSPC standard.

2.7 ACCESSORIES

- A. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.
1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
 2. Reinforce members as required to receive fastener threads.
 3. Use exposed fasteners with countersunk Phillips screw heads, finished to match framing system.
- B. Anchors: Three-way adjustable anchors with minimum adjustment of 1 inch (25.4 mm) that accommodate fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended by manufacturer.
1. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A 123/A 123M or ASTM A 153/A 153M requirements.

- C. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials
- D. Bituminous Paint: Cold-applied asphalt-mastic paint containing no asbestos, formulated for 30-mil (0.762-mm) thickness per coat.
- E. Rigid PVC Filler.

2.8 FABRICATION

- A. Form or extrude aluminum shapes before finishing.
- B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
- C. Fabricate components that, when assembled, have the following characteristics:
 - 1. Profiles that are sharp, straight, and free of defects or deformations.
 - 2. Accurately fitted joints with ends coped or mitered.
 - 3. Physical and thermal isolation of glazing from framing members.
 - 4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
 - 5. Provisions for field replacement of glazing from interior.
 - 6. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
- D. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.
- E. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.
 - 1. At interior and exterior doors, provide compression weather stripping at fixed stops.
- F. Entrance Doors: Reinforce doors as required for installing entrance door hardware.
 - 1. At pairs of exterior doors, provide sliding-type weather stripping retained in adjustable strip and mortised into door edge.
 - 2. At exterior doors, provide weather sweeps applied to door bottoms.
- G. Entrance Door Hardware Installation: Factory install entrance door hardware to the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes.
- H. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.9 ALUMINUM FINISHES

- A. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or thicker.
 - 1. Color: As selected by Architect from full range of industry colors and color densities.

2.10 SOURCE QUALITY CONTROL

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

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare surfaces that are in contact with structural sealant according to sealant manufacturer's written instructions, to ensure compatibility and adhesion. Preparation includes, but is not limited to, cleaning and priming surfaces.

3.3 INSTALLATION

- A. General:
 - 1. Comply with manufacturer's written instructions.
 - 2. Do not install damaged components.
 - 3. Fit joints to produce hairline joints free of burrs and distortion.
 - 4. Rigidly secure nonmovement joints.
 - 5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
 - 6. Seal perimeter and other joints watertight unless otherwise indicated.
- B. Metal Protection:
 - 1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with materials recommended by manufacturer for this purpose or by installing nonconductive spacers.
 - 2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

- C. Set continuous sill members and flashing in full sealant bed, as specified in Division 07, Section "Concrete Joint Sealants," to produce weathertight installation.
- D. Install components plumb and true in alignment with established lines and grades.
- E. Install glazing as specified in Division 08, Section "Glazing."
- F. Install weather seal sealant according to Division 07, Section "Concrete Joint Sealants" and according to sealant manufacturer's written instructions to produce weatherproof joints. Install joint filler behind sealant as recommended by sealant manufacturer.
- G. Entrance Doors: Install doors to produce smooth operation and tight fit at contact points.
 - 1. Exterior Doors: Install to produce weathertight enclosure and tight fit at weather stripping.
 - 2. Field-Installed Entrance Door Hardware: Install surface-mounted entrance door hardware according to entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.

3.4 ERECTION TOLERANCES

- A. Erection Tolerances: Install aluminum-framed entrances and storefronts to comply with the following maximum tolerances:
 - 1. Plumb: **1/8 inch in 10 feet (3.2 mm in 3 m); 1/4 inch in 40 feet (6.35 mm in 12.2 m).**
 - 2. Level: **1/8 inch in 20 feet (3.2 mm in 6 m); 1/4 inch in 40 feet (6.35 mm in 12.2 m).**
 - 3. Alignment:
 - a. Where surfaces abut in line or are separated by reveal or protruding element up to **1/2 inch (12.7 mm)** wide, limit offset from true alignment to **1/16 inch (1.6 mm).**
 - b. Where surfaces are separated by reveal or protruding element from **1/2 to 1 inch (12.7 to 25.4 mm)** wide, limit offset from true alignment to **1/8 inch (3.2 mm).**
 - c. Where surfaces are separated by reveal or protruding element of **1 inch (25.4 mm)** wide or more, limit offset from true alignment to **1/4 inch (6 mm).**
 - 4. Location: Limit variation from plane to **1/8 inch in 12 feet (3.2 mm in 3.6 m); 1/2 inch (12.7 mm)** over total length.

3.5 FIELD QUALITY CONTROL

- A. Field Quality-Control Testing: Perform the following test on representative areas of aluminum-framed entrances and storefronts.
 - 1. Water-Spray Test: Before installation of interior finishes has begun, areas designated by Architect shall be tested according to AAMA 501.2 and shall not evidence water penetration.

- a. Perform a minimum of two tests in areas as directed by Architect.
 - b. Perform tests in each test area as directed by Architect. Perform at least three tests, prior to 70 percent completion.
2. Water Penetration: ASTM E 1105 at a minimum uniform static-air-pressure differential of 0.67 times the static-air-pressure differential specified for laboratory testing in "Performance Requirements" Article, but not less than 6.24 lbf/sq. ft. (300 Pa), and shall not evidence water penetration.
- B. Structural-Sealant Adhesion: Test structural sealant according to recommendations in ASTM C 1401, Destructive Test Method A, "Hand Pull Tab (Destructive)," Appendix X2.
 1. Test a minimum of two areas on each building facade.
 2. Repair installation areas damaged by testing.
- C. Aluminum-framed entrances and storefronts will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

END OF SECTION 08 41 13

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SECTION 08 71 00 - DOOR HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Mechanical door hardware for the following:
 - a. Swinging doors.
 - 2. Cylinders for door hardware specified in other Sections.
 - 3. Electrified door hardware.
- B. Related Requirements:
 - 1. Division 08, Section "Aluminum Frames" for door silencers provided as part of aluminum frames.

1.3 COORDINATION

- A. Floor-Recessed Door Hardware: Coordinate layout and installation with floor construction.
 - 1. Cast anchoring inserts into concrete.
- B. Installation Templates: Distribute for doors, frames, and other work specified to be factory prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.
- C. Security: Coordinate installation of door hardware, keying, and access control with **City's** security consultant.
- D. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: For electrified door hardware.
 1. Include diagrams for power, signal, and control wiring.
 2. Include details of interface of electrified door hardware and building safety and security systems.
- C. Door Hardware Schedule: Prepared by or under the supervision of Installer's Architectural Hardware Consultant. Coordinate door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
 1. Submittal Sequence: Submit door hardware schedule after submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate the fabrication of other work that is critical in Project construction schedule.
 2. Format: Use same scheduling sequence and format[as in door hardware schedule in the Contract Documents.
 3. Content: Include the following information:
 - a. Identification number, location, hand, fire rating, size, and material of each door and frame.
 - b. Locations of each door hardware set, cross-referenced to Drawings on floor plans and to door and frame schedule.
 - c. Complete designations, including name and manufacturer, type, style, function, size, quantity, function, and finish of each door hardware product.
 - d. Description of electrified door hardware sequences of operation and interfaces with other building control systems.
 - e. Fastenings and other installation information.
 - f. Explanation of abbreviations, symbols, and designations contained in door hardware schedule.
 - g. Mounting locations for door hardware.
 - h. List of related door devices specified in other Sections for each door and frame.
- D. Keying Schedule: Prepared by or under the supervision of Installer's Architectural Hardware Consultant, detailing **City's** final keying instructions for locks. Include schematic keying diagram and index each key set to unique door designations that are coordinated with the Contract Documents.

1.5 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of electrified door hardware.
 1. Certify that door hardware for use on each type and size of labeled fire-rated doors complies with listed fire-rated door assemblies.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of door hardware to include in maintenance manuals.
- B. Schedules: Final door hardware and keying schedule.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Supplier of products and an employer of workers trained and approved by product manufacturers and of an Architectural Hardware Consultant who is available during the course of the Work to consult Contractor, Architect, and **City** about door hardware and keying.
 - 1. Warehousing Facilities: In Project's vicinity.
 - 2. Scheduling Responsibility: Preparation of door hardware and keying schedule.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Inventory door hardware on receipt and provide secure lock-up for door hardware delivered to Project site.
- B. Tag each item or package separately with identification coordinated with the final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain each type of door hardware from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Means of Egress Doors: Latches do not require more than **15 lbf (67 N)** to release the latch. Locks do not require use of a key, tool, or special knowledge for operation.
- B. Accessibility Requirements: For door hardware on doors in an accessible route, comply with the DOJ's "2010 ADA Standards for Accessible Design."
 - 1. Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than **5 lbf (22.2 N)**.
 - 2. Comply with the following maximum opening-force requirements:
 - a. Interior, Non-Fire-Rated Hinged Doors: **5 lbf (22.2 N)** applied perpendicular to door.
 - b. Sliding or Folding Doors: **5 lbf (22.2 N)** applied parallel to door at latch.

- c. Fire Doors: Minimum opening force allowable by authorities having jurisdiction.
3. Bevel raised thresholds with a slope of not more than 1:2. Provide thresholds not more than **1/2 inch (13 mm)** high.
4. Adjust door closer sweep periods so that, from an open position of 90 degrees, the door will take at least 5 seconds to move to a position of 12 degrees from the latch.
5. Adjust spring hinges so that, from an open position of 70 degrees, the door will take at least 1.5 seconds to move to the closed position.

2.3 SCHEDULED DOOR HARDWARE

- A. Provide products for each door that comply with requirements indicated in Part 2 and door hardware schedule.
 1. Door hardware is scheduled on Drawings.

2.4 HINGES

- A. Hinges: BHMA A156.1. Provide template-produced hinges for hinges installed on hollow-metal doors and hollow-metal frames.
 1. **Manufacturers:** Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. [Allegion plc.](#)
 - b. [Baldwin Hardware Corporation.](#)
 - c. [Bommer Industries, Inc.](#)
 - d. [Cal-Royal Products, Inc.](#)
 - e. [Design Hardware.](#)
 - f. [Don-Jo Mfg., Inc.](#)
 - g. [Hager Companies.](#)
 - h. [Lawrence Hardware Inc.](#)
 - i. [McKinney Products Company; an ASSA ABLOY Group company.](#)
 - j. [PBB, Inc.](#)
 - k. [Stanley Commercial Hardware; a division of Stanley Security Solutions.](#)

2.5 MECHANICAL LOCKS AND LATCHES

- A. Strikes: Provide manufacturer's standard strike for each lock bolt or latchbolt complying with requirements indicated for applicable lock or latch and with strike box and curved lip extended to protect frame; finished to match lock or latch.
 1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
 2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.

3. Aluminum-Frame Strike Box: Manufacturer's special strike box fabricated for aluminum framing.
 4. Rabbet Front and Strike: Provide on locksets for rabbeted meeting stiles.
- B. Bored Locks: BHMA A156.2; Grade 1; Series 4000.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Allegion plc.
 - b. Arrow USA; an ASSA ABLOY Group company.
 - c. Best Access Systems; Stanley Security Solutions, Inc.
 - d. Cal-Royal Products, Inc.
 - e. Corbin Russwin, Inc.; an ASSA ABLOY Group company.
 - f. Design Hardware.
 - g. Hager Companies.
 - h. Lawrence Hardware Inc.
 - i. Marks USA.
 - j. PDQ Manufacturing.
 - k. SARGENT Manufacturing Company; ASSA ABLOY.
 - l. Stanley Commercial Hardware; a division of Stanley Security Solutions.
 - m. Weiser Lock Corp.
 - n. Yale Security Inc; an ASSA ABLOY Group company.
- C. Mortise Locks: BHMA A156.13; Operational Grade 1 stamped steel case with steel or brass parts; Series 1000.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Accurate Lock & Hardware Co.
 - b. Adams Rite Manufacturing Co; an ASSA ABLOY Group company.
 - c. Allegion plc.
 - d. Arrow USA; an ASSA ABLOY Group company.
 - e. Best Access Systems; Stanley Security Solutions, Inc.
 - f. Brink, R. R. Locking Systems, Inc.
 - g. Cal-Royal Products, Inc.
 - h. Corbin Russwin, Inc.; an ASSA ABLOY Group company.
 - i. Design Hardware.
 - j. Hager Companies.
 - k. Lawrence Hardware Inc.
 - l. Marks USA.
 - m. PDQ Manufacturing.
 - n. SARGENT Manufacturing Company; ASSA ABLOY.
 - o. Stanley Commercial Hardware; a division of Stanley Security Solutions.
 - p. Yale Security Inc; an ASSA ABLOY Group company.

- D. Push-Pull Latches: Bored, BHMA A156.2; Series 4000; with paddle handles that retract latchbolt; capable of being mounted vertically or horizontally.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Adams Rite Manufacturing Co; an ASSA ABLOY Group company.
 - b. Allegion plc.
 - c. Architectural Builders Hardware Mfg., Inc.
 - d. Corbin Russwin, Inc.; an ASSA ABLOY Group company.
 - e. Rockwood Manufacturing Company; an ASSA ABLOY Group company.
 - f. SARGENT Manufacturing Company; ASSA ABLOY.
 - g. Trimco.
 2. Grade: [1] [2].

2.6 EXIT DEVICES AND AUXILIARY ITEMS

- A. Exit Devices and Auxiliary Items: BHMA A156.3.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Adams Rite Manufacturing Co; an ASSA ABLOY Group company.
 - b. Allegion plc.
 - c. Arrow USA; an ASSA ABLOY Group company.
 - d. Cal-Royal Products, Inc.
 - e. Corbin Russwin, Inc.; an ASSA ABLOY Group company.
 - f. Design Hardware.
 - g. Detex Corporation.
 - h. Door Controls International, Inc.
 - i. DORMA Architectural Hardware; a division of DORMA Group North America.
 - j. Hager Companies.
 - k. Lawrence Hardware Inc.
 - l. PDQ Manufacturing.
 - m. Precision Hardware, Inc.; a Stanley company.
 - n. Rutherford Controls Int'l. Corp.
 - o. SARGENT Manufacturing Company; ASSA ABLOY.
 - p. Stanley Commercial Hardware; a division of Stanley Security Solutions.
 - q. Yale Security Inc; an ASSA ABLOY Group company.

2.7 LOCK CYLINDERS

- A. Lock Cylinders: Tumbler type, constructed from brass or bronze, stainless steel, or nickel silver. Provide cylinder from same manufacturer of locking devices.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Allegion plc.
 - b. Arrow USA; an ASSA ABLOY Group company.
 - c. ASSA, Inc.
 - d. Best Access Systems; Stanley Security Solutions, Inc.
 - e. Cal-Royal Products, Inc.
 - f. Corbin Russwin, Inc.; an ASSA ABLOY Group company.
 - g. Hager Companies.
 - h. Medeco Security Locks; an ASSA ABLOY Group company.
 - i. PDQ Manufacturing.
 - j. SARGENT Manufacturing Company; ASSA ABLOY.
 - k. Stanley Commercial Hardware; a division of Stanley Security Solutions.
 - l. Yale Security Inc; an ASSA ABLOY Group company.
- B. Standard Lock Cylinders: BHMA A156.5; Grade 1 permanent cores; face finished to match lockset.
 1. Core Type: Interchangeable.
- C. Construction Master Keys: Provide cylinders with feature that permits voiding of construction keys without cylinder removal. Provide 10 construction master keys.

2.8 KEYING

- A. Keying System: Factory registered, complying with guidelines in BHMA A156.28, appendix. Provide one extra key blank for each lock.
 1. No Master Key System: Only change keys operate cylinders.
 - a. Provide three cylinder change keys.
 2. Master Key System: Change keys and a master key operate cylinders.
 - a. Provide three cylinder change keys and five master keys.
 3. Grand Master Key System: Change keys, a master key, and a grand master key operate cylinders.
 - a. Provide three cylinder change keys and five each of master and grand master keys.
 4. Great-Grand Master Key System: Change keys, a master key, a grand master key, and a great-grand master key operate cylinders.
 - a. Provide three cylinder change keys and five each of master, grand master, and great-grand master keys.

5. Existing System:

- a. Master key or grand master key locks to **City's** existing system.
- b. Re-key **City's** existing master key system into new keying system.

6. Keyed Alike: Key all cylinders to same change key.

B. Keys: Brass.

1. Stamping: Permanently inscribe each key with a visual key control number and include the following notation:
 - a. Notation: **"DO NOT DUPLICATE."**

2.9 KEY CONTROL SYSTEM

A. Key Control Cabinet: BHMA A156.28; metal cabinet with baked-enamel finish; containing key-holding hooks, labels, two sets of key tags with self-locking key holders, key-gathering envelopes, and temporary and permanent markers; with key capacity of 150 percent of the number of locks.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. American Key Boxes and Cabinets.
 - b. GE Security, Inc.
 - c. HPC, Inc.
 - d. Lund Equipment Co., Inc.
 - e. MMF Industries.
 - f. TelKee; Oasis International.
2. Portable Cabinet: Grade 1 tray for mounting in file cabinet, equipped with key-holding panels, envelopes, and cross-index system.

B. Key Lock Boxes: Designed for storage of 10 keys.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. GE Security, Inc.
 - b. HPC, Inc.
 - c. Knox Company.

2.10 OPERATING TRIM

A. Operating Trim: BHMA A156.6; [aluminum] [brass] [bronze] [stainless steel] unless otherwise indicated.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Allegion plc.
 - b. Burns Manufacturing Incorporated.
 - c. Don-Jo Mfg., Inc.
 - d. Forms+Surfaces.
 - e. Hager Companies.
 - f. Hiawatha, Inc; a division of the Activar Construction Products Group.
 - g. Rockwood Manufacturing Company; an ASSA ABLOY Group company.
 - h. Trimco.

2.11 SURFACE CLOSERS

- A. Surface Closers: BHMA A156.4; rack-and-pinion hydraulic type with adjustable sweep and latch speeds controlled by key-operated valves and forged-steel main arm. Comply with manufacturer's written instructions for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Allegion plc.
 - b. Arrow USA; an ASSA ABLOY Group company.
 - c. Cal-Royal Products, Inc.
 - d. Corbin Russwin, Inc.; an ASSA ABLOY Group company.
 - e. Design Hardware.
 - f. DORMA Architectural Hardware; a division of DORMA Group North America.
 - g. Hager Companies.
 - h. Norton Door Controls; an ASSA ABLOY Group company.
 - i. PDQ Manufacturing.
 - j. Rixson Specialty Door Controls; an ASSA ABLOY Group company.
 - k. SARGENT Manufacturing Company; ASSA ABLOY.
 - l. Stanley Commercial Hardware; a division of Stanley Security Solutions.
 - m. Yale Security Inc; an ASSA ABLOY Group company.

2.12 MECHANICAL STOPS AND HOLDERS

- A. Wall- and Floor-Mounted Stops: BHMA A156.16.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Allegion plc.

- b. [Architectural Builders Hardware Mfg., Inc.](#)
- c. [Baldwin Hardware Corporation.](#)
- d. [Burns Manufacturing Incorporated.](#)
- e. [Cal-Royal Products, Inc.](#)
- f. [Don-Jo Mfg., Inc.](#)
- g. [Door Controls International, Inc.](#)
- h. [Hager Companies.](#)
- i. [Hiawatha, Inc; a division of the Activar Construction Products Group.](#)
- j. [Rockwood Manufacturing Company; an ASSA ABLOY Group company.](#)
- k. [Trimco.](#)

2.13 DOOR GASKETING

- A. Door Gasketing: BHMA A156.22; with resilient or flexible seal strips that are easily replaceable and readily available from stocks maintained by manufacturer.
 - 1. [Manufacturers:](#) Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. [Hager Companies.](#)
 - b. [M-D Building Products, Inc.](#)
 - c. [National Guard Products, Inc.](#)
 - d. [Pemko Manufacturing Co.](#)
 - e. [Reese Enterprises, Inc.](#)
 - f. [Sealeze.](#)
 - g. [Zero International, Inc.](#)
- B. Maximum Air Leakage: When tested according to ASTM E 283 with tested pressure differential of **0.3-inch wg (75 Pa)**, as follows:
 - 1. Smoke-Rated Gasketing: **0.3 cfm/sq. ft. (3 cu. m per minute/sq. m)** of door opening.

2.14 THRESHOLDS

- A. Thresholds: BHMA A156.21; fabricated to full width of opening indicated.
 - 1. [Manufacturers:](#) Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. [Hager Companies.](#)
 - b. [M-D Building Products, Inc.](#)
 - c. [National Guard Products, Inc.](#)
 - d. [Pemko Manufacturing Co.](#)
 - e. [Reese Enterprises, Inc.](#)
 - f. [Rixson Specialty Door Controls; an ASSA ABLOY Group company.](#)

- g. Sealeze.
- h. Zero International, Inc.

2.15 FABRICATION

- A. Manufacturer's Nameplate: Do not provide products that have manufacturer's name or trade name displayed in a visible location except in conjunction with required fire-rating labels and as otherwise approved by Architect.
 - 1. Manufacturer's identification is permitted on rim of lock cylinders only.
- B. Base Metals: Produce door hardware units of base metal indicated, fabricated by forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness. Furnish metals of a quality equal to or greater than that of specified door hardware units and BHMA A156.18.
- C. Fasteners: Provide door hardware manufactured to comply with published templates prepared for machine, wood, and sheet metal screws. Provide screws that comply with commercially recognized industry standards for application intended, except aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware unless otherwise indicated.
 - 1. Concealed Fasteners: For door hardware units that are exposed when door is closed, except for units already specified with concealed fasteners. Do not use through bolts for installation where bolt head or nut on opposite face is exposed unless it is the only means of securely attaching the door hardware. Where through bolts are used on hollow door and frame construction, provide sleeves for each through bolt.
 - 2. Fire-Rated Applications:
 - a. Steel Through Bolts: For the following unless door blocking is provided:
 - 1) Surface hinges to doors.
 - 2) Closers to doors and frames.
 - 3) Surface-mounted exit devices.
 - 3. Spacers or Sex Bolts: For through bolting of hollow-metal doors.
 - 4. Gasketing Fasteners: Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.

2.16 FINISHES

- A. Provide finishes complying with BHMA A156.18 as indicated in door hardware schedule.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

- C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance of the Work.
- B. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Steel Doors and Frames: For surface-applied door hardware, drill and tap doors and frames according to ANSI/SDI A250.6.

3.3 INSTALLATION

- A. Mounting Heights: Mount door hardware units at heights to comply with the following unless otherwise indicated or required to comply with governing regulations.
 - 1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
- B. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work. Do not install surface-mounted items until finishes have been completed on substrates involved.
 - 1. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
 - 2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.
- C. Hinges: Install types and in quantities indicated in door hardware schedule, but not fewer than the number recommended by manufacturer for application indicated or one hinge for every 30 inches (750 mm) of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.

- D. Lock Cylinders: Install construction cores to secure building and areas during construction period.
 - 1. Replace construction cores with permanent cores as directed by **City**.
 - 2. Furnish permanent cores to **City** for installation.
- E. Key Control System:
 - 1. Key Control Cabinet: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.
 - 2. Key Lock Boxes: Install where indicated or approved by Architect to provide controlled access for fire and medical emergency personnel.
 - 3. Key Control System Software: Set up multiple-index system based on final keying schedule.
- F. Thresholds: Set thresholds for exterior doors and other doors indicated in full bed of sealant complying with requirements specified in Division 07, Section "Concrete Joint Sealants."
- G. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they will impede traffic.
- H. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.
 - 1. Do not notch perimeter gasketing to install other surface-applied hardware.
- I. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.
- J. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

3.4 ADJUSTING

- A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.
 - 1. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.
 - 2. Spring Hinges: Adjust to achieve positive latching when door is allowed to close freely from an open position of 70 degrees and so that closing time complies with accessibility requirements of authorities having jurisdiction.
 - 3. Electric Strikes: Adjust horizontal and vertical alignment of keeper to properly engage lock bolt.

3.5 CLEANING AND PROTECTION

- A. Clean adjacent surfaces soiled by door hardware installation.
- B. Clean operating items as necessary to restore proper function and finish.
- C. Provide final protection and maintain conditions that ensure that door hardware is without damage or deterioration at time of Substantial Completion.

END OF SECTION 08 71 00

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SECTION 08 80 00 - GLAZING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes:
 - 1. Glass for windows doors storefront framing glazed curtain walls.
 - 2. Glazing sealants and accessories.

1.3 DEFINITIONS

- A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.
- B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C 1036.
- C. IBC: International Building Code.
- D. Interspace: Space between lites of an insulating-glass unit.

1.4 COORDINATION

- A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.
- C. Delegated-Design Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer, glass testing agency.
- B. Product Certificates: For glass.
- C. Product Test Reports: For glazing sealants, for tests performed by a qualified testing agency.
 - 1. For glazing sealants, provide test reports based on testing current sealant formulations within previous 36-month period.
- D. Preconstruction adhesion and compatibility test report.
- E. Sample Warranties: For special warranties.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.
- B. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Protect glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

1.9 FIELD CONDITIONS

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

1.10 WARRANTY

- A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed

to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.

1. Warranty Period: 10 years from date of Substantial Completion.
- B. Manufacturer's Special Warranty for Laminated Glass: Manufacturer agrees to replace laminated-glass units that deteriorate within specified warranty period. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.
1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. **Manufacturers:** Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
1. [AGC Glass Company North America, Inc.](#)
 2. [Cardinal Glass Industries.](#)
 3. [Cristacurva.](#)
 4. [Dlubak Corporation.](#)
 5. [Gardner Glass, Inc.](#)
 6. [GGI; General Glass International.](#)
 7. [Glasswerks LA, Inc.](#)
 8. [GTI; Glaz-Tech Industries.](#)
 9. [Guardian Industries Corp.; SunGuard.](#)
 10. [Hartung Glass Industries.](#)
 11. [JE Berkowitz, LP.](#)
 12. [Northwestern Industries, Inc.](#)
 13. [Oldcastle BuildingEnvelope™.](#)
 14. [Pilkington North America.](#)
 15. [PPG Industries, Inc.](#)
 16. [Schott North America, Inc.](#)
 17. [Tecnoglass.](#)
 18. [Trulite Glass & Aluminum Solutions, LLC.](#)
 19. [Vetrotech Saint-Gobain.](#)
 20. [Viracon, Inc.](#)
- B. Source Limitations for Glass: Obtain from single source from single manufacturer for each glass type.

1. Obtain tinted glass from single source from single manufacturer.
 2. Obtain reflective-coated glass from single source from single manufacturer.
- C. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer for each product and installation method.

2.2 PERFORMANCE REQUIREMENTS

- A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.
- B. Delegated Design: Engage a qualified professional engineer, as defined in Division 01, Section "Quality Control," to design glazing.
- C. Structural Performance: Glazing shall withstand the following design loads within limits and under conditions indicated determined according to the IBC and ASTM E 1300.
1. Design Wind Pressures: As indicated on Drawings.
 2. Design Wind Pressures: Determine design wind pressures applicable to Project according to ASCE/SEI 7, based on heights above grade indicated on Drawings.
 3. Maximum Lateral Deflection: For glass supported on all four edges, limit center-of-glass deflection at design wind pressure to not more than 1/50 times the short-side length or **1 inch (25 mm)**, whichever is less.
- D. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.
- E. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:
1. For monolithic-glass lites, properties are based on units with lites of thickness indicated.
 2. For laminated-glass lites, properties are based on products of construction indicated.
 3. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

2.3 GLASS PRODUCTS, GENERAL

- A. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass that complies with performance requirements and is not less than the thickness indicated.
1. Minimum Glass Thickness for Exterior Lites: 6 mm

- B. Strength: Where annealed float glass is indicated, provide annealed float glass, heat-strengthened float glass, or fully tempered float glass as needed to comply with "Performance Requirements" Article.

2.4 GLASS PRODUCTS

- A. Clear Annealed Float Glass: ASTM C 1036, Type I, Class 1 (clear), Quality-Q3.
- B. Tinted Annealed Float Glass: ASTM C 1036, Type I, Class 2 (tinted), Quality-Q3.
- C. Fully Tempered Float Glass: ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.
 - 1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.

2.5 LAMINATED GLASS

- A. Laminated Glass: ASTM C 1172. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.
 - 1. Construction: Laminate glass with ionomeric polymer interlayer or cast-in-place and cured-transparent-resin interlayer to comply with interlayer manufacturer's written instructions.
 - 2. Interlayer Thickness: Provide thickness not less than that indicated and as needed to comply with requirements.
 - 3. Interlayer Color: Clear unless otherwise indicated.
- B. Windborne-Debris-Impact-Resistant Laminated Glass: Comply with requirements specified above for laminated glass except laminate glass with one of the following to comply with interlayer manufacturer's written instructions:
 - 1. Polyvinyl butyral interlayer.
 - 2. Polyvinyl butyral interlayers reinforced with polyethylene terephthalate film.
 - 3. Ionomeric polymer interlayer.
 - 4. Cast-in-place and cured-transparent-resin interlayer.
 - 5. Cast-in-place and cured-transparent-resin interlayer reinforced with polyethylene terephthalate film.

2.6 GLAZING SEALANTS

- A. General:
 - 1. Compatibility: Compatible with one another and with other materials they contact, including glass products, seals of insulating-glass units, and glazing channel

- substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
 3. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range.
- B. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 100/50, Use NT.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Dow Corning Corporation.
 - b. GE Construction Sealants; Momentive Performance Materials Inc.
 - c. May National Associates, Inc.; a subsidiary of Sika Corporation.
 - d. Pecora Corporation.
 - e. Sika Corporation.
 - f. Tremco Incorporated.

2.7 GLAZING TAPES

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

2.8 MISCELLANEOUS GLAZING MATERIALS

- A. General: Provide products of material, size, and shape complying with referenced glazing standard, with requirements of manufacturers of glass and other glazing

materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.

- B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
- C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
- D. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
- E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).
- F. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

2.9 FABRICATION OF GLAZING UNITS

- A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.
 - 1. Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.
 - a. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
- B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites to produce square edges with slight chamfers at junctions of edges and faces.
- C. Grind smooth and polish exposed glass edges and corners.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:
 - 1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
 - 2. Presence and functioning of weep systems.

3. Minimum required face and edge clearances.
 4. Effective sealing between joints of glass-framing members.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.
- B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that leave visible marks in the completed Work.

3.3 GLAZING, GENERAL

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass includes glass with edge damage or other imperfections that, when installed, could weaken glass, impair performance, or impair appearance.
- C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
- D. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- F. Provide spacers for glass lites where length plus width is larger than 50 inches (1270 mm).
1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
 2. Provide 1/8-inch (3-mm) minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.
- G. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

- H. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.
- I. Set glass lites with proper orientation so that coatings face exterior or interior as specified.

3.4 TAPE GLAZING

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

3.5 GASKET GLAZING (DRY)

- A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
- B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.
- C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets.

Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

- E. Install gaskets so they protrude past face of glazing stops.

3.6 SEALANT GLAZING (WET)

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

3.7 CLEANING AND PROTECTION

- A. Immediately after installation remove nonpermanent labels and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains.
 - 1. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer. Remove and replace glass that cannot be cleaned without damage to coatings.
- C. Remove and replace glass that is damaged during construction period.
- D. Wash glass on both exposed surfaces not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

END OF SECTION 08 80 00

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SECTION 08 91 19 - FIXED LOUVERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Fixed, extruded-aluminum louvers.

1.3 DEFINITIONS

- A. Louver Terminology: Definitions of terms for metal louvers contained in AMCA 501 apply to this Section unless otherwise defined in this Section or in referenced standards.
- B. Horizontal Louver: Louver with horizontal blades (i.e., the axes of the blades are horizontal).
- C. Drainable-Blade Louver: Louver with blades having gutters that collect water and drain it to channels in jambs and mullions, which carry it to bottom of unit and away from opening.
- D. Wind-Driven-Rain-Resistant Louver: Louver that provides specified wind-driven rain performance, as determined by testing according to AMCA 500-L.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. For louvers specified to bear AMCA seal, include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals.
- B. Shop Drawings: For louvers and accessories. Include plans, elevations, sections, details, and attachments to other work. Show frame profiles and blade profiles, angles, and spacing.
 - 1. Show weep paths, gaskets, flashing, sealant, and other means of preventing water intrusion.
 - 2. Show mullion profiles and locations.

- C. Samples: For each type of metal finish required.

1.5 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: Based on evaluation of comprehensive tests performed according to AMCA 500-L by a qualified testing agency or by manufacturer and witnessed by a qualified testing agency, for each type of louver and showing compliance with performance requirements specified.

1.6 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."

1.7 FIELD CONDITIONS

- A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain louvers from single source from a single manufacturer where indicated to be of same type, design, or factory-applied color finish.

2.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design louvers, including comprehensive engineering analysis by a qualified professional engineer, using structural performance requirements and design criteria indicated.
 - 1. Wind Loads: Determine loads based on pressures as indicated on Drawings.
- B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
 - 1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces
- C. SMACNA Standard: Comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" for fabrication, construction details, and installation procedures.

2.3 FIXED, FORMED-METAL LOUVERS

A. Horizontal, Nondrainable-Blade Louver.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Air Balance Inc.; a division of MESTEK, Inc.
 - b. Air Flow Company, Inc.
 - c. Airolite Company, LLC (The).
 - d. All-Lite Architectural Products.
 - e. American Warming and Ventilating; a Mestek Architectural Group company.
 - f. Arrow United Industries.
 - g. Cesco Products; a division of MESTEK, Inc.
 - h. Construction Specialties, Inc.
 - i. Dowco Products Group.
 - j. Greenheck Fan Corporation.
 - k. Industrial Louvers Inc.
 - l. Metal Form Manufacturing, Inc.
 - m. NCA Manufacturing, Inc.
 - n. Pottorff.
 - o. Ruskin Company.
 - p. United Enertech Corporation.
 - q. Vent Products Co., Inc.
2. Louver Depth: 4 inches (100 mm).
3. Blade Profile: Blade with center baffle.
4. Frame and Blade Material and Nominal Thickness: Galvanized-steel sheet, not less than 0.052 inch (1.32 mm) for frames and 0.040 inch (1.02 mm) for blades
5. Mullion Type: Exposed.
6. Louver Performance Ratings:
 - a. Free Area: Not less than 7.0 sq. ft. (0.65 sq. m) for 48-inch- (1220-mm-) wide by 48-inch- (1220-mm-) high louver.
 - b. Point of Beginning Water Penetration: Not less than 600 fpm (3.0 m/s).

2.4 LOUVER SCREENS

A. General: Provide screen at each exterior louver.

1. Screen Location for Fixed Louvers: Interior face.
2. Screening Type: Insect screening.

B. Secure screen frames to louver frames with machine screws with heads finished to match louver, spaced a maximum of 6 inches (150 mm) from each corner and at 12 inches (300 mm) o.c.

C. Louver Screen Frames: Fabricate with mitered corners to louver sizes indicated.

1. Metal: Same type and form of metal as indicated for louver to which screens are attached. Reinforce extruded-aluminum screen frames at corners with clips.
2. Finish: Same finish as louver frames to which louver screens are attached.
3. Type: Rewirable frames with a driven spline or insert.

D. Louver Screening for Aluminum Louvers:

2.5 MATERIALS

- A. Aluminum Sheet: **ASTM B 209 (ASTM B 209M)**, Alloy 3003 or 5005 with temper as required for forming, or as otherwise recommended by metal producer for required finish.
- B. Fasteners: Use types and sizes to suit unit installation conditions.
1. Use tamper-resistant screws for exposed fasteners unless otherwise indicated.
 2. For fastening aluminum, use aluminum or 300 series stainless-steel fasteners.
 3. For fastening galvanized steel, use hot-dip-galvanized steel or 300 series stainless-steel fasteners.
 4. For fastening stainless steel, use 300 series stainless-steel fasteners.
 5. For color-finished louvers, use fasteners with heads that match color of louvers.
- C. Postinstalled Fasteners for Concrete and Masonry: Torque-controlled expansion anchors, made from stainless-steel components, with capability to sustain, without failure, a load equal to 4 times the loads imposed, for concrete, or 6 times the load imposed for masonry, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.
- D. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.6 FABRICATION

- A. Factory assemble louvers to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.
- B. Vertical Assemblies: Where height of louver units exceeds fabrication and handling limitations, fabricate units to permit field-bolted assembly with close-fitting joints in jambs and mullions, reinforced with splice plates.
- C. Maintain equal louver blade spacing, including separation between blades and frames at head and sill, to produce uniform appearance.
- D. Fabricate frames, including integral sills, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.
1. Frame Type: Channel unless otherwise indicated.

- E. Include supports, anchorages, and accessories required for complete assembly.
- F. Provide subsills made of same material as louvers or extended sills for recessed louvers.
- G. Join frame members to each other and to fixed louver blades with fillet welds threaded fasteners, or both, as standard with louver manufacturer unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.

2.7 ALUMINUM FINISHES

- A. Finish louvers after assembly.
- B. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

- A. Coordinate setting drawings, diagrams, templates, instructions, and directions for installation of anchorages that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to Project site.

3.3 INSTALLATION

- A. Locate and place louvers level, plumb, and at indicated alignment with adjacent work.
- B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.
- C. Form closely fitted joints with exposed connections accurately located and secured.
- D. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.
- E. Protect unpainted galvanized and nonferrous-metal surfaces that are in contact with concrete, masonry, or dissimilar metals from corrosion and galvanic action by applying a heavy coating of bituminous paint or by separating surfaces with waterproof gaskets or nonmetallic flashing.

- F. Install concealed gaskets, flashings, joint fillers, and insulation as louver installation progresses, where weathertight louver joints are required. Comply with Division 07, Section "Concrete Joint Sealants" for sealants applied during louver installation.

3.4 ADJUSTING AND CLEANING

- A. Clean exposed louver surfaces that are not protected by temporary covering, to remove fingerprints and soil during construction period. Do not let soil accumulate during construction period.
- B. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Thoroughly rinse surfaces and dry.
- C. Restore louvers damaged during installation and construction so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by Architect, remove damaged units and replace with new units.
 - 1. Touch up minor abrasions in finishes with air-dried coating that matches color and gloss of, and is compatible with, factory-applied finish coating.

END OF SECTION 08 91 19

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SECTION 09 29 00 - GYPSUM BOARD

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Interior gypsum board.
 - 2. Exterior gypsum board for ceilings and soffits.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Sustainable Design Submittals:
 - 1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
 - 2. Product Certificates: For regional materials, indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include distance to Project and cost for each regional material.
 - 3. Product Data: For adhesives and sealants, indicating VOC content.
 - 4. Laboratory Test Reports: For adhesives and sealants, indicating compliance with requirements for low-emitting materials.
 - 5. Laboratory Test Reports: For ceiling and wall materials, indicating compliance with requirements for low-emitting materials.
- C. Samples: For the following products:
 - 1. Trim Accessories: Full-size Sample in 12-inch- (300-mm-) long length for each trim accessory indicated.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

1.5 FIELD CONDITIONS

- A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written instructions, whichever are more stringent.
- B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.
- C. Do not install panels that are wet, moisture damaged, and mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.
- B. Ceiling and wall materials shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.2 GYPSUM BOARD, GENERAL

- A. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- B. Regional Materials: Products shall be manufactured within **100 miles (160 km)** of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within **100 miles (160 km)** of Project site.
- C. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.3 INTERIOR GYPSUM BOARD

- A. Gypsum Wallboard: ASTM C 1396/C 1396M.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. [American Gypsum.](#)
 - b. [CertainTeed Corporation.](#)
 - c. [Continental Building Products, LLC.](#)
 - d. [Georgia-Pacific Building Products.](#)
 - e. [National Gypsum Company.](#)
 - f. [PABCO Gypsum.](#)
 - g. [Temple-Inland Building Products by Georgia-Pacific.](#)
 - h. [USG.](#)
 2. Thickness: **1/2 inch (12.7 mm).**
 3. Long Edges: Tapered
- B. Gypsum Board, Type X: ASTM C 1396/C 1396M.
1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
 - a. [American Gypsum.](#)
 - b. [CertainTeed Corporation.](#)
 - c. [Continental Building Products, LLC.](#)
 - d. [Georgia-Pacific Building Products.](#)
 - e. [National Gypsum Company.](#)
 - f. [PABCO Gypsum.](#)
 - g. [Temple-Inland Building Products by Georgia-Pacific.](#)
 - h. [USG.](#)
 2. Thickness: **5/8 inch (15.9 mm).**
 3. Long Edges: Tapered

2.4 SPECIALTY GYPSUM BOARD

- A. Gypsum Board, Type C: ASTM C 1396/C 1396M. Manufactured to have increased fire-resistive capability.
1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
 - a. [American Gypsum.](#)
 - b. [CertainTeed Corporation.](#)
 - c. [Continental Building Products, LLC.](#)
 - d. [Georgia-Pacific Building Products.](#)
 - e. [National Gypsum Company.](#)
 - f. [PABCO Gypsum.](#)
 - g. [Temple-Inland Building Products by Georgia-Pacific.](#)
 - h. [United States Gypsum Company.](#)
 2. Thickness: As required by fire-resistance-rated assembly indicated on Drawings.
 3. Long Edges: Tapered.

2.5 EXTERIOR GYPSUM BOARD FOR CEILINGS AND SOFFITS

- A. Exterior Gypsum Soffit Board: ASTM C 1396/C 1396M, with manufacturer's standard edges.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Gypsum.
 - b. CertainTeed Corporation.
 - c. Continental Building Products, LLC.
 - d. Georgia-Pacific Building Products.
 - e. National Gypsum Company.
 - f. PABCO Gypsum.
 - g. Temple-Inland Building Products by Georgia-Pacific.
 - h. United States Gypsum Company.
 - 2. Core: 5/8 inch (15.9 mm), Type X.

2.6 TRIM ACCESSORIES

- A. Interior Trim: ASTM C 1047.
 - 1. Material: Paper-faced galvanized-steel sheet.
 - 2. Shapes:
 - a. Cornerbead.
 - b. LC-Bead: J-shaped; exposed long flange receives joint compound.
 - c. L-Bead: L-shaped; exposed long flange receives joint compound.
 - d. U-Bead: J-shaped; exposed short flange does not receive joint compound.
 - e. Expansion (control) joint.
- B. Exterior Trim: ASTM C 1047.
 - 1. Material: Hot-dip galvanized-steel sheet, plastic, or rolled zinc.
 - 2. Shapes:
 - a. Cornerbead.
 - b. LC-Bead: J-shaped; exposed long flange receives joint compound.
 - c. Expansion (Control) Joint: One-piece, rolled zinc with V-shaped slot and removable strip covering slot opening.

2.7 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C 475/C 475M.
- B. Joint Tape:

1. Interior Gypsum Board: Paper.
 2. Exterior Gypsum Soffit Board: Paper.
 3. Glass-Mat Gypsum Sheathing Board: 10-by-10 glass mesh.
 4. Tile Backing Panels: As recommended by panel manufacturer.
- C. Joint Compound for Interior Gypsum Board: For each coat, use formulation that is compatible with other compounds applied on previous or for successive coats.
1. Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.
 2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use drying-type, all-purpose compound.
 - a. Use setting-type compound for installing paper-faced metal trim accessories.
 3. Fill Coat: For second coat, use setting-type, sandable topping compound.
 4. Finish Coat: For third coat, use, all-purpose compound.
- D. Joint Compound for Exterior Applications:
1. Exterior Gypsum Soffit Board: Use setting-type taping compound and setting-type, sandable topping compound.

2.8 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.
1. Adhesives shall have a VOC content of 50 g/L or less.
 2. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- B. Steel Drill Screws: ASTM C 1002 unless otherwise indicated.
1. Use screws complying with ASTM C 954 for fastening panels to steel members from **0.033 to 0.112 inch (0.84 to 2.84 mm)** thick.
 2. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- C. Thermal Insulation: As specified in Division 07, Section "Thermal Insulation."
- D. Vapor Retarder: As specified in Division 07, Section "Vapor Retarders."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and substrates including welded hollow-metal frames and support framing, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLYING AND FINISHING PANELS, GENERAL

- A. Comply with ASTM C 840.
- B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
- C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than **1/16 inch (1.5 mm)** of open space between panels. Do not force into place.
- D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
- E. Form control and expansion joints with space between edges of adjoining gypsum panels.
- F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
 - 1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than **8 sq. ft. (0.7 sq. m)** in area.
 - 2. Fit gypsum panels around ducts, pipes, and conduits.
 - 3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow **1/4- to 3/8-inch- (6.4- to 9.5-mm-)** wide joints to install sealant.
- G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments. Provide **1/4- to 1/2-inch- (6.4- to 12.7-mm-)** wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

- H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

3.3 APPLYING INTERIOR GYPSUM BOARD

- A. Install interior gypsum board in the following locations:
 - 1. Wallboard Type: Vertical surfaces unless otherwise indicated.
 - 2. Type X: Where required for fire-resistance-rated assembly.
 - 3. Ceiling Type: Ceiling surfaces.
- B. Single-Layer Application:
 - 1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing unless otherwise indicated.
 - 2. On partitions/walls, apply gypsum panels horizontally (perpendicular to framing) unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
 - a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
 - b. At stairwells and other high walls, install panels horizontally unless otherwise indicated or required by fire-resistance-rated assembly.
 - 3. On Z-shaped furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
 - 4. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

3.4 APPLYING EXTERIOR GYPSUM PANELS FOR CEILINGS AND SOFFITS

- A. Apply panels perpendicular to supports, with end joints staggered and located over supports.
 - 1. Install with **1/4-inch (6.4-mm)** open space where panels abut other construction or structural penetrations.

3.5 INSTALLING TRIM ACCESSORIES

- A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
- B. Control Joints: Install control joints according to ASTM C 840 and in specific locations approved by Architect for visual effect.
- C. Interior Trim: Install in the following locations:

1. Cornerbead: Use at outside corners unless otherwise indicated.
2. L-Bead: Use where panel abut precast conc. or CMU Construction.

D. Exterior Trim: Install in the following locations:

1. Cornerbead: Use at outside corners.
2. LC-Bead: Use where panel abut precast conc. or CMU Construction

3.6 FINISHING GYPSUM BOARD

- A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
- B. Prefill open joints, rounded or beveled edges, and damaged surface areas.
- C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.
- D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:
 1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
 2. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated.
 - a. Primer and its application to surfaces are specified in Division 09, Section "Interior Painting."

3.7 PROTECTION

- A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.
- B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- C. Remove and replace panels that are wet, moisture damaged, and mold damaged.
 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 09 29 00

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SECTION 09 91 13 - EXTERIOR PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes surface preparation and the application of paint systems on the following exterior substrates:
 - 1. Concrete.
 - 2. Concrete masonry units (CMUs).
 - 3. Steel and iron.
 - 4. Galvanized metal.
 - 5. Gypsum board.
- B. Related Requirements:
 - 1. Division 05, Section "Structural Steel Framing" for shop priming of metal substrates.
 - 2. Division 05, Section "Metal Fabrications" for shop priming metal fabrications.
 - 3. Division 05, Section "Pipe and Tube Railings" for shop priming pipe and tube railings.
 - 4. Division 09, Section "High-Performance Coatings" for tile-like coatings.

1.3 DEFINITIONS

- A. MPI Gloss Level 1 (Matte Finish): Not more than five units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.
- B. MPI Gloss Level 3 ('Egg-Shell-Like' Finish): 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
- C. MPI Gloss Level 4 ('Satin-Like' Finish): 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.
- D. MPI Gloss Level 5 (Semi-Gloss): 35 to 70 units at 60 degrees, according to ASTM D 523.
- E. MPI Gloss Level 6 (Gloss): 70 to 85 units at 60 degrees, according to ASTM D 523.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
 - 1. Include printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.
 - 2. Indicate VOC content.
- B. Sustainable Design Submittals:
 - 1. Product Data: For paints and coatings, indicating VOC content.
- C. Samples for Initial Selection: For each type of topcoat product.
- D. Samples for Verification: For each type of paint system and each color and gloss of topcoat.
 - 1. Submit Samples on rigid backing, 8 inches (200 mm) square.
 - 2. Apply coats on Samples in steps to show each coat required for system.
 - 3. Label each coat of each Sample.
 - 4. Label each Sample for location and application area.
- E. Product List: Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules. Include color designations.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials ,from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Paint: 5 percent, but not less than 1 gal. (3.8 L) of each material and color applied.

1.6 QUALITY ASSURANCE

- A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Architect will select one surface to represent surfaces and conditions for application of each paint system.
 - a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).
 - b. Other Items: Architect will designate items or areas required.
 - 2. Final approval of color selections will be based on mockups.

- a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to **City**.
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than **45 deg F (7 deg C)**.
 1. Maintain containers in clean condition, free of foreign materials and residue.
 2. Remove rags and waste from storage areas daily.

1.8 FIELD CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between **50 and 95 deg F (10 and 35 deg C)**.
- B. Do not apply paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than **5 deg F (3 deg C)** above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Behr Process Corporation.
 2. Benjamin Moore & Co.
 3. Dunn-Edwards Corporation.
 4. Glidden Professional.
 5. Kelly-Moore Paint Company Inc.
 6. PPG Architectural Finishes, Inc.
 7. Pratt & Lambert.
 8. Sherwin-Williams Company (The).

2.2 PAINT, GENERAL

- A. MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products Lists."
- B. Material Compatibility:
 - 1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 - 2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.
- C. VOC Content: For field applications, paints and coatings shall comply with VOC content limits of authorities having jurisdiction and the following VOC content limits:
 - 1. Flat Paints and Coatings: 50 g/L.
 - 2. Nonflat Paints and Coatings: 50 g/L.
 - 3. Dry-Fog Coatings: 150 g/L.
 - 4. Primers, Sealers, and Undercoaters: 100 g/L.
 - 5. Rust-Preventive Coatings: 100 g/L.
 - 6. Zinc-Rich Industrial Maintenance Primers: 100 g/L.
 - 7. Pretreatment Wash Primers: 420 g/L.
- D. Colors: As selected by Architect from manufacturer's full range

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 - 1. Concrete: 12 percent.
 - 2. Masonry (Clay and CMUs): 12 percent.
 - 3. Gypsum Board: 12 percent.
- C. Exterior Gypsum Board Substrates: Verify that finishing compound is sanded smooth.
- D. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.
- E. Proceed with coating application only after unsatisfactory conditions have been corrected.
 - 1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
 - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection.
- C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
 - 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.
- D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
- E. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceeds that permitted in manufacturer's written instructions.
- F. Steel Substrates: Remove rust, loose mill scale, and shop primer if any. Clean using methods recommended in writing by paint manufacturer[.] but not less than the following:
 - 1. SSPC-SP 2.
 - 2. SSPC-SP 3.
- G. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.
- H. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual."
 - 1. Use applicators and techniques suited for paint and substrate indicated.

2. Paint surfaces behind movable items same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed items with prime coat only.
 3. Paint both sides and edges of exterior doors and entire exposed surface of exterior door frames.
 4. Paint entire exposed surface of window frames and sashes.
 5. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
 6. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.
- B. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- C. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:
1. Paint the following work where exposed to view:
 - a. Equipment, including panelboards
 - b. Uninsulated metal piping.
 - c. Pipe hangers and supports.
 - d. Metal conduit.

3.4 FIELD QUALITY CONTROL

- A. Dry Film Thickness Testing: **City** may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.
1. Contractor shall touch up and restore painted surfaces damaged by testing.
 2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

3.5 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 EXTERIOR PAINTING SCHEDULE

A. Concrete Substrates, Non-traffic Surfaces:

1. Latex System MPI EXT 3.1A:

a. Prime Coat: Primer, alkali resistant, water based, MPI #3.

- 1) Benjamin Moore; Ultra Spec - Masonry Int/Ext 100 Acrylic Sealer.
- 2) Sherwin-Williams; Loxon - Loxon Concrete & Masonry Primer.
- 3) PPG Architectural; PPG Paints – Seal Grip Int/Ext Acrylic Universal Primer/Sealer.
- 4) Equivalent products by other manufacturers and approved by Architect/Engineer.

b. Topcoat: Latex, exterior, flat (MPI Gloss Level 1), MPI #10.

- 1) Benjamin Moore; Ultra Spec – Exterior Flat Finish.
- 2) Sherwin-Williams; SuperPaint – Exterior Latex Flat.
- 3) PPG Architectural; PPG Paints – Ultra-Hide 150 Exterior Acrylic Flat.
- 4) Equivalent products by other manufacturers and approved by Architect/Engineer.

B. CMU Substrates:

1. Latex System MPI EXT 4.2A:

a. Prime Coat: Block filler, latex, interior/exterior, MPI #4.

- 1) Benjamin Moore; Ultra Spec - Int/Ext High-Build Masonry Block Filler.
- 2) Sherwin-Williams; PrepRite – Int/Ext Block Filler.
- 3) PPG Architectural; PPG Paints - Speedhide Int/Ext. Masonry Hi Fill Latex Block Filler.
- 4) Equivalent products by other manufacturers and approved by Architect/Engineer.

b. Topcoat: Latex, exterior, low sheen (MPI Gloss Level 3-4), MPI #15.

- 1) Benjamin Moore; Ultra Spec - Exterior Satin Finish.
- 2) Sherwin-Williams; SuperPaint – Exterior Latex Satin.
- 3) PPG Architectural; PPG Paints - Speedhide Exterior 100% Acrylic Latex Satin.
- 4) Equivalent products by other manufacturers and approved by Architect/Engineer.

C. Steel and Iron Substrates:

1. Alkyd System MPI EXT 5.1D:

- a. Prime Coat: Primer, alkyd, anticorrosive, for metal, MPI #79.
 - 1) Benjamin Moore; Super Spec HP – Alkyd Metal Primer.
 - 2) Sherwin-Williams; Protective & Marine - Kem Kromik Universal Primer.
 - 3) Equivalent products by other manufacturers and approved by Architect/Engineer.
- b. Topcoat: Alkyd, exterior, gloss (MPI Gloss Level 6), MPI #9.
 - 1) Benjamin Moore; Corotech - Alkyd Gloss Enamel.
 - 2) Sherwin-Williams; Protective & Marine - Seaguard 1000 Marine.
 - 3) Equivalent products by other manufacturers and approved by Architect/Engineer.

A. Galvanized-Metal Substrates:

1. Latex System MPI EXT 5.3H:

- a. Prime Coat: Primer, galvanized, water based, MPI #134.
 - 1) Behr Paint; Premium Plus - Exterior Multi-Surface Primer & Sealer.
 - 2) Sherwin-Williams; Pro Industrial - DTM Acrylic Primer/Finish
 - 3) Equivalent products by other manufacturers and approved by Architect/Engineer.
- b. Intermediate Coat: Latex, exterior, matching topcoat.
- c. Topcoat: Latex, exterior, gloss (MPI Gloss Level 6), MPI #119.
 - 1) Behr Paint; Behr Plus - Int/Ext Hi-Gloss Enamel.
 - 2) Sherwin-Williams; Pro Industrial – DTM Acrylic Gloss
 - 3) Equivalent products by other manufacturers and approved by Architect/Engineer.

B. Exterior Gypsum Board Substrates:

1. Latex System MPI EXT 9.2A:

- a. Prime Coat: Primer, latex for exterior wood (reduced), MPI #6.
 - 1) Benjamin Moore; Ultra Spec - Latex Exterior Primer.
 - 2) Sherwin-Williams; Multi-Purpose - Multi-Purpose Latex Primer/Sealer.
 - 3) PPG Architectural; PPG Paints - Seal Grip Int/Ext Acrylic Universal Primer/Sealer.
 - 4) Equivalent products by other manufacturers and approved by Architect/Engineer.
- b. Topcoat: Latex, exterior, low sheen (MPI Gloss Level 3-4), MPI #15.

- 1) Benjamin Moore; Ultra Spec – Exterior Satin Finish.
- 2) Sherwin-Williams; Super Paint – Exterior Latex Satin.
- 3) PPG Architectural; PPG Paints Superhide Exterior 100% Acrylic Latex Satin.
- 4) Equivalent products by other manufacturers and approved by Architect/Engineer.

END OF SECTION 09 91 13

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SECTION 09 91 20 - PAVEMENT MARKING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes surface preparation and application of paint systems for the high build, two coat systems for the items of types, patterns, sizes, and colors described in this article.
- B. Provide the following systems as shown on Drawings:
 - 1. Parking Stall Stripes - Yellow.
 - 2. Traffic Arrows, crosswalks, accessible stall access aisles, walkways, symbols, stop bars, words and other markings.
 - 3. International Symbol of Accessibility.
- C. Provide painting of curbs and curb ramps as described in the following paragraphs:
 - 1. Paint vertical surface and the first 6 in. of the abutting horizontal surface at the top of all curbs and islands (including PARCS equipment islands) within parking facility except those which do not exceed 3'0" in width and abut a wall, spandrel panel, bumper wall guardrail or other construction (not including landscaping or equipment) which prevents passage of pedestrians.
 - 2. Paint color for curbs and curb ramps shall be yellow.
- D. Proportion International Symbol of Accessibility in accordance with New York State's modifications to ICC A117.1-2009 Accessible and Usable Buildings or 2010 ADA Standards for Accessible Design.
- E. Related Work:
 - 1. Pavement Marking Contractor shall verify compatibility with sealers, joint sealants, caulking and all other surface treatments as specified in Division 07.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Provide product data as follows:

1. Manufacturer's certification that the material complies with standards referenced within this Section.
 2. Intended paint use.
 3. Pigment type and content.
 4. Vehicle type and content.
- C. Submit list of similar projects (minimum of 5) where pavement-marking paint has been in use for a period of not less than 2 yrs.

1.4 PROJECT CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 degrees F.
- B. Do not apply paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 degrees F above the dew point; or to damp or wet surfaces.

1.5 QUALITY ASSURANCE

- A. Provide written 2-year warranty to **City** that pavement markings will be free of defects due to workmanship, inadequate surface preparation, and materials including, but not limited to, fading and/or loss of markings due to abrasion, peeling, bubbling and/or delamination. Excessive delamination, peeling, bubbling or abrasion loss shall be defined as more than 15% loss of marking material within one year of substantial completion and/or occupancy of the parking area. With no additional cost to **City**, repair and/or recoat all pavement marking where defects develop or appear during warranty period and all damage to other Work due to such defects.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Pavement marking materials shall meet Federal, State and Local environmental standards.
- B. All paints shall be manufactured, formulated and designed for use a pavement and/or traffic marking.
- C. Paint shall be manufactured and formulated from first grade raw materials and shall be free from defects or imperfections that might adversely affect product serviceability.
- D. Paints shall comply with the National Organic Compound Emission Standards for Architectural Coatings, Environmental Protection Agency, 40 CFR Part 59.
- E. The product shall not contain mercury, lead, hexavalent chromium, or halogenated solvents.

2.2 PAVEMENT MARKING PAINTS:

- A. Epoxy paint may be used for all markings, unless noted otherwise on the Drawings. Paint shall be a two-component system consisting of minimum 99 percent solids. The material shall be specifically formulated as a pavement marking material and shall be spray applied at ambient temperatures.
 - 1. The specific paint formulation shall be approved for use on highways by the state and/or local DOT where the project is located.
- B. Solvent based chlorinated rubber paint may be employed for white and yellow pavement markings on concrete and shall meet the requirements of MPI #32 or Federal Specification TT-P-115F.
 - 1. Acceptable Projects:
 - a. Promar Acrylic Copolymer Traffic Paint by Sherwin Williams
 - b. Setfast Chlorinated Rubber Zone Marking by Sherwin Williams
- C. 100% acrylic waterborne - paint may be used for asphalt pavement: for white and yellow pavement markings and shall meet requirements of MPI #70 or Federal Standard TT-P-1952E Type I and II.
 - 1. 100% acrylic waterborne paint for special color pavement markings (blue, green, red, black) shall meet requirements of Federal Specification TT-P-1952E. Special color marking materials shall be compatible with the white and yellow pavement markings where they are layered.
 - 2. Acceptable Products:
 - a. Setfast Latex Traffic Marking Paint by Sherwin Williams,
 - b. Hotline Waterborne Traffic by Sherwin Williams
 - c. EF Series Durasheen Waterborne Traffic Paint by Ennis Flint
 - d. Fast Dry Series Waterborne Traffic Paint by American Traffic Products, Inc.
 - e. Zone Line 100% Acrylic 11-53 Series by Pittsburgh Paint

2.3 COLOR OF PAINT

- A. Color of paint unless noted otherwise on Contract Drawings, shall be white and shall match federal color chip 37925. The Light Reflectance Value (without glass beads) shall not be less than 84%.
- B. Paint color for traffic yellow, where shown on Contract Drawings or specified herein, shall match federal color chip No. 33538 commonly referred to as federal highway yellow. The Light Reflectance Value (without glass beads) shall not be less than 45%.
- C. Paint color for blue accessible parking space pavement markings shall match federal color chip No. 35180. The Light Reflectance Value (without glass beads) shall not be less than 10%.

- D. Paint color for green ev charger/special-use parking space pavement markings shall match federal color chip No. 34108. The Light Reflectance Value (without glass beads) shall not be less than 10%.
- E. Paint color for red special-use parking space pavement markings, if shown on Contract Drawings, shall match federal color chip No. 31136. The Light Reflectance Value (without glass beads) shall not be less than 10%.
- F. Paint color for black special-use pavement markings, if shown on Contract Drawings, shall match federal color chip No. 37038. Black paint shall also meet Federal Specification TT-P-110.

2.4 BEADS

- A. Use Glass Beads (Spheres) in all pavement markings except stall striping lines. Conform to Federal Specification TT-B-1325D, Type I. Broadcast beads into markings at rate not less than 6 lbs. per gallon of paint.

2.5 SILICA SAND

- A. Silica Sand, where used, shall be foundry grade silica sand composed of at least 99.5 percent silicon dioxide when tested in accordance with ASTM C 146. The gradation of silica sand shall meet the paint manufacturer's recommendation. Sand shall broadcast into markings at rate not less than 6 lbs per gallon of paint.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.
- B. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- C. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.
 - 1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.
- D. Striping shall not be placed until full cure of concrete slab and sealer. Concrete surfaces generally require 30 to 90 days @ 70°F or higher. Sealers (other than silane) generally require 14 days @ 70°F or higher. Silane sealers require 24 hrs @ 70°F or higher. Bituminous surfaces generally require 30 days @ 45° F or higher.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.
- B. Do not paint or finish any surface that is wet or damp.
- C. Clean substrates of substances that could impair bond of paints, including dirt, dust, oil, grease, and incompatible paints and encapsulants.
- D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
- E. Lay out all striping on each tier, using dimensions and details shown on Contract Drawings, before painting that tier. Report any discrepancies, interferences or changes in striping due to field conditions to Engineer/Architect prior to painting. Pavement Marking Contractor shall be required to remove paint, repair surface treatment and repaint stripes not applied in strict accordance with Contract Drawings.
- F. Where pavement markings and/or stripes must be removed due to installation which does not conform to contract requirements, remove existing paint markings, using care to avoid scarring substrate surface.
 - 1. Concrete and asphalt surfaces: Material shall be removed by methods acceptable to Engineer/Architect and cause as little damage as possible to surface texture of pavement. Methods, that can provide acceptable results, are grinding and air or shot blasting. Use of chemicals to remove pavement markings prohibited. Collect residue generated by removal of pavement markings and dispose of as required by all applicable laws and regulations. If grinding is used, lightly grind floor surface using wheel mounted floor grinder or similar equipment with positive elevation control of grinder head. For all removal techniques: On test area, demonstrate to **City** acceptable removal of paint material and control of paint removal equipment to prevent substrate scarring.
 - 2. Traffic Topping/Membrane surfaces: Remove existing pavement markings by solvent washing or high-pressure water washing. Submit letter from traffic topping/membrane manufacturer certifying that solvents and/or water pressures are acceptable for this use and will not damage material. On test area, demonstrate to **City** acceptable removal of paint material and control of paint removal equipment to prevent substrate scarring.
 - 3. Contractor shall not use paint, bituminous bond coat or other methods of covering markings to obliterate existing pavement markings.
 - 4. Material deposited on pavement as a result of removal shall be removed as work progresses. Accumulation of material, that might interfere with drainage or might constitute a hazard to traffic, prohibited.
 - 5. Curing compounds on new concrete surfaces (less than 1 yr old) shall be removed per existing pavement marking removal requirements prior to installation of new pavement markings.

G. Work Areas:

1. Store, mix and prepare paints only in areas designated by Contractor for that purpose.
2. Provide clean cans and buckets required for mixing paints and for receiving rags and other waste materials associated with painting. Clean buckets regularly. At close of each day's Work, remove used rags and other waste materials associated with painting.
3. Take precautions to prevent fire in or around painting materials. Provide and maintain appropriate hand fire extinguisher near paint storage and mixing area.

H. Mixing:

1. Do not intermix materials of different character or different manufacturer.
2. Do not thin material except as recommended by manufacturer.

I. Disposal:

1. Contractor shall properly dispose of unused materials and containers in compliance with Federal Resource Conservation Recovery Act (RCRA) of 1976 as amended, and all other applicable laws and regulations.

3.3 APPLICATION

- A. Apply paint in 2-coat system; first coat shall be 50% of total 15 wet mil minimum thickness, not to exceed 8 mils. First coat shall be cured prior to installation of second coat. At Contractor's option, one coat may be applied before substantial completion, with a second coat delayed for 3-6 months until weather conditions are appropriate and the concrete has cured sufficiently for proper adhesion.
1. Two coat system total wet mil thickness of 0.015 in (0.381 mm).
 2. Two coat system total wet mil thickness of 0.018 to 0.025 in (0.457 – 0.635 mm) When Type IVA beads are used.
 3. Two coat system total wet mil thickness of 0.015 to 0.018 in (0.381 – 0.457 mm) When Type IVB beads are used.
- B. Apply painting and finishing materials in accordance with manufacturer's directions. Use applications and techniques best suited for material and surfaces to which applied. Minimum air shall be used to prevent overspray. Temperature during application shall be minimum of 40° F and rising, unless manufacturer requires higher minimum temperature. Maximum relative humidity shall be as required by manufacturer.
- C. Application of beads and/or silica sand shall coincide with application of paint, but shall be done as separate operation by a suitable dispenser. Sand may be premixed with paint for application to curbs only. Glass beads and silica sand shall adhere to the cured paint or all marking operations shall cease until corrections are made.
- D. All lines shall be straight, true, and sharp without fuzzy edges, overspray or non-uniform application. Corners shall be at right angles, unless shown otherwise, with no overlaps.

Line width shall be uniform (-0%, +5% from specified width). No excessive humping (more material in middle than at edges or vice versa).

3.4 APPLICATION OF TEMPORARY PAVEMENT MARKING

- A. Temporary pavement markings shall be pre-formed tape, conforming to ASTM D4592, type 1, removable.
- B. Temporary pavement markings shall be applied after paving, but before being opened to traffic and parking. Markings that are improperly applied and come loose shall be replaced at Contractor's expense, as directed by Engineer/Architect.
- C. Temporary pavement markings on finished pavement surface shall be installed allowing for lateral tolerance of ± 2 in. center to center. Temporary pavement markings that are installed outside specified lateral tolerances shall be removed and replaced, as directed by Engineer/Architect, at Contractor's expense.
- D. All marking shall have width of 4 in. unless otherwise specified. Markings shall be either white or yellow per Contract Drawings.
- E. Apply and remove preformed tape per manufacturer's instructions.
- F. Remove all temporary pavement markings prior to placing permanent pavement markings.

END OF SECTION 09 91 20

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SECTION 09 91 23 - INTERIOR PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes surface preparation and the application of paint systems on **[interior substrates.] [the following interior substrates:]**
 - 1. Concrete.
 - 2. Concrete masonry units (CMUs).
 - 3. Steel and iron.
 - 4. Galvanized metal.
 - 5. Gypsum board.
- B. Related Requirements:
 - 1. Division 05, Section "Metal Fabrications" for shop priming metal fabrications.
 - 2. Division 05, Section "Pipe and Tube Railings" for shop priming pipe and tube railings.

1.3 DEFINITIONS

- A. MPI Gloss Level 1 (Matte Finish): Not more than five units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.
- B. MPI Gloss Level 3 ('Egg-shell-Like' Finish): 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
- C. MPI Gloss Level 4 ('Satin-Like' Finish): 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.
- D. MPI Gloss Level 5 (Semi-Gloss Finish): 35 to 70 units at 60 degrees, according to ASTM D 523.
- E. MPI Gloss Level 6 (Gloss): 70 to 85 units at 60 degrees, according to ASTM D 523.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.

1. Include Printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.
 2. Indicate VOC content.
- B. Sustainable Design Submittals:
1. **Product Data:** For paints and coatings, indicating VOC content.
 2. Laboratory Test Reports: For paints and coatings, indicating compliance with requirements for low-emitting materials.
- C. Samples for Initial Selection: For each type of topcoat product.
- D. Samples for Verification: For each type of paint system and in each color and gloss of topcoat.
1. Submit Samples on rigid backing, **8 inches (200 mm)** square.
 2. Apply coats on Samples in steps to show each coat required for system.
 3. Label each coat of each Sample.
 4. Label each Sample for location and application area.
- E. Product List: Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules. Include color designations.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials[, **from the same product run,**] that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Paint: 5 percent, but not less than **1 gal. (3.8 L)** of each material and color applied.

1.6 QUALITY ASSURANCE

- A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
1. Architect will select one surface to represent surfaces and conditions for application of each paint system.
 - a. Vertical and Horizontal Surfaces: Provide samples of at least **100 sq. ft. (9 sq. m)**.
 - b. Other Items: Architect will designate items or areas required.
 2. Final approval of color selections will be based on mockups.
 - a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to **City**.

3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).
 1. Maintain containers in clean condition, free of foreign materials and residue.
 2. Remove rags and waste from storage areas daily.

1.8 FIELD CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).
- B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 1. Behr Process Corporation.
 2. Benjamin Moore & Co.
 3. California Paints.
 4. Conco Paints.
 5. Coronado Paint; Benjamin Moore Company.
 6. Diamond Vogel Paints.
 7. Dulux (formerly ICI Paints); a brand of AkzoNobel.
 8. Dunn-Edwards Corporation.
 9. Duron, Inc.
 10. Frazee Paint; Comex Group.
 11. Glidden Professional.
 12. Kelly-Moore Paint Company Inc.
 13. Kwal Paint; Comex Group.
 14. M.A.B. Paints.
 15. Parker Paint; Comex Group.
 16. PPG Architectural Finishes, Inc.

17. [Pratt & Lambert.](#)
18. [Rodda Paint Co.](#)
19. [Rust-Oleum Corporation; a subsidiary of RPM International, Inc.](#)
20. [Sherwin-Williams Company \(The\).](#)
21. [Zinsser; Rust-Oleum Corporation.](#)

- B. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to products listed in the Interior Painting Schedule for the paint category indicated.

2.2 PAINT, GENERAL

- A. MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products Lists."
- B. Material Compatibility:
1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.
- C. [VOC Content](#): For field applications that are inside the weatherproofing system, paints and coatings shall comply with VOC content limits of authorities having jurisdiction and the following VOC content limits:
1. Flat Paints and Coatings: 50 g/L.
 2. Nonflat Paints and Coatings: 50 g/L.
 3. Dry-Fog Coatings: 150 g/L.
 4. Primers, Sealers, and Undercoaters: 100 g/L.
 5. Rust-Preventive Coatings: 100 g/L.
 6. Zinc-Rich Industrial Maintenance Primers: 100 g/L.
 7. Pretreatment Wash Primers: 420 g/L.
- D. Low-Emitting Materials: For field applications that are inside the weatherproofing system, 90 percent of paints and coatings shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- E. Colors: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 - 1. Concrete: 12 percent.
 - 2. Masonry (CMUs): 12 percent.
 - 3. Gypsum Board: 12 percent.
- C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.
- D. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.
- E. Proceed with coating application only after unsatisfactory conditions have been corrected.
 - 1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
 - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
- C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
 - 1. Remove incompatible primers and re-prime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.
- D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
- E. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceeds that permitted in manufacturer's written instructions.

- F. Steel Substrates: Remove rust, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by paint manufacturer but not less than the following:
 - 1. SSPC-SP 2.
 - 2. SSPC-SP 3.
- G. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions and to recommendations in "MPI Manual."
 - 1. Use applicators and techniques suited for paint and substrate indicated.
 - 2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
 - 3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
 - 4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
 - 5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.
- B. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- C. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- D. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:
 - 1. Paint the following work where exposed in equipment rooms:
 - a. Equipment, including panelboards.
 - b. Uninsulated metal piping.
 - c. Pipe hangers and supports.
 - d. Metal conduit.
 - e. Tanks that do not have factory-applied final finishes.
 - 2. Paint the following work where exposed in occupied spaces:
 - a. Equipment, including panelboards.
 - b. Uninsulated metal piping.
 - c. Pipe hangers and supports.

- d. Metal conduit.
- e. Other items as directed by Architect.

3.4 FIELD QUALITY CONTROL

- A. Dry Film Thickness Testing: **City** may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.
 - 1. Contractor shall touch up and restore painted surfaces damaged by testing.
 - 2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

3.5 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 INTERIOR PAINTING SCHEDULE

- A. Concrete Substrates, Non-traffic Surfaces:
 - 1. Latex System MPI INT 3.1A or MPI INT 3.1E
 - a. Prime Coat: Primer, alkali resistant, water based, MPI #3.
 - b. Prime Coat: Latex, interior, matching topcoat.
 - c. Topcoat: Latex, interior, flat (MPI Gloss Level 1), MPI #53.
- B. CMU Substrates:
 - 1. Institutional Low-Odor/VOC Latex System MPI INT 4.2E:
 - a. Block Filler: Block filler, latex, interior/exterior, MPI #4.

- b. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 2), MPI #144.

C. Steel Substrates:

- 1. Alkyd over Shop-Applied Quick-Drying Shop Primer System MPI INT 5.1W:
 - a. Prime Coat: Primer, quick dry, for shop application, MPI #275.
 - b. Topcoat: Alkyd, interior, gloss (MPI Gloss Level 6), MPI #48.

D. Galvanized-Metal Substrates:

- 1. Alkyd over Cementitious Primer System [MPI INT 5.3C]:
 - a. Prime Coat: Primer, galvanized, cementitious[, MPI #26].
 - b. Topcoat: Alkyd, interior, gloss (MPI Gloss Level 6)[, MPI #48].

E. Gypsum Board Substrates:

- 1. Latex over Latex Sealer System MPI INT 9.2A:
 - a. Prime Coat: Primer sealer, latex, interior, MPI #50.
 - b. Prime Coat: Latex, interior, matching topcoat.
 - c. Topcoat: Latex, interior (MPI Gloss Level 3), MPI #52.

END OF SECTION 09 91 23

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SECTION 10 14 00 – SIGNAGE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes following types of signs:
 - 1. Reflective vehicular directional and information signs (V- Signs).
 - 2. Retroreflective regulatory signs (R- Signs).
 - 3. Retroreflective warning signs (W-Signs).
 - 4. Non-reflective pedestrian directional and informational signs (PP- Signs).
 - 5. Pedestrian Supergraphic Signs (PS- Signs).
 - 6. PVC Pipe Clearance Signs (PVC- Signs).
 - 7. Vandal-resistant Signs (VR- Signs).
 - 8. Brailled ADA Compliant Identification Signs (A-Signs).
 - 9. Dimensional Characters (D-Signs).
 - 10. Traffic Controller Signs (TC- Signs).
 - 11. Other code required signs.
- B. Related Sections include following:
 - 1. Division 09 Sections “Exterior Painting” or “Interior Painting” for painting by others of surfaces to which signs specified herein may be applied. Painting of signs is included in this Section.
 - 2. Division 14 Section “Elevators” for elevator door jamb markings and “In Case of Fire...” signage.
 - 3. Division 23 Section “Common Work Results for HVAC” for labels, tags, and nameplates for mechanical equipment.
 - 4. Division 26 Section “Common Work Results for Electrical Transmissions, Lighting, and Control Devices” for labels, tags, and nameplates for electrical equipment. (Room destination signage is included herein.)
 - 5. Division 26 Section “Interior Lighting” for illuminated exit signs.
 - 6. See Division 26 Sections for electrical service and connections for electrified and/or illuminated signs and/or letters.
 - 7. Divisions 28 Section “Zoned (DC Loop) Fire Alarm System”.

1.3 SUBMITTALS

- A. General: Submit following in accordance with Conditions of Contract and Division 01 Specification Sections.
- B. Product Data: Include manufacturer's construction details relative to materials, dimensions of individual components, profiles, and finishes for each type of sign required.
- C. Shop Drawings: Provide shop drawings for fabrication and erection of signs. Include plans, elevations, and large-scale sections of typical members and other components. Show mounting methods, mounting heights, anchors, grounds, reinforcement, accessories, layout, spacing, dimensions and installation details.
 - 1. Provide message list, typestyles, graphic elements, including tactile characters and Braille and artwork as shown on drawings, and layout of lettering. Include large scale details of sign layout.
 - 2. For signs supported by or anchored to permanent construction, provide setting drawings, templates, and directions for installation of anchor bolts and other anchors to be installed as a unit of Work in other Sections.
 - 3. Wiring Diagrams from manufacturer of electrified signs for power, signal and control wiring.
- D. Samples: Provide following samples of each sign component for verification of compliance with requirements indicated.
 - 1. Samples of each sign material type (V-, R-, PP-, VR-, etc), on not less than 6-in. squares of extrusion, sheet or plate, showing full range of colors to be provided.
 - 2. Dimensional characters and castings: Full size sample showing character, material, texture, finish, color, style and attachment method.
 - 3. Brailled Copy: Sample of ADA compliant sign showing raised image text, brailled copy and colors.
- E. Maintenance Data: For signage cleaning and maintenance requirements to be included in maintenance manual.

1.4 QUALITY ASSURANCE

- A. Qualifications: Manufacturers: Only pre-approved manufacturers as listed herein allowed. Sign manufacturer shall have completed a minimum of 3 projects in last 3 years with similar materials and methods of manufacture as required for this project.
- B. Qualifications: Bidder/Installers: When proposed bidder/installer is not proposed manufacturer of at least 75% of signs on project, Bidder/Installer shall be pre-approved. Three weeks before bidding, prospective bidders shall submit to Engineer/Architect 2 copies of portfolio containing 3 representative projects successfully completed over 3 years preceding Bid. One of 3 projects shall be prospective bidder's most recently completed project. Portfolio shall contain plans, shop drawings, reference letters, material samples, and color photographs of representative projects. Engineer/Architect will review all submitted portfolios with **City** and will issue list of acceptable sign

subcontractors 1 week before Bid date. Qualification for Project will prequalify Bidder for future projects with Engineer/Architect for 1 year from Project Bid date.

- C. Where warranties are required, manufacturer and/or installers shall be authorized by the entity providing the warranty.
- D. All completed signs shall be free from defects in materials and workmanship and effectively present specified or permitted message under both day and night viewing conditions. Sign faces shall be reasonably smooth, shall exhibit uniform color and brightness over entire background surface and shall not appear mottled, streaked, or stained when viewed either in ordinary daylight or incidental beams of automobile headlamps.
- E. Support structures for signs that are free-standing or extending from any exterior surface of the building, including but not limited to the roof level parking signs on cantilever supports, shall be designed by a licensed professional engineer in the State of <insert state> in accordance with ASCE 7-98's requirements for wind loads.
- F. Internally illuminated or electrified sign cases (TC-): Housing shall be waterproof and shall comply with NEMA Standards Publication 250-Enclosures for Electrical Equipment, for Type 4 enclosures.
- G. Electrical Components, Devices and Accessories: All components shall be listed and labeled by UL and shall comply with NEMA and NFPA standards.
- H. Electrical Service: Sign contractor shall review electrical drawings and coordinate with electrical contractor for any minor changes to design and installation of equipment and/or electrical service for powering signs and/or illumination thereof. If change order(s) are possible, use the Request for Information process.
- I. Regulatory Requirements:
 - 1. Comply with Americans with Disabilities Act (ADA) and state and local codes as adopted by authorities having jurisdiction. Signs affected, may include, but not be limited to:
 - a. Illuminated Exit Signs: Refer to Division 26.
 - b. Permanently Designated Rooms and Spaces: A- Signs.
 - c. Fire Doors.
 - d. Live Load Capacity.
 - e. Elevator Signs.
 - f. Stairway Identification.
 - 2. MUTCD:
 - a. Regulatory R- and Warning W- signs shall be fully compliant with all requirements of the Manual on Uniform Traffic Control Devices (MUTCD) except that sign size may be modified due to space constraints.

- J. Single-Source Responsibility: For each separate required type of sign as defined herein, obtain signs from a single firm specializing in this type of work so that there will be undivided responsibility for such work.
- K. Design Criteria: Drawings indicate sizes, profiles, and dimensional requirements of signs. Other signs with deviations from indicated dimensions and profiles may be considered, provided deviations do not change design concept. Burden of proof of equality is on proposer.
- L. Coordinate sign placement with structural configuration and lighting location. Before sign installation, arrange meeting with Engineer/Architect and lighting installer at site to review sign placement. Additional compensation not allowed for relocating signs after installation if relocation required due to conflicts with lighting or structure.
- M. Trade Names: Do not display manufacturer's name, trade name, trademarks, or similar markings on exterior or visible surfaces.
- N. Sign Quantity Count: Sign Fabricator shall be responsible for determining the final quantity count of all signs, as indicated on the Signage Schedule and Location Plans, prior to fabrication.
- O. Provide written 5-year full replacement warranty to **City** that all signage will be free of defects due to workmanship and materials including, but not limited to, fading, peeling, delamination, and installation. With no additional cost to **City**, repair all defects that develop during warranty period and all damage to other Work due to such defects. NOTE: Additional warranties apply to specific sign types and products, as specified herein.
- P. Finishes Warranty: Submit five-year written warranty, signed by the Contractor and Installer, warranting that the architectural signage finishes will not develop excessive fading or excessive non-uniformity of color or shade and will not crack, peel, pit or corrode or otherwise fail as a result in defects, within the warranty period, make necessary repairs or replacement at the convenience of the **City** or facility's management.
 - 1. "Excessive Fading": A change in appearance which is perceptible and objectionable as determined by the Designer when visually compared with the original color range standards.
 - 2. "Excessive Non-Uniformity": Non-Uniform fading during the period of the guarantee, to the extent that adjacent panels have a color difference greater than the original acceptance range of color.
 - 3. "Will Not Pit or Otherwise Corrode": No Pitting or other type of corrosion discernible from a distance of 10'-0", resulting from the natural elements in the atmosphere at the project site.
- Q. Replacement or Repairs: The **City** or facilities management shall have the right to continue use of the defective part until such time that the part is replaced or repaired without loss or inconvenience to the **City** or facility's management. Warranties shall also state that the replaced or repaired part shall have a warranty period equal to the remaining warranty period for the replaced or repaired part plus an additional one year.

1.5 PROJECT CONDITIONS

- A. Field Measurements: Take field measurements prior to preparation of shop drawings and fabrication to ensure proper fitting and mounting. Where sizes of signs may be affected by dimensions of surfaces on which they are installed, verify dimensions by field measurement. Show recorded measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delay.

1.6 COORDINATION

- A. For signs to be supported by or anchored to permanent construction, provide installers with specific requirements for anchorage devices. Furnish templates for installation.
- B. Coordinate location of remote transformers with building construction. Ensure that transformers are accessible after completion of work.

1.7 MAINTENANCE

- A. Maintenance Instruction: Furnish maintenance manual to instruct the **City** or facility's management personnel in procedures to be followed in cleaning and maintaining the signage. Provide manufacturer's brochures describing the actual materials used in the work, including metal alloys and finishes.
 - 1. Include a list of cleaning materials appropriate for continued cleaning of signs. Include written instructions for proper maintenance, service access, replacement procedures, etc. Include recommended methods for removal of residual adhesives from wall surfaces after removal of adhesive mounted signs.
- B. Extra Materials: Deliver to the **City** or facility's management in manufacturer's original packaging and store at the project site where directed.
 - 1. Furnish one quart of each finish paint color for touch-up purposes.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis of Design Product: Where named products are specified, subject to compliance with requirements specific to this project, provide either named product or an equivalent product by other manufacturers specified.
- B. Manufacturers: Subject to compliance with requirements specific to this project, accepted manufacturers listed in Part 2 are considered to have been prequalified in conformance with paragraph 1.4.A and B of this section. Acceptable manufacturers include, but are not limited to the following:

1. Manufacturers of panel signs, including V-,R-,W-, PP-,PS-,VR-, D- and EP- signs:
 - a. APCO Graphics, Inc.
 - b. Architectural Graphics, Inc.
 - c. ASI Sign Systems, Inc.
 - d. Interstate Highway Sign Corp.
 - e. Henry Graphics.
 - f. Britten Studios.
 - g. Pannier Graphics.
 - h. Tapco.
 - i. Vomar.
 - j. Signs + Decal Corp., Brooklyn, NY
 - k. Takeform, Medina, NY
 - l. Design Communications Ltd. (DCL).
2. Manufacturers of Brailled Signs (A-):
 - a. Supersine Company.
 - b. APCO Graphics, Inc.
 - c. ASI Sign Systems, Inc.
 - d. Jet Signs.
 - e. Britten Studios.
 - f. Signs + Decal Corp., Brooklyn, NY
 - g. Vomar.
 - h. Takeform, Medina, NY
3. Manufacturers of TC- signs:
 - a. National Sign & Signal Company.
 - b. Colite Industries, Inc.
 - c. Daktronics.
 - d. Signal Tech (formerly Howard Industries).
 - e. 3M Dynamic Message Signs (formerly American Electronic Sign).
 - f. Tapco.
4. Manufacturers of I- and non-illuminated EP- signs:
 - a. ASI Sign Systems, Inc.
 - b. Interstate Highway Sign Company.
 - c. Vomar.
 - d. Signs + Decal Corp., Brooklyn, NY
 - e. Design Communications Ltd. (DCL)

2.2 MATERIALS

A. Graphics:

1. Graphics shall be highest quality with sharp lines and smooth curves. Images shall be uniform colors and free from streaks or spotting.
2. Content and Style: Provide sign copy that complies with requirements indicated for size, style, spacing, content, position, material, finishes, and colors of letters, numbers, and other graphic devices. Notations contained within the comments section of the sign schedule indicate additional text required on sign such as street name, etc. Notations contained within parenthesis () in the sign schedule and instructions for logos or symbols that are to be included on the sign, as shown on the design drawings. Refer to the sign schedule for copy, description of signs, and reference to sign types.
3. Silk screening: Where specified or permitted, silk screening shall be highest quality, with sharp lines, no sawtooths, or uneven ink coverage.
 - a. Screens shall be photographically reproduced.
 - b. Background ink shall be process inks as recommended by manufacturer of substrate employed.
 - c. Ink application through screens: 1 flood pass and 1 print pass. Images: uniform color and ink thickness; free from squeegee marks and lines.
 - d. Signs: dry in adequate racks with 2 in. spacing for ample air flow and forced air drying and curing.
 - e. Package signs only after they have dried completely per ink manufacturer's time allowances.
 - f. Where reflective messages are specified or permitted to be reverse silk-screened with a non-reflective, opaque background, the sheeting material shall be 3M Scotchlite Engineer Grade Reflective Sheeting Series 3200 or equivalent meeting US Department of Transportation Standard Specification for Construction of Roads and Bridges on Federal Highway Products, 1985 FP-85, Type II, Section 718.01.
 - g. Where reflective messages are specified or permitted to be reverse silk-screened with a reflective, transparent background, the sheeting material shall be 3M Scotchlite High Intensity Grade Sheeting Series 3930 or equivalent meeting US Department of Transportation Standard Specification for Construction of Roads and Bridges on Federal Highway Products, 1985 FP-85, Type IIIA, Section 718.01.
4. Pressure applied graphics:
 - a. Where pressure-applied graphics applied to a painted background are specified or permitted, the paint shall be flat, opaque acrylic polyurethane as recommended by manufacturer of substrate and graphic media.
 - b. Where pressure-applied, reflective graphics on an opaque painted background are specified or permitted, letters shall be digitally produced, and cut by electronic cutting machines from 3M Scotchlite Electrocut Engineer Grade Sheeting Series 3260 material, colors as noted on drawings or equivalent. Edges shall be sealed per manufacturer recommendation.

- c. Where pressure-applied, reflective graphics on a reflective background are specified or permitted, the sheeting material shall be 3930 Hi Intensity Prismatic or equivalent meeting US Department of Transportation Standard Specification for Construction of Roads and Bridges on Federal Highway Products, 1985 FP-85, Type IIIA, Section 718.01. The letters shall be digitally produced and cut by electronic cutting machines from 3M Scotchlite Electronic Cutable Film Series 1170, colors as noted on drawings or equivalent.
 - d. Where pressure-applied, non-reflective graphics are specified, letters shall be digitally produced, and cut by computer-driven processes from 3M Scotchcal Electrocut 7725 film.
 - e. Where electronically cut letters and symbols are specified, the inside corners shall be rounded using the largest radius consistent with acceptable appearance. Minimum radius shall be 1/8 inch on a 3 inch letter. Use prespacing tape as recommended by manufacturer of sheeting as a carrier for letters, numerals and symbols.
- 5. Digital Imaging: Where digital imaging for original art and multicolored graphics are specified.
 - a. Where first surface, reflective graphics are specified, the image shall be electronically produced and electrostatically printed onto the transfer media and then heat transferred onto 3M Scotchlite Plus Sheeting Series 680 using IJ680-10 technology. Image to be protected with 3M recommended graphic protective clear coating. Not to be used for regulatory signs.
 - b. Where first surface non-reflective graphics are required, the image shall be electronically produced and electrostatically printed onto the transfer media and then heat transferred onto 3M Scotchprint flexible reflective graphic film IJ180-10 technology. Image to be protected with 3M recommended graphic protective clear coating.
 - c. Where second surface, non-reflective graphics are required, the image shall be produced using 3M Scotchprint Electronic Graphics System using Scotchcal 7725 marking film and lamination.
- 6. Where specified, dry film transfer shall be produced digitally using computer-driven Dry Thermal Transfer system over 3M high intensity reflective vinyl substrates.
- 7. All products specified to employ 3M sheeting, films, or other components shall be guaranteed and backed by 3M MCS Warranty or equivalent.

B. Inks and Paints:

- 1. All inks and paints shall be a type made for surface material to which it is applied, and recommended by manufacturer. Exact identification shall be noted on shop drawings, with data describing application method, if other than air-drying. Prohibited: paint or ink that will fade, discolor, or delaminate due to UV or heat exposure.
- 2. All colors for which color match specified shall be approved by Engineer/Architect prior to production.

3. Acceptable manufacturers and suppliers of inks for silk-screening shall be only those materials recommended by the manufacturer of the sheeting and as required for 3M MCS warranty, or equivalent, where applicable.
 4. Paints: all materials best quality. Products of DuPont DeNemours & Company, Pittsburgh Plate Glass Company, Glidden, Matthews or Sherwin-Williams acceptable.
 - a. Opaque background for pressure applied graphics: Two-part acrylic polyurethane, low gloss. Care shall be taken to provide proper curing so that outgassing does not occur after application of sheeting and/or graphics.
 - b. Painted graphics on steel doors: Refer to Painting specification section. Ferrous metal paint selection for door base. Graphics paint to be compatible with base paint.
 - c. Base for painted graphics on concrete, stucco, masonry and concrete masonry units to be prepared per Paint specifications. Graphics two-part acrylic polyurethane, low gloss.
 - d. High gloss enamel base: Graphics medium to be determined by installer and approved by Architect/Engineer. Primer may be required.
 5. Applied color whether ink or paint shall conform to color and accelerated weathering requirements of FP-79 and shall not be removable when tested by Film Adhesion Test and by Film Hardness Test.
- C. Blank Panels: Comply with requirements indicated for materials, thickness, finish, color, design, shape, size, and details of construction.
1. General:
 - a. Produce smooth, even, level sign panel surfaces, constructed to remain flat under installed conditions within a tolerance of plus or minus 0.0625 in. measured diagonally.
 - b. The back side and edges of all panel signs shall be painted with acrylic polyurethane, color to match the specified background color.
 - c. Edge Condition: Square cut.
 - d. Corner Condition: Square cut for all signs except Regulatory and Warning signs. Regulatory and Warning sign corners shall be rounded per MUTCD.
 2. Fiberglass reinforced plastic (FRP) panels.
 - a. Panels shall be manufactured of clear resin or UV stabilized, acrylic-modified polyester resin reinforced with high solubility, chopped strand fiberglass mat. Glass fibers shall not be readily discernable on sign face. In addition, sign shall have a glass content of no less than 28% of total sign weight. FRP panels which outgas and cause bubbling of sheeting will not be accepted. Sign shall meet following:
 - 1) Ambient temperature range of -50° F to +300° F.
 - 2) Minimum Barcol hardness of 50, tensile strength of 12,000 psi, compressive strength of 20000 psi and flexural strength of 18000 psi.

- 3) Minimum impact strength of 6 ft lbs/in notch with fire resistance of 500 degree F.

3. Aluminum:

- a. Provide aluminum sheet of 6061-T6 or 5052-H38 alloys and temper recommended by aluminum producer or finisher for use type and finish indicated, and with not less than strength and durability properties specified in ASTM B209 for 5005-H15.
- b. Aluminum extrusions shall be of alloy and temper recommended by aluminum producer for type of use and finish and with not less than strength and durability properties specified in ASTM B221 for 6063-T5.
- c. Panels shall be etched, degreased, flat, and free of ragged edges. Radius corners by stamping. All signs of same size shall be totally uniform in size. Surface shall be completely clear of dust and dirt before finishes applied.
- d. Panels to receive 3M sheeting and/or paint shall be treated with an anodizing conversion coating to provide resistance to corrosion and white rust formation. Conversion coating may be:
 - 1) Chromate, meeting ASTM B449 class 2. Coating weight should be 10 to 35 mg per sq ft with a median of 25 mg per square foot. Coating shall not be dusty and shall be tightly bonded within itself and to the aluminum substrate.
 - 2) Non-chromate coatings must meet the requirements for ASTM B449 class 1 chromate coatings. The non-chrome coating shall be adherent and non-powdery. Adhesion of air dried acrylic coating shall meet ASTM D 3359 or ASTM D 4541 and must be equivalent to that of the coating on chromate coated aluminum of the same alloy.
- e. Fabricate aluminum signs with adequately sized, full-length stiffener members as indicated on Drawings.

4. ACM (Aluminum Composite Material)

- a. Provide aluminum composite material panels, one or both sides platinum white stove-lacquered or one side metallic-aluminum, reverse mill finish.
 - 1) Outer layers are aluminum; inner core is polyethylene.
- b. Provide sign panels with overall thickness in accordance with the following minimums:
 - 1) Wall or Column surface mounted signs: 3mm (0.12").
 - 2) Overhead signs less than 5'-0" long: 4mm (0.15").
 - 3) Overhead signs greater than 5'-0" long: 6mm (0.23").
- c. Product shall be compatible with temperature ranges varying from -50°C to +80°C.
- d. Product shall have a minimum modulus of elasticity of 70,000 N/mm².
- e. Product shall have water absorption in % according to Din 53 495-0, 01.

- f. Product shall have linear thermal expansion dimensional change of 2.4 mm/m at 100k temperature difference.
- D. V- Signs: Vehicular signs with retroreflective graphics and retroreflective message on an opaque background.
 1. Base materials:
 - a. Aluminum with either reverse silk screened graphics or pressure-applied retroreflective letters.
 2. Graphics and Copy: Any of the following methods of producing graphics and copy may be employed.
 - a. Pressure applied retroreflective white letters/symbols. Use 3M High Intensity Prismatic White Sheeting 3930.
 - b. Silk screened; background inks shall be opaque, with retroreflective message.
- E. R- Regulatory and W- Warning vehicular signs with retroreflective graphics and message on a retroreflective background.
 1. All regulatory and warning signs to fully comply with MUTCD standards.
 2. Base material: Aluminum.
 3. R and W signs shall have retroreflective messages and retroreflective background using either silk screening or pressure applied retroreflective letters and symbols.
 4. Retroreflective colors determined by 23 CFR Appendix to Subpart F of Part 655, Alternate Method to Determining the Color of Retro-reflective Sign Materials and pavement marking materials.
 - a. Federal Highway Authority (FHWA) Reflective Sheeting Identification Guide using ASTM D 4956-04.
 - b. Sheeting Types I through IX.
 - c. The daytime color of non-fluorescent retroreflective materials may be measured in accordance with ASTM Method E 1349, Standard Test Method for Reflectance Factor and Color by Spectrophotometry using Bi-directional Geometry of ASTM Test Method E 1347. Standard Test Method for Color and Color-Difference Measurement by Tristimulus Colorimetry.
 - d. The geometric conditions to be used in both test methods are 0/45 or 45/0 circumferential illumination or viewing. The CIE standard illuminant used in computing the colorimetric coordinates shall be D 65.
 - e. For fluorescent retroreflective materials ASTM E991 may be used to determine the chromaticity provided that the D65 illumination meets the requirements for E 991.
 - f. The following 3M Diamond Grade DG³ Reflective Sheeting materials meet the MUTCD retroreflective requirements:
 - 1) White – DG³4090
 - 2) Red - DG³ 4092
 - 3) Blue – DG³ 4095

- 4) Yellow - DG³ 4091
- 5) Green – DG³ 4097
- 6) Brown – DG³ 4099
- 7) Fluorescent Yellow – DG³ 4081
- 8) Fluorescent Yellow Green – DG³ 4083
- 9) Fluorescent Orange - DG³ 4084

F. PP- Pedestrian Panel Wayfinding and Directional Signs.

- 1. Base materials:
 - a. Aluminum with either reverse silk screened graphics or pressure-applied letters and graphics.
- 2. Graphics and Copy: Any of the following methods of producing graphics and copy may be employed:
 - a. Pressure applied non-reflective letters/symbols.
 - b. Silk screened over a flat opaque background.
 - c. Original art and/or multi-color graphics shall be digitally produced on graphic media.

G. PS-Supergraphics, Pedestrian Wayfinding and Directional Signs:

- 1. Painted Super-Graphics: Where graphics painted directly on walls, doors or other surfaces are specified, message template to be:
 - a. Pressure applied electronically cut graphics.
 - b. Adhesive masking paper with digitized characters.
- 2. Apply primer and/or background color as specified on the drawings to surface as required. Sign contractor shall assure that paint employed for graphics is compatible with surface treatment(s) by others, including but not limited to concrete sealers and/or form release agents.

H. PVC- Signs: PVC pipe clearance signs shall have pressure applied decals on black PVC pipe, rectangular retroreflective yellow base sticker 3M Diamond Grade yellow sheeting DG³ 4091 with black border, rounded corners, and black text. See drawings.

- 1. Electronically cut letters: 3M Scotchlite 3840 reflective sheeting.
- 2. 10 in. diameter, Schedule 80 PVC pipe, Corrosion Fluid Products Corporation, Addison, IL, or accepted equivalent. Color black.
- 3. If black PVC is not available, Paint: "Spraylat" Lacryl B No. 482 High Hiding Black. Meet Lacryl system specifications for painting on PVC.

I. VR- Signs: Vandal-resistant signs where specified, shall have copy and graphics on second surface.

- 1. Base material shall be one of the following:

- a. "Lexan" General Electric Co., or accepted equivalent. Permanently laminate face panels to backing sheets of material and thickness indicated using manufacturer's standard process. Except where digital art is required, signs shall be silk screened on second surface or single sheet.
 - b. "Modulite/Moducal" by Pannier Graphics or equivalent fiberglass reinforced plastic (FRP) material. Copy and graphics shall be permanently embedded in fiberglass panel. Resulting sign shall be a solid, one-piece panel with graphic elements inseparable from fiberglass in which they are embedded. Laminated or encapsulated products will not be accepted.
 2. Sign shall not be permanently defaced by steam, acids, aromatics, scratching, inks or paints and should be capable of being readily wiped clean with paint remover without affecting appearance or legibility of graphics. Sign shall retain legibility and finished appearance when sprayed with a 10% solution of hydrochloric, nitric or sulfuric acid for one-half hour or when scrubbed by a brush of medium hardness using common commercial cleaning compounds such as ammonia, laundry soaps, detergents, carbon tetrachloride or petroleum based solvents.
 3. Sign shall be translucent with a clear or matte finish, as indicated. The index of refraction shall ensure clarity of color, copy and graphics.
 4. Sign shall be router cut with sign edges not crazed or cracked and edge finish shall be smooth, neat and clean.
 5. Original art and/or multi-colored graphics shall be digitally produced, electronic media.
 6. Use colored coatings, including inks and paints for copy and background colors, recommended by manufacturer of sheet for optimum adherence to sheet surface and that are non-fading for application.
 7. Fasteners shall be mechanical, concealed and tamper proof.
- J. A- Signs: All signs required to be brailled in compliance with ADA requirements for designating permanent rooms and spaces shall comply with ADA Accessibility Guidelines (ADAAG) as published by the Architectural and Transportation Barriers Compliance Board and ICC/ANSI A117.1. latest editions.
1. Aluminum:
 - a. Text to be produced with Supersine process die-cut raised letters and brailled copy.
 2. Phenolic-Backed Photopolymer Sheet, "Jet-388 Phenolic Signage" by Jet USA or equivalent. Provide light sensitive, water-wash photopolymer face layer bonded to a phenolic base layer to produce composite sheet with overall thickness of 0.15 inches, and substrate thickness of 0.12 inches and a Type D Shore Durometer hardness of 95.
 3. Lettering and Grade II brailled to be raised 1/32". Lettering to be painted white matte finish. Grade II brailled to be painted out with matte finish background in color shown on drawings. Edges painted same as face.
 4. Produce precisely formed characters with square cut edges free from burrs and cut marks.
 5. Fasteners shall be mechanical, concealed and tamper proof.

K. Dimensional Characters (D-Signs):

1. Aluminum Castings: Provide aluminum castings of alloy and temper recommended by sign manufacturer for casting process used and for type of use and finish indicated. Finish shall be color anodic finish, integrally colored or electrolytically deposited color coating, 0.018 mm or thicker in color specified on schedule, with a satin mechanical finish.
2. Characters shall have smooth flat faces, sharp corners and precisely formed lines and profiles, free from pits scale, sand holes and other defects. Cast lugs into back of characters and tap to receive threaded mounting studs.

L. Illuminated Traffic Controller Signs (TC- Signs):

1. Illuminated traffic control signs shall be Signal Tech LED controller or equivalent. Traffic arrows shall be TCL1212 series; open/closed or full messages shall be TCL718 series.
2. Display technology shall be super bright LED using aluminum gallium indium phosphide (ALGaInP) diodes. Viewing angle shall be 70°.
3. Provide for automatic control from PARCS system computer with individual manual override operator control switches located in parking office. In addition, provide additional manual override switches in cashier booth nearest lane controlled.

M. Internally Illuminated Signs (I Signs):

1. Sign design, construction fabrication and assembly shall be contractor responsibility, subject to Engineer's review. ACM or aluminum cabinets are acceptable. All aluminum to be anodized or painted with a premium acrylic polyurethane. Colors shall be as specified on drawings.
2. Aluminum panels, when proposed, to be extruded, anodized aluminum with welded corners and aluminum tube framing as required for straight profiles. Case shall be finished with baked enamel or duranodic in color as shown on the drawings. Illuminated messages, where required, shall be precision cut and filled with translucent material. Illuminated graphics shall be integral and flush with sign face for flat appearance. Raised letters or those projecting beyond sign face will not be accepted.
3. ACM panels, where proposed shall be assembled into final configurations following the manufacturer's recommendations for cutting, drilling, punching, joining, etc. Acceptable joining materials for connecting panels are aluminum, plastic or stainless steel. All other joining materials are prohibited. ACM panels may be fastened using threaded fasteners, rivets or adhesives as recommended by the manufacturer. All final assemblies shall accommodate thermal expansion movements as recommended by the manufacturer. The final assembly shall be supported as required by aluminum framework. Illuminated messages, where required, shall be precision cut and filled with translucent material. Illuminated graphics shall be integral and flush with sign face for flat appearance. Raised letters or those projecting beyond sign face will not be accepted.
4. Fiberglass panels, where proposed, shall be 3/16 inches with integral molded side returns mounted to an aluminum casing supported by aluminum framework. Posts to match specified cabinet color. Illuminated message shall be subsurface printed, and integral with sign face. Illuminated single color messages without original art

may be translucent. Multi-color messages or signs with original art shall be digitally produced using 3M Electronic Graphics system and Scotchcal marking films. Provide matte UV and vandal resistant overcoat.

5. Non-illuminated messages, where specified, shall employ pressure applied non-reflective letters/symbols. any of the following methods:
6. Pressure applied non-reflective letters/symbols.
7. Silk screened.
8. Digitally produced graphic media.
9. Full message where shown shall be white **LED** letters. Full message shall not be readable when turned off. Full message shall be controlled by PARC system.
10. No buckling, weaving, or oil canning of face panels.
11. Sign mounting shall be as noted as drawings from among following:
 - a. Wall or ceiling mount: Provide mounting channel brackets as required by sign size and location.
 - b. Post mount: Sign to be mounted on aluminum posts at both ends, with base plate bolted to concrete foundation to below local frost depth or a minimum of 1/3 the pole height which ever is greater. Coordinate anchor bolt locations with general contractor.
 - c. Concrete pedestal mount. Sign to be mounted on concrete pedestal as detailed on drawings. Coordinate anchor bolt, post sleeves and concealed electrical connections with pedestal contractor.
 - d. Aluminum pedestal mount: Provide aluminum pedestal cover per drawings. Coordinate anchor bolt, post sleeves and concealed electrical connections with pedestal contractor.
12. All fasteners and brackets shall be non-corrosive.
13. All electrical connections shall be concealed but accessible and serviceable.
14. Interior of cabinet to be primed and painted white with acrylic polyurethane, high gloss finish.
15. Illumination shall be designed by contractor. Incandescent light sources will not be accepted. Each sign shall contain terminal board with adequate wiring. Lamps to be spaced to prevent shadows and hot spots. Uneven illumination will be rejected. Ballast shall be appropriate to temperature ranges at project site. Minimum luminance of sign message shall be 10 cd/m² at night and 30 cd/m² during the day.

N. Fasteners and Supports:

1. Bolts, nylon insert lock nuts: ASTM A 320, Grade B stainless steel.
2. Rivets for signs: ASTM B 316, Alloy 6063-T61 or equivalent. Aluminum alloy blind rivets of self-plugging variety may be substituted for solid aluminum alloy rivets, subject to acceptance by Engineer/Architect.
3. Use concealed fasteners fabricated from metals not corrosive to sign material and mounting surface.
4. Anchors and Inserts: Use nonferrous metal or hot dipped galvanized anchors and inserts for exterior installations and elsewhere as required for corrosion resistance. Use toothed steel or lead expansion bolt devices for drilled in place anchors. Furnish inserts, as required, to be set into concrete or masonry work.
5. Sign posts: ASTM A 499 Grade 60 or ASTM A 576, Grade 1080 and meeting mechanical properties specified in ASTM A 499 for Grade 60 steel.

6. Posts shall be zinc coated per ASTM A 123. Posts shall be straight, with smooth, uniform finish, free from defects affecting strength, durability, or appearance. Punch bolt holes such that post face shall be smooth and even. All holes and ends shall be burr free. After all fabrication, flow coat posts with durable, exterior type, rust inhibiting paint. Paint color: black, unless otherwise indicated on drawings.
7. Adhesives, where used for wall mounted signs, shall be Loctite PL Premium Construction Adhesive with a bond strength of >100 lbs. per 2 square feet, or approved equal. Adhesive application install temperature shall be between 42°F to 94°F. Adhesive properties shall be, but not limited to the following: Low VOC, waterproof, paintable, non-flammable and Greenguard certified. Allow 24 hours for adhesive to cure or per the sign material manufacturer's recommendations.
8. For ACM signs, fasteners and mountings shall follow manufacturer's recommendations. Minimum edge distance of 0.75" or 2.5 times the diameter of the fastener being used is recommended as the distance from the center of the hole to the edge of the panel. Large flat washers shall be used to prevent crushing of the sign material.

O. Cantilever Sign Supports:

1. Pipe for poles and arms: steel pipe, ASTM A53, Grade B, Type E or S.
2. Gusset, flange, and base plates: ASTM A 36.
3. Castings: Free of sharp edges and irregularities. Pole top and end cap castings: ASTM A 126, Class A.
4. Bolts: Connect arm connection flanges with galvanized high strength steel bolts, nuts, and washers per ASTM A 325. Hot dip galvanized fasteners per ASTM A 153. Galvanized nuts shall be tapped oversized per ASTM A 563, and Supplementary requirement S1, "Lubricant and Test for Coated Nuts."
5. Welding: Applicable requirements of Sections of Division 05.

PART 3 - EXECUTION

3.1 SURFACE PREPARATION OF SUBSTRATE FOR PAINTED SIGNS

- A. Prepare and clean in strict accordance with paint manufacturer's instructions and as specified here, for each substrate condition.
- B. Clean surfaces to be painted before applying paint or surface treatments. Remove oil and grease prior to mechanical cleaning. Program cleaning and painting so contaminants from cleaning process will not fall onto wet, newly painted surfaces.
- C. Cementitious Surfaces:
 1. Prepare surfaces to be painted by removing all efflorescence, chalk, dust, dirt, grease, oils, and, by roughening as required, glaze.
 2. Determine alkalinity and moisture content of surfaces to be painted by appropriate testing. If surfaces found to be sufficiently alkaline to cause blistering and burring of finish paint, correct before painting. Do not paint on surfaces with moisture content exceeds manufacturer's limits.

- D. Ferrous Metals: Clean uncoated ferrous surfaces of oil, grease, dirt, loose mill scale, and other foreign substances by solvent or mechanical cleaning. Clean previously coated metals in accordance with manufacturer recommendation.

3.2 MATERIALS PREPARATION FOR PAINTED SIGNS

- A. Mix and prepare painting materials per manufacturer's directions.
- B. Store materials not in use in tightly covered containers. Keep all containers clean, free of foreign materials and residue.
- C. Stir materials before applying to produce uniform mixture, and stir as required during application. Do not stir surface film into material. Remove film and strain material before using if necessary.

3.3 INSTALLATION

- A. General: Locate signs where shown using mounting methods of type described and in compliance with manufacturer's instructions. Install sign units level, plumb, and at height shown, with sign surfaces free from appearance defects.
- B. For drilled anchors in concrete, verify location of embedded reinforcing steel, post-tensioning, or pre-stressing cables prior to installation.
- C. Wall Mounted Panel Signs: Attach to wall surfaces with Hilti "Hit" anchors or ITW Ramset/Red Head Hammer Set anchors into concrete or masonry surfaces as shown on Drawings. DO NOT OVERDRIVE anchors, as overdriven anchors will damage sign faces and spall concrete.
- D. Bracket Mounted Units: Provide manufacturer's standard brackets, fittings, and hardware as appropriate for mounting signs which project at right angles from walls or ceilings. Attach brackets securely to walls or ceilings with concealed fasteners and anchors per manufacturer's directions.
- E. Installation of signs shall conform to requirements of Americans with Disabilities Act (ADA) and/or state or local accessibility standards.

3.4 CLEANING AND PROTECTION

- A. At completion of installation, clean soiled sign surfaces in accordance with manufacturer's instructions. Protect units from damage until acceptance by **City**.
- B. Cleanup: During progress of Work, remove from site all discarded materials and rubbish at end of each day.

- C. Upon completion of painting, clean all paint spattered surfaces. Remove spattered paint by proper methods of washing and scraping, using care not to scratch or otherwise damage finished surfaces.
- D. Protection: Protect work of other trades, whether to be painted or not, against damage by painting and finishing. Correct any damage by cleaning, repairing, or replacing, and repainting, as acceptable to Engineer/Architect.
- E. Provide "Wet Paint" signs as required.

END OF SECTION 10 14 00

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SECTION 10 44 13 - FIRE PROTECTION CABINETS

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Fire-protection cabinets for the following:
 - a. Portable fire extinguishers.
- B. Related Requirements:
 - 1. Division 10, Section "Fire Extinguishers."

1.3 UNIT PRICES

- A. Work of this Section is affected by unit price.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product. Show door hardware, cabinet type, trim style, and panel style. Include roughing-in dimensions and details showing recessed-, semirecessed-, or surface-mounting method and relationships of box and trim to surrounding construction.
- B. Shop Drawings: For fire-protection cabinets. Include plans, elevations, sections, details, and attachments to other work.
- C. Samples for Initial Selection: For each type of exposed finish required.
- D. Product Schedule: For fire-protection cabinets. Indicate whether recessed, semirecessed, or surface mounted. Coordinate final fire-protection cabinet schedule with fire-extinguisher schedule to ensure proper fit and function.
- E. CLOSEOUT SUBMITTALS
- F. Maintenance Data: For fire-protection cabinets to include in maintenance manuals.

1.5 COORDINATION

- A. Coordinate size of fire-protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.

1.6 SEQUENCING

- A. Apply decals or vinyl lettering on field-painted fire-protection cabinets after painting is complete.

PART 2 - PRODUCTS

2.1 FIRE-PROTECTION CABINET

- A. Cabinet Type: Suitable for fire extinguisher.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. American Specialties, Inc.
 - b. Fire-End & Croker Corporation.
 - c. GMR International Equipment Corporation.
 - d. Guardian Fire Equipment, Inc.
 - e. JL Industries, Inc.; a division of the Activar Construction Products Group.
 - f. Kidde Residential and Commercial Division.
 - g. Larsens Manufacturing Company.
 - h. Modern Metal Products, Division of Technico Inc.
 - i. MOON American.
 - j. Nystrom, Inc.
 - k. Potter Roemer LLC.
 - l. Strike First Corporation of America.
- B. Door Material: Steel sheet or Aluminum sheet.
- C. Door Style: Center glass panel with frame.
- D. Door Glazing: Wire glass.
- E. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.
 - 1. Provide manufacturer's standard.
 - 2. Provide manufacturer's standard hinge permitting door to open 180 degrees.
- F. Accessories:

1. Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to fire-protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
2. Lettered Door Handle: One-piece, cast-iron door handle with the word "FIRE" embossed into face.
3. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location.
 - a. Identify fire extinguisher in fire-protection cabinet with the words "**FIRE EXTINGUISHER**".
 - 1) Location: Applied to location indicated on Drawings.
 - 2) Application Process: Silk-screened or Decals or Pressure-sensitive vinyl letters.
 - 3) Lettering Color: Black.
 - 4) Orientation: Vertical.
4. Alarm: Manufacturer's standard alarm that actuates when fire-protection cabinet door is opened and that is powered by low voltage, complete with transformer.

G. Materials:

1. Cold-Rolled Steel: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B.
 - a. Finish: Baked enamel or powder coat.
 - b. Color: Red.
2. Aluminum: ASTM B 221 (ASTM B 221M), with strength and durability characteristics of not less than Alloy 6063-T5 for aluminum sheet. ASTM B 221 (ASTM B 221M) for extruded shapes.
 - a. Finish: Clear anodic Baked enamel or powder coat.
 - b. Color: As selected by Architect from full range of industry colors and color densities.
3. Tempered Float Glass: ASTM C 1048, Kind FT, Condition A, Type I, Quality q3, 3 mm thick, Class 1 (clear)

2.2 FABRICATION

- A. Fire-Protection Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.
 1. Weld joints and grind smooth.
 2. Provide factory-drilled mounting holes.
 3. Prepare doors and frames to receive locks.
 4. Install door locks at factory.

- B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles.
 - 1. Fabricate door frames with tubular stiles and rails and hollow-metal design, minimum 1/2 inch (13 mm) thick.
 - 2. Miter and weld perimeter door frames.
- C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

2.3 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's AMP 500, "Metal Finishes Manual for Architectural and Metal Products," for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces of fire-protection cabinets from damage by applying a strippable, temporary protective covering before shipping.
- C. Finish fire-protection cabinets after assembly.
- D. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Install fire-protection cabinets in locations and at mounting heights indicated or, if not indicated, at heights acceptable to authorities having jurisdiction.
- B. Fire-Protection Cabinets: Fasten cabinets to structure, square and plumb.
 - 1. Fasten mounting brackets to inside surface of fire-protection cabinets, square and plumb.
- C. Identification: Apply decals or vinyl lettering at locations indicated.

3.2 ADJUSTING AND CLEANING

- A. Remove temporary protective coverings and strippable films, if any, as fire-protection cabinets are installed unless otherwise indicated in manufacturer's written installation instructions.
- B. Adjust fire-protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.

- C. On completion of fire-protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.
- D. Touch up marred finishes, or replace fire-protection cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by fire-protection cabinet and mounting bracket manufacturers.
- E. Replace fire-protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 10 44 13

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SECTION 10 44 16 - FIRE EXTINGUISHERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes portable, hand carried fire extinguishers.
- B. Related Requirements:
 - 1. Division 10, Section "Fire Protection Cabinets."

1.3 UNIT PRICES

- A. Work of this Section is affected by unit price.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include rating and classification, material descriptions, dimensions of individual components and profiles, and finishes for fire extinguisher.
- B. Product Schedule: For fire extinguishers. Coordinate final fire-extinguisher schedule with fire-protection cabinet schedule to ensure proper fit and function.
- C. INFORMATIONAL SUBMITTALS
- D. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fire extinguishers to include in maintenance manuals.

1.6 COORDINATION

- A. Coordinate type and capacity of fire extinguishers with fire-protection cabinets to ensure fit and function.

1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Failure of hydrostatic test according to NFPA 10.
 - b. Faulty operation of valves or release levers.
 - 2. Warranty Period: Six years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."
- B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.
 - 1. Provide fire extinguishers approved, listed, and labeled by FM Global.

2.2 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

- A. Fire Extinguishers: Type, size, and capacity for each fire-protection cabinet indicated.
 - 1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
 - a. Amerex Corporation.
 - b. Ansul Incorporated; Tyco International.
 - c. Badger Fire Protection.
 - d. Buckeye Fire Equipment Company.
 - e. Fire End & Croker Corporation.
 - f. Guardian Fire Equipment, Inc.
 - g. JL Industries, Inc.; a division of the Activar Construction Products Group.
 - h. Kidde Residential and Commercial Division.
 - i. Larsens Manufacturing Company.
 - j. MOON American.
 - k. Nystrom, Inc.
 - l. Pem All Fire Extinguisher Corp.; Pem Systems, Inc.
 - m. Potter Roemer LLC.
 - n. Pyro-Chem; Tyco Fire Suppression & Building Products.
 - o. Strike First Corporation of America.

2. Valves: Manufacturer's standard.
 3. Handles and Levers: Manufacturer's standard.
 4. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B[, and bar coding for documenting fire-extinguisher location, inspections, maintenance, and recharging.
- B. Multipurpose Dry-Chemical Type 2-AC: UL-rated 5lb nominal capacity, with monoammonium phosphate-based dry chemical in manufacturer's standard enameled container.
- C. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Architect.
1. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.
 - a. Orientation: Vertical.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine fire extinguishers for proper charging and tagging.
1. Remove and replace damaged, defective, or undercharged fire extinguishers.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install fire extinguishers in locations indicated and in compliance with requirements of authorities having jurisdiction.

END OF SECTION 10 44 16

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SECTION 101455

TRAFFIC AND REGULATORY SIGNAGE (SITE)

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This Section specifies requirements for site traffic and regulatory signs and supports.
- B. The work includes:
 - 1. The furnishing and installation of new signs and sign supports.
 - 2. The removal of existing signs.
 - 3. New signs and sign supports in public roadways under the jurisdiction of the City of New Rochelle Department of Public Works. The signs and supports shall conform to the requirements of the latest edition of the National Manual of Uniform Traffic Control Devices and the New York Supplement, NYSDOT Standard Sheets 685-01 sheets 1 through 9, and NYSDOT Approved List for Materials and Standard Specification, subsection 730-24 and installation shall conform to NYSDOT Standard Sheet 654-03.

1.2 SUBMITTALS

- A. Shop Drawings:
 - 1. Shop drawings of all signs and supports. Do not order material or begin fabrication until Engineer's approval has been obtained.
 - 2. Show sizes and thicknesses of all members, types of materials, methods of construction and assembly, type of surface treatment, complete dimensions, hangers, brackets, anchorage, fasteners, relationship to surrounding work by other trades, shop finishes, sign designs, layouts, and lettering, and other pertinent details of fabrication and installation.

1.3 QUALITY ASSURANCE

- A. The manufacturer shall have experience in the type of work required and a reputation for producing satisfactory work on time.
- B. Deliver and store in a manner that prevents cracking, chipping, stress of the components, and damage.

PART 2 - PRODUCTS

2.1 ALUMINUM SIGN PANELS

- A. Aluminum Sign Panel: Fabricated from flat aluminum sheeting, ASTM B209, Alloy 6061-T6 or Alloy 5052-H38, of the following thickness and mounting, unless otherwise specified:

Area of Sign (square feet)	Mounting	Thickness (Inches)
Less than or equal to 10	Single Post	0.080
Between 10 and 20	Two Posts	0.080
Between 20 and 25	Single Post (Top Mounted)	0.250

- B. Sign supporting hardware shall be aluminum or stainless steel.

2.2 REFLECTIVE SHEETING

- A. Reflective sheeting shall meet the requirements of AASHTO M 268.

1. Panel sheeting shall be Type II (Engineering Grade).
2. Legend sheeting shall be Type III (High Intensity).

- B. Reflective sheeting shall be applied to properly treated base panels with mechanical equipment in a manner specified for the manufacture of traffic control signs by the sheeting manufacturer. Heat activated adhesive coating sheeting shall be pre-perforated.

1. No splices shall be allowed on sign panels.

- C. When pressure sensitive adhesive coating reflective sheeting is used all sheeting splices and sign edges shall be sealed with materials recommended by and in a manner specified by the sheeting manufacturer.

1. Dry heat activated adhesive coated reflective sheeting when applied to aluminum shall be edge sealed as specified by the sheeting manufacturer.

- D. Reflective sheeting shall be applied to properly treated base panels with mechanical equipment in a manner specified by the sheeting manufacturer.

- E. The numerals shall be black, die-cut, pre-spaced, conforming to the detail on the Drawings. Numerals shall have a pre-coated, pressure-activated adhesive applied as recommended by the manufacturer of the reflective sheeting or be opaque black permanent inks applied on approved high intensity sheeting.

- F. Treatment of Aluminum Sign Panels Prior to Application of Reflective Sheeting.

1. Degreasing:
 - a. Vapor degreasing: By total immersion of the panel in a saturated vapor or trichloroethylene. Trademark printing shall be removed with lacquer thinner or controlled alkaline cleaning system.
 - b. Alkaline degreasing: By total immersion of the panel in a tank containing alkaline solutions, controlled and titrated to the solution manufacturer's specification.

2. Rinsing: After satisfactory degreasing, the panels shall be thoroughly washed with running water.
3. Drying: The panel shall be thoroughly dried by use of a forced hot air dryer.
4. Metal shall not be handled between cleaning and etching operation and the application of reflective sheeting, except with devices or clean canvas gloves.
5. Metal shall not come in contact with greases, oils, or other contaminants prior to the application of reflective sheeting.

2.3 LEGENDS

A. Permanently Applied Legends:

1. Permanently applied legends shall be reflective or opaque sheeting applied directly to clean, dust-free background in a manner specified by the sheeting manufacturer.
2. Heat activated adhesive-coated material shall be applied only by mechanical means.
3. Finishes shall be as recommended by and applied in the manner specified by the sheeting manufacturer.
4. Legends shall be neatly cut.

B. Silk Screen Processed:

1. The legends shall be of the series and size specified in the AASHTO Manual for "Signing and Pavement Markings" (current edition), and the dimension and details of the letters in to each series shall be as specified in the U.S. Department of Transportation FHWA publication "Standard Alphabets for Highway Signs and Pavement Markings" (current edition), or as shown on the Drawings.

2.4 FASTENERS AND ANCHORS

- ### A.
- The sign fabricator shall design a complete system of fastenings and anchorage devices for the various signs, as required for attachment to the various supporting structures. These may include concealed clip systems, face screws and epoxy adhesives. Wherever reasonably possible, fastenings and anchorage devices shall be fully concealed and shall be vandal proof. The Contractor shall provide safe and secure installations in strict conformance to the governing laws and building code.

2.5 SIGN SUPPORTS

- ### A.
- On-site sign supports shall be 2½ inch diameter galvanized steel post.
- ### B.
- For signs within the right-of-way, all signs shall be installed on Type A Breakaway sign posts Item 645.81. Type A sign supports shall conform to they NYSDOT approved list for materials and standard specification, subsection 730-24, breakaway supports for roadway signs. The installation shall conform to NYSDOT standard sheet 654-03.

PART 3 - EXECUTION

3.1 PROTECTION AND TEMPORARY COVERS

- A. Completed sign panels shall be protected and maintained in good condition, free from dirt, scratches, hand marks or other blemishes. The panels shall be transported in a manner that prevents damage.
- B. Subsequent to erection, if required by the Engineer, exterior signs shall be covered until the actual use is desired. Material used to temporarily cover any sign panel shall effectively conceal the message, be non-injurious to the panel, its finish, its structural integrity, and shall be of sufficient durability for the time period required.

3.2 INSTALLATION

- A. Erection of all signs shall be performed by experienced sign erectors. Signs shall be installed true, plumb, and level, located where shown on the Drawings or as required by the Engineer. No field cutting of any sign work will be allowed. Exercise extreme care in all handling and stacking of signs to avoid chipping.
- B. All work shall be rigidly anchored to the supporting construction in accordance with the approved shop drawings.

3.3 CLEAN-UP

- A. Surfaces of signs shall be cleaned as recommended by the sign manufacturer after installation.
- B. All defective work shall be removed and replaced with work conforming to the specified requirements.

3.4 ERECTION OF POSTS

- A. Posts shall be installed as shown on the drawings.
- B. Posts shall be supported in a concrete base as detailed in the drawings.
- C. Posts specifically indicated on the drawings to be driven, shall be driven a minimum of three feet into firm ground.
- D. The height of signs above ground surfaces shall meet Americans with Disabilities Act (ADA) requirements.

END OF SECTION

SECTION 14 21 01 - ELECTRIC TRACTION ELEVATORS MACHINE ROOM-LESS (MRL)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes electric traction service/hospital configuration elevator.
- B. Related Sections include the following:
 - 1. Division 03 Section "Cast-in-Place Concrete" for setting sleeves, inserts, and anchoring devices in concrete.
 - 2. Division 04 Section "Unit Masonry" for setting sleeves, inserts, and anchoring devices in masonry and for grouting elevator entrance frames installed in masonry walls.
 - 3. Division 05 Section "Metal Fabrications" for the following:
 - a. Attachment plates and angle brackets for supporting guide-rail brackets.
 - b. Machine beams.
 - c. Weld plates for anchoring elevator machine to machine room floor slab.
 - d. Divider beams.
 - e. Hoist beams.
 - f. Structural-steel shapes for subsills.
 - g. Pit ladders.
 - h. Cants in hoistways made from steel sheet.
 - 4. Division 28 for security access system equipment used to restrict elevator use.
 - 5. Division 28 for smoke detectors in elevator lobbies to initiate emergency recall operation[and heat detectors in shafts and machine rooms to disconnect power from elevator equipment before sprinkler activation and for connection to elevator controllers.
 - 6. Division 26 Sections for electrical service for elevators to and including fused disconnect switches at machine room door or in control space and standby power source, transfer switch, and connection from auxiliary contacts in transfer switch to controller.

1.3 DEFINITIONS

- A. Definitions in ASME A17.1 apply to work of this Section.

- B. Defective Elevator Work: Repeated operation or control system failure, including excessive malfunctions; performances below specified ratings; excessive wear; unusual deterioration or aging of materials or finishes; unsafe conditions; need for excessive maintenance; abnormal noise or vibration; and similar unusual, unexpected, and unsatisfactory conditions.
- C. Service Elevator: A passenger elevator that is also used to carry freight.

1.4 SUBMITTALS

- A. Product Data: Include capacities, sizes, performances, operations, safety features, finishes, and similar information. Include product data for the following:
 - 1. Car enclosures and hoistway entrances.
 - 2. Operation, control, and signal systems.
- B. Shop Drawings: Show plans, elevations, sections, and large-scale details indicating service at each landing, machine room layout, coordination with building structure, relationships with other construction, and locations of equipment and signals. Include large-scale layout of car control station and standby power operation control panel. Indicate variations from specified requirements, maximum dynamic and static loads imposed on building structure at points of support, and maximum and average power demands.
- C. Samples for Initial Selection: For finishes involving color selection.
- D. Samples for Verification: For exposed finishes of cars, hoistway doors and frames, and signal equipment; 3-inch- (75-mm-) square Samples of sheet materials; and 4-inch (100-mm) lengths of running trim members.
- E. Manufacturer Certificates: Signed by elevator manufacturer certifying that hoistway, pit, and machine room layout and dimensions, as shown on Drawings, and electrical service, as shown and specified, are adequate for elevator system being provided.
- F. Qualification Data: For Installer.
- G. Operation and Maintenance Data: For elevators to include in emergency, operation, and maintenance manuals.
- H. Inspection and Acceptance Certificates and Operating Permits: As required by authorities having jurisdiction for normal, unrestricted elevator use.
- I. Warranty: Special warranty specified in this Section.
- J. Continuing Maintenance Proposal: Service agreement specified in this Section.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Elevator manufacturer or manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
- B. Source Limitations: Obtain elevators, through one source from a single manufacturer.
 - 1. Provide major elevator components, including driving machines, controllers, signal fixtures, door operators, car frames, cabs, and entrances, manufactured by a single manufacturer.
- C. Regulatory Requirements: Comply with ASME A17.1 and elevator design requirements for earthquake loads in ASCE 7.
 - 1. Effective peak velocity acceleration (A_v) for Project's location is greater than or equal to 0.10, but less than 0.20 (seismic risk zone 2)
 - 2. Provide earthquake equipment required by ASME A17.1.
 - 3. Design earthquake spectral response acceleration, short period (sds) for Project is 0.251.
 - 4. Project's seismic design category is B.
 - 5. Elevator importance factor is 1.0.
- D. Accessibility Requirements: Comply with Section [4.10 in the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)."] [407 in ICC A117.1.]
- E. Fire-Rated Hoistway Entrance Assemblies: Door and frame assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing at as close to neutral pressure as possible according to [NFPA 252] [UBC Standard 7-2] [or] [UL 10B].

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle materials, components, and equipment in manufacturer's protective packaging.
- B. Store materials, components, and equipment off of ground, under cover, and in a dry location. Handle according to manufacturer's written recommendations to prevent damage, deterioration, or soiling.

1.7 COORDINATION

- A. Coordinate installation of sleeves, block outs, elevator equipment with integral anchors, and other items that are embedded in concrete or masonry for elevator equipment. Furnish templates, sleeves, elevator equipment with integral anchors, and installation instructions and deliver to Project site in time for installation.

- B. Coordinate sequence of elevator installation with other work to avoid delaying the Work.
- C. Coordinate locations and dimensions of other work relating to electric traction elevators including pit ladders, sumps, and floor drains in pits; entrance subsills; machine beams; and electrical service, electrical outlets, lights, and switches in pits and machine rooms, control space, hoistways.

1.8 WARRANTY

- A. Special Manufacturer's Warranty: Manufacturer's standard form in which manufacturer agrees to repair, restore, or replace defective elevator work within specified warranty period.
 - 1. Warranty Period: One year from date of Substantial Completion.

1.9 MAINTENANCE SERVICE

- A. Initial Maintenance Service: Beginning at Substantial Completion, provide one year's full maintenance service by skilled employees of elevator Installer. Include monthly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper elevator operation at rated speed and capacity. Provide parts and supplies same as those used in the manufacture and installation of original equipment.
 - 1. Perform maintenance, including emergency callback service, during normal working hours.
 - 2. Include 24-hour-per-day, 7-day-per-week emergency callback service.
 - a. Response Time: Two hours or less.
- B. Continuing Maintenance Proposal: Provide a continuing maintenance proposal from Installer to **City**, in the form of a standard two-year and five-year maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Product: The design for electric traction elevators is based on Otis Elevator Co. Elevator model Gen2 (G2S 4000H). Subject to compliance with requirements, provide the named product or a comparable product by one of the following:
 - 1. Otis Elevator Co.
 - 2. Schindler Elevator Corp.

3. ThyssenKrupp Elevator.
4. Kone Elevator

2.2 SYSTEMS AND COMPONENTS

- A. General: Provide manufacturer's standard elevator systems. Where components are not otherwise indicated, provide standard components published by manufacturer as included in standard pre-engineered elevator systems and as required for complete system.
- B. Elevator Machines: Provide variable-voltage, variable-frequency, ac-type hoisting machines. Provide solid-state power converters.
 1. Provide regenerative or non-regenerative system.
 2. Limit total harmonic distortion of regenerated power to 5 percent per IEEE 519.
 3. Provide line filters or chokes to prevent electrical peaks or spikes from feeding back into building power system.
- C. Fluid for Oil Buffers: If oil buffers are used, use only fire-resistant hydraulic fluid containing antioxidant, anticorrosive, antifoaming, and metal-passivating additives.
- D. Inserts: Furnish required concrete and masonry inserts and similar anchorage devices for installing guide rails, machinery, and other components of elevator work where installation of devices is specified in another Section.
- E. Machine Beams: Provide framing to support elevator hoisting machine and deflector sheaves from the building structure. Comply with Division 05 Section "Metal Fabrications" for materials and fabrication.
- F. Car Frame and Platform: Bolted or welded steel units.
- G. Guides: Provide roller guides or polymer-coated, non-lubricated sliding guides at top and bottom of car and counterweight frames.

2.3 OPERATION SYSTEMS

- A. General: Provide manufacturer's standard microprocessor operation system for the elevator as required to provide type of operation system indicated.
 1. Loss of Power: On loss of power, if car is at a floor, it remains at that floor, opens its doors, and shuts down. If car is between floors, it is lowered to the next floor below, cycles its doors, and shuts down with its doors closed. Elevator Supplier to provide backup power to facilitate this function.
 2. Automatic Dispatching of Loaded Car: When car load exceeds 80 percent of rated capacity, doors will begin closing.
 3. Nuisance Call Cancel: When car calls exceed a preset number while the car load is less than a predetermined weight, all car calls are canceled after the car makes one run. Number of calls and predetermined weight can be adjusted.

- B. Security Features: Provide the following security features, where indicated. Security features shall not affect emergency firefighters' service.
1. Keyswitch Operation: Push buttons are activated and deactivated by security keyswitches at car control stations and hall push-button stations. Key is removable only in deactivated position.
 2. Car-to-Lobby Feature: Feature, activated by keyswitch at main lobby that causes car to return immediately to lobby and open doors for inspection. On deactivation, by keyswitch, calls registered before keyswitch activation is completed and normal operation is resumed.

2.4 DOOR REOPENING DEVICES

- A. Infrared Array: Provide door reopening devices with uniform array of 40 or more microprocessor-controlled, infrared light beams projecting across car entrance. Interruption of one or more of the light beams shall cause doors to stop and reopen.
- B. Nudging Feature: After car doors are prevented from closing for predetermined adjustable time, through activating door reopening device, a loud buzzer shall sound. Doors shall begin to close at reduced kinetic energy when the re-opening device is deactivated.

2.5 FINISH MATERIALS

- A. General: Provide the following materials for exposed parts of elevator car enclosures, car doors, hoistway entrance doors and frames, and signal equipment as indicated.
- B. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, commercial steel, Type B, exposed, matte finish.
- C. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, commercial steel, Type B, pickled.
- D. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 301.
1. Textured Stainless-Steel Sheet: Product with embossed texture rolled into exposed surface.
 - a. Product: Subject to compliance with requirements, provide Stainless steel doors, jambs and interior walls.
 - b. Metal surface is **satin relieved** after rolling.
- E. Stainless-Steel Bars: ASTM A 276, Type 301.
- F. Stainless-Steel Tubing: ASTM A 554, Grade MT 301.
- G. Bronze Plate and Sheet: ASTM B 36/B 36M, Alloy UNS No. C28000 (muntz metal).
- H. Bronze Extrusions: ASTM B 455, Alloy UNS No. C38500 (architectural bronze).

- I. Bronze Tubing: ASTM B 135 (ASTM B 135M), Alloy UNS No. C23000 (red brass, 85 percent copper).
- J. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), Alloy 6063.
- K. Nickel Silver Extrusions: ASTM B 151/B 151M, Alloy UNS No. C74500 or No. C77600.
- L. Plastic Laminate: High-pressure type complying with NEMA LD 3, Type HGS for flat applications or Type HGL for flat applications, Type HGP for post-formed applications and] Type BKV for panel backing.

2.6 CAR ENCLOSURES

- A. General: Provide steel-framed car enclosures with non-removable wall panels, with ceiling frame, access doors, power door operators, and ventilation.
 - 1. Provide standard railings complying with ASME A17.1 on car tops where required by ASME A17.1.
 - 2. Provide finished car including materials and finishes specified below.
- B. Materials and Finishes: Provide manufacturer's standards, but not less than the following:
 - 1. Subfloor: Underlayment grade, exterior plywood, 5/8-inch (16-mm) nominal thickness.
 - 2. Floor Finish: Elevator manufacturer's standard heavy traffic flooring; color as selected by Architect from manufacturer's full range.
 - 3. Stainless-Steel Wall Panels: Flush, hollow-metal construction; fabricated from stainless-steel sheet brushed finish.
 - 4. Fabricate car with swing return recesses and cutouts for signal equipment.
 - 5. Fabricate car door frame integrally with front wall of car.
 - 6. Stainless-Steel Doors: Flush, hollow-metal construction; fabricated from stainless-steel sheet or by laminating stainless-steel sheet to exposed faces and edges of enameled cold-rolled steel doors using adhesive that fully bonds metal to metal without telegraphing or oil-canning.
 - 7. Sight Guards: Provide sight guards on car doors.
 - 8. Sills:
 - a. Extruded metal, of grooveless type with door(s) guided from below; 1/4 inch (6.4 mm) thick. Provide satin finish on aluminum.
 - 9. Metal Ceiling: Flush panels, with LED downlights (4 total minimum) in each panel.
 - 10. Handrails: Manufacturer's standard handrails, of shape, metal, and finish indicated.

2.7 HOISTWAY ENTRANCES

- A. General: Provide manufacturer's standard horizontal-sliding, door-and-frame hoistway entrances complete with track systems, hardware, sills, and accessories. Provide frame size and profile to coordinate with hoistway wall construction.
- B. Materials and Fabrication: Provide manufacturer's standards, but not less than the following:
 - 1. Stainless-Steel Frames: Formed from stainless-steel sheet.
 - 2. Stainless-Steel Doors and Transoms: Flush, hollow-metal construction; fabricated from stainless-steel sheet
 - 3. Sight Guards: Provide sight guards on doors matching door edges.
 - 4. Sills:
 - a. Extruded metal, of grooveless type with door(s) guided from below; 1/4 inch (6.4 mm) thick. Provide satin finish on aluminum.
 - 5. Non-shrink, Nonmetallic Grout: Factory-packaged, non-staining, non-corrosive, nongaseous grout complying with ASTM C 1107.

2.8 SIGNAL EQUIPMENT

- A. General: Provide hall-call and car-call buttons that light when activated. Fabricate lighted elements with LEDs and acrylic or other permanent, non-yellowing translucent plastic diffusers.
- B. Car Control Stations: Provide manufacturer's standard recessed or semi-recessed behind a locked door for destination dispatch car control stations. Mount in return panel adjacent to car door, unless otherwise indicated.
- C. Swing-Return Car Control Stations: Provide car control stations mounted on rear of hinged return panel adjacent to car door and with buttons, switches, controls, and indicator lights projecting through return panel but substantially flush with face of return panel.
 - 1. Mark buttons and switches with standard identification for required use or function that complies with ASME A17.1. Use both tactile symbols and Braille.
 - 2. Provide "No Smoking" sign matching car control station, either integral with car control station or mounted adjacent to it, with text and graphics as required by authorities having jurisdiction.
- D. Emergency Communication System: Provide system that complies with ASME A17.1 and the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)." On activation, system dials preprogrammed number of monitoring station and identifies elevator location to monitoring station. System provides two-way voice communication without using a handset and provides visible signals that indicate when system has been activated and when monitoring station has responded. System is contained in flush-mounted cabinet, or integrated into the car control station, with identification, instructions for use, and battery backup power supply.

- E. Firefighters' Two-Way Telephone Communication Service: Provide flush-mounted cabinet telephone jack in each car and required conductors in traveling cable for firefighters' two-way telephone communication service specified in Division 28 Section "Zoned (DC Loop) Fire Alarm System."
- F. Car Position Indicator: Provide illuminated, digital-type car position indicator, located above car door or above car control station. Also provide audible signal to indicate to passengers that car is either stopping at or passing each of the floors served.
 - 1. Include travel direction arrows if not provided in car control station.
- G. Hall Push-Button Stations: Provide one hall push-button station at each landing for each single elevator.
 - 1. Provide manufacturer's standard vandal resistant wall-mounted units.
 - 2. Provide units with flat faceplate for mounting with body of unit recessed in wall.
 - 3. Equip units with buttons for calling elevator and for indicating desired direction of travel.
- H. Hall Lanterns: Units with illuminated arrows; but provide single arrow at terminal landings. Provide one of the following:
 - 1. Units mounted in both car door jambs; may be used only for single elevator.
- I. Hall Annunciator: With each hall lantern, provide audible signals indicating car arrival and direction of travel. Signals sound once for up and twice for down.
 - 1. At manufacturer's option, audible signals may be placed on car.
- J. Hall Position Indicators: Provide illuminated, digital-display-type position indicators, located above hoistway entrance at ground floor. Provide units with flat faceplate for mounting with body of unit recessed in wall.
- K. Corridor Call Station Pictograph Signs: Provide signs matching hall push-button stations, with text and graphics as required by authorities having jurisdiction, indicating that in case of fire elevators are out of service and exits should be used instead. Provide one sign at each hall push-button station, unless otherwise indicated.

2.9 ELEVATORS

- A. Elevator Description:
 - 1. Service Elevator Number : <1>
 - 2. Type: Geared traction.
 - 3. Machine Location: Hoistway; no machine room is provided. Control room provided on ground level.
 - 4. Rated Load: 4000 lb (1816 kg).
 - 5. Freight Loading Class for Service Elevator(s): Class A.
 - 6. Rated Speed: 200 fpm (1.0 m/s) or 250 fpm (1.25 m/s).
 - 7. Operation System: Selective collective automatic operation.
 - 8. Auxiliary Operations:

- a. Standby power operation.
 - b. Standby powered lowering.
 - c. Earthquake Emergency Operation: Comply with requirements in ASME A17.1.
 - d. Automatic dispatching of loaded car.
 - e. Nuisance call cancel.
9. Security Features: Card-reader operation, Keyswitch operation, Keypad operation Car-to-lobby feature.
10. Car Enclosures:
 - a. Inside Width: 5'-5 9/16" from side wall to side wall.
 - b. Inside Depth: 7'-4 7/8" from back wall to front wall (return panels).
 - c. Inside Height: 7'-9" to underside of ceiling.
 - d. Front Walls (Return Panels): Satin stainless steel, No. 4 finish.
 - e. Car Fixtures: Satin stainless steel, No. 4 finish.
 - f. Side and Rear Wall Panels: Satin stainless steel, No. 4 finish.
 - g. Reveals: Satin stainless steel, No. 4 finish.
 - h. Door Faces (Interior): Satin stainless steel, No. 4 finish
 - i. Door Sills: Aluminum, mill finish.
 - j. Ceiling: Satin stainless steel, No. 4 finish.
 - k. Handrails: 1-1/2 inches (38 mm) round satin stainless steel, No. 4 finish, at sides of car.
 - l. Floor: Manufacturer's standard Heavy Duty.
11. Hoistway Entrances: As follows:
 - a. Width: 48 inches (1219 mm).
 - b. Height: 84 inches (2134 mm)
 - c. Type: Single-speed center opening.
 - d. Frames Satin stainless steel, No. 4 finish.
 - e. Doors and Transoms Satin stainless steel, No. 4 finish.
 - f. Sills: Aluminum, mill finish.
12. Hall Fixtures Satin stainless steel, No. 4 finish.
13. Hall Fixtures at Other Floors: Satin stainless steel, No. 4 finish.
14. Additional Requirements:
 - a. Provide inspection certificate in each car, mounted under acrylic cover with frame made from satin stainless steel, No. 4 finish.
 - b. Provide blanket (protection pad) hooks and one complete set(s) of full-height protective blankets.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine elevator areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance. Examine hoistways, hoistway openings, pits, and machine rooms as constructed; verify critical dimensions; and examine supporting structure and other conditions under which elevator work is to be installed.
 - 1. For the record, prepare a written report, endorsed by Installer, listing dimensional discrepancies and conditions detrimental to performance or indicating that dimensions and conditions were found to be satisfactory.
 - 2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with manufacturer's written instructions.
- B. Welded Construction: Provide welded connections for installing elevator work where bolted connections are not required for subsequent removal or for normal operation, adjustment, inspection, maintenance, and replacement of worn parts. Comply with AWS standards for workmanship and for qualifications of welding operators.
- C. Sound Isolation: Mount rotating and vibrating equipment on vibration-isolating mounts designed to minimize transmission of vibrations to structure and thereby minimize structure-borne noise from elevator system.
- D. Lubricate operating parts of systems, including ropes (if required), as recommended by manufacturers.
- E. Alignment: Coordinate installation of hoistway entrances with installation of elevator guide rails for accurate alignment of entrances with car. Where possible, delay final adjustment of sills and doors until car is operable in shaft. Reduce clearances to minimum, safe, workable dimension at each landing.
- F. Leveling Tolerance: 1/8 inch (3 mm), up or down, regardless of load and direction of travel.
- G. Set sills flush with finished floor surface at landing. Fill space under sill solidly with non-shrink, nonmetallic grout.
- H. Locate hall signal equipment for elevators as follows, unless otherwise indicated:
 - 1. Place hall lanterns either above or beside each hoistway entrance.
 - 2. Mount hall lanterns at a minimum of 72 inches (1829 mm) above finished floor.

3.3 FIELD QUALITY CONTROL

- A. Acceptance Testing: On completion of elevator installation and before permitting use (either temporary or permanent) of elevators, perform acceptance tests as required and recommended by ASME A17.1 and by governing regulations and agencies.

- B. Operating Test: Load elevator to rated capacity and operate continuously for 30 minutes over full travel distance, stopping at each level and proceeding after a 5 second delay to the next. Record temperature rise of elevator machine during 30-minute test period. Record failure to perform as required.
- C. Advise City, Architect, and authorities having jurisdiction in advance of dates and times tests are to be performed on elevators.

3.4 PROTECTION

- A. Temporary Use: Comply with the following requirements for elevator used for construction purposes:
 - 1. Provide car with temporary enclosure, either within finished car or in place of finished car, to protect finishes from damage.
 - 2. Provide strippable protective film on entrance and car doors and frames.
 - 3. Provide padded wood bumpers on entrance door frames covering jambs and frame faces.
 - 4. Provide other protective coverings, barriers, devices, signs, and procedures as needed to protect elevator and elevator equipment.
 - 5. Do not load elevators beyond their rated weight capacity.
 - 6. Engage elevator Installer to provide full maintenance service. Include preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as necessary for proper elevator operation at rated speed and capacity. Provide parts and supplies same as those used in the manufacture and installation of original equipment.
 - 7. Engage elevator Installer to restore damaged work, if any, so no evidence remains of correction. Return items that cannot be refinished in the field to the shop, make required repairs and refinish entire unit, or provide new units as required.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train **City's** maintenance personnel to operate [and perform general day to day inspection] of elevator(s). Refer to Division 01 Section "Demonstration and Training."
- B. Check operation of elevator with **City's** personnel present and before date of Substantial Completion. Determine that operation systems and devices are functioning properly.
- C. Check operation of elevator with **City's** personnel present not more than one month before end of warranty period. Determine that operation systems and devices are functioning properly.

END OF SECTION 14 21 01

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SECTION 210500 - COMMON WORK RESULTS FOR FIRE SUPPRESSION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Piping materials and installation instructions common to most piping systems.
 - 2. Mechanical sleeve seals.
 - 3. Sleeves.
 - 4. Escutcheons.
 - 5. Grout.
 - 6. Fire-suppression equipment and piping demolition.
 - 7. Equipment installation requirements common to equipment sections.
 - 8. Painting and finishing.
 - 9. Concrete bases.
 - 10. Supports and anchorages.

1.3 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- F. The following are industry abbreviations for plastic materials:

1. CPVC: Chlorinated polyvinyl chloride plastic.

G. The following are industry abbreviations for rubber materials:

1. EPDM: Ethylene-propylene-diene terpolymer rubber.
2. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

A. Product Data: For the following:

1. Mechanical sleeve seals.
2. Escutcheons.

B. Welding certificates.

1.5 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. Electrical Characteristics for Fire-Suppression Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

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

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

1.7 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for fire-suppression installations.

- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- C. Coordinate requirements for access panels and doors for fire-suppression items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 21 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

- A. Refer to individual Division 21 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
 - 1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
 - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
 - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
 - 2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

- E. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- F. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.
- G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.4 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
 - 1. Manufacturers:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Metraflex Co.
 - d. Pipeline Seal and Insulator, Inc.
 - 2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - 3. Pressure Plates: Carbon steel. Include two for each sealing element.
 - 4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.5 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 - 1. Underdeck Clamp: Clamping ring with set screws.

2.6 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Cast-Brass Type: With set screw.
 - 1. Finish: Polished chrome-plated.
- D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
 - 1. Finish: Polished chrome-plated.
- E. One-Piece, Stamped-Steel Type: With set screw and chrome-plated finish.
- F. Split-Plate, Stamped-Steel Type: With concealed hinge, set screw set screw or spring clips, and chrome-plated finish.
- G. One-Piece, Floor-Plate Type: Cast-iron floor plate.
- H. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 21 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.

- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
 - 1. New Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
 - b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
 - c. Insulated Piping: One-piece, stamped-steel type with spring clips.
 - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
 - e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
 - f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
 - g. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished chrome-plated finish.
 - h. Bare Piping in Equipment Rooms: One-piece, cast-brass type.
 - i. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.
- M. Sleeves are not required for core-drilled holes.
- N. Permanent sleeves are not required for holes formed by removable PE sleeves.
- O. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.
- P. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
 - 1. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
 - 2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
 - 3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:

- a. Steel Pipe Sleeves: For pipes smaller than NPS 6.
 - b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.
 - c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Division 07 Section "Sheet Metal Flashing and Trim" for flashing.
 - 1) Seal space outside of sleeve fittings with grout.
4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.
- Q. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
1. Install steel pipe for sleeves smaller than 6 inches in diameter.
 2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
 3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- R. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- S. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.
- T. Verify final equipment locations for roughing-in.
- U. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.2 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 21 Sections specifying piping systems.

- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- E. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- F. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.3 PAINTING

- A. Painting of fire-suppression systems, equipment, and components is specified in Division 09 Sections "Interior Painting" and "Exterior Painting."
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.
- C. Paint all systems in accordance with LL 33/2007 and its amendments with sections 903 and 905 of the NYS Building Code.

3.4 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 05 Section "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor fire-suppression materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

3.5 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor fire-suppression materials and equipment.

- B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.
- C. Attach to substrates as required to support applied loads.

3.6 GROUTING

- A. Mix and install grout for fire-suppression equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

END OF SECTION 210500

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SECTION 210533 - HEAT TRACING FOR FIRE SUPPRESSION PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes heat tracing with the following electric heating cables:
 - 1. Self-regulating, parallel resistance.

1.3 SUBMITTALS

- A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for each type of product indicated.
 - 1. Schedule heating capacity, length of cable, spacing, and electrical power requirement for each electric heating cable required.
- B. Field quality-control test reports.
- C. Operation and Maintenance Data: For electric heating cables to include in operation and maintenance manuals.
- D. Warranty: Special warranty specified in this Section.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. All heating-cable components shall be UL Listed, CSA Certified, or FM Approved for use as part of the system to provide pipe freeze protection.

1.5 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace electric heating cable that fails in materials or workmanship within specified warranty period.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SELF-REGULATING, PARALLEL-RESISTANCE HEATING CABLES

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 1. BH Thermal Corporation.
 2. Chromalox, Inc.; Wiegard Industrial Division; Emerson Electric Company.
 3. Delta-Therm Corporation.
 4. Easy Heat Inc.
 5. Nelson Heat Trace.
 6. Pyrotenax; a division of Tyco Thermal Controls.
 7. Raychem; a division of Tyco Thermal Controls.
 8. Thermon Manufacturing Co.
 9. Trasor Corp.
- B. Heating Element: Pair of parallel No. 16 AWG, nickel-coated] stranded copper bus wires embedded in crosslinked conductive polymer core, which varies heat output in response to temperature along its length. Terminate with waterproof, factory-assembled nonheating leads with connectors at one end, and seal the opposite end watertight. Cable shall be capable of crossing over itself once without overheating.
- C. Electrical Insulating Jacket: Flame-retardant polyolefin.
- D. Cable Cover: Tinned-copper braid[, and polyolefin outer jacket with UV inhibitor.
- E. Maximum Operating Temperature (Power On): 150 deg F.
- F. Maximum Exposure Temperature (Power Off): 185 deg F.
- G. Maximum Operating Temperature: 300 deg F .
- H. Capacities and Characteristics:
 1. Maximum Heat Output: 8 W/ft.
 2. Piping Diameter: 2-1/2"
 3. Volts: 120 V.
 4. Phase: 1
 5. Hertz: 60

2.2 CONTROLS

- A. Remote bulb unit with adjustable temperature range from 30 to 50 deg.

- B. Snap action; open-on-rise, single-pole switch with minimum current rating adequate for connected cable.
- C. Remote bulb on capillary, resistance temperature device, or thermistor for directly sensing pipe-wall temperature.
- D. Corrosion-resistant, waterproof control enclosure.

2.3 ACCESSORIES

- A. Cable Installation Accessories: Fiberglass tape, heat-conductive putty, cable ties, silicone end seals and splice kits, and installation clips all furnished by manufacturer, or as recommended in writing by manufacturer.
- B. Warning Tape: Continuously printed "Electrical Tracing"; vinyl, at least 3 mils thick, and with pressure-sensitive, permanent, waterproof, self-adhesive back.
 - 1. Width for Markers on Pipes with OD, Including Insulation, Less Than 6 Inches: 3/4 inch minimum.
 - 2. Width for Markers on Pipes with OD, Including Insulation, 6 Inches or Larger: 1-1/2 inches minimum.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces and substrates to receive electric heating cables for compliance with requirements for installation tolerances and other conditions affecting performance.
 - 1. Ensure surfaces and pipes in contact with electric heating cables are free of burrs and sharp protrusions.
 - 2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install electric heating cable across expansion joints according to manufacturer's written recommendations using slack cable to allow movement without damage to cable.
- B. Install electric heating cables after piping has been tested and before insulation is installed.
- C. Install electric heating cables according to IEEE 515.1.
- D. Install insulation over piping with electric cables according to Division 23 Section "HVAC Insulation."
- E. Install warning tape on piping insulation where piping is equipped with electric heating cables.
- F. Set field-adjustable switches and circuit-breaker trip ranges.

- G. Protect installed heating cables, including nonheating leads, from damage.

3.3 CONNECTIONS

- A. Ground equipment according to Division 26.
- B. Connect wiring according to Division 26.
- C. All branch circuits shall be connected to a GFI type circuit breaker.

3.4 FIELD QUALITY CONTROL

- A. Testing: Perform tests after cable installation but before application of coverings such as insulation, wall or ceiling construction, or concrete.
 - 1. Test cables for electrical continuity and insulation integrity before energizing.
 - 2. Test cables to verify rating and power input. Energize and measure voltage and current simultaneously.
- B. Repeat tests for continuity, insulation resistance, and input power after applying thermal insulation on pipe-mounting cables.
- C. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION 210533

SECTION 211100 - FACILITY FIRE-SUPPRESSION WATER-SERVICE PIPING

PART - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes fire-suppression water-service piping and related components outside the building and service entrance piping through floor into the building.
- B. Utility-furnished products include water meters that will be furnished to the site, ready for installation.
- C. Related Sections:
 - 1. Division 21 Section "Fire-Suppression Standpipes " for fire-suppression standpipes inside the building.
 - 2. Division 21 Section "Wet-Pipe Sprinkler Systems" for wet-pipe fire-suppression sprinkler systems inside the building.
 - 3. Division 21 Section "Electric-Drive Centrifugal Fire Pumps" for fire pumps, pressure-maintenance pumps and controllers.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings:
 - 1. Detail precast concrete vault assemblies and indicate dimensions, method of field assembly, and components.
 - 2. Wiring Diagrams: For power, signal, and control wiring.
- C. Coordination Drawings: For piping and specialties including relation to other services in same area, drawn to scale. Show piping and specialty sizes and valves, meter and specialty locations, and elevations.
- D. Field quality-control reports.
- E. Environmental Sustainability Documentation: Contractor shall submit for approval, a fully completed Environmental Building Materials Certification Form and backup documentation from the manufacturer or supplier of each type used in this section. Such backup documentation shall be typewritten on the manufacturer's letterhead or product data sheet published by the manufacturer.

1. Adhesives and Sealants

- a. All adhesives and sealants used inside the building shall comply with South Coast Air Quality Management District Rule #1168. Documentation shall include product data submission for each material and shall demonstrate the volatile organic compound (VOC) content of the material.

2. Paints and Coatings

- a. All paints and coatings used inside the building must not exceed the VOC content limits established in Green Seal Standard GS-11, Paints, 1st Edition, May 20, 1993 and Green Seal Standard GC-03, Anti-Corrosive Paints, 2nd Edition, January 7, 1997. Documentation shall include product data submission for each material and shall demonstrate the volatile organic compound (VOC) level of the material

1.4 QUALITY ASSURANCE

A. Regulatory Requirements:

1. Comply with requirements of utility company supplying water. Include tapping of water mains and backflow prevention.
2. Comply with standards of authorities having jurisdiction for fire-suppression water-service piping, including materials, hose threads, installation, and testing.

B. Piping materials shall bear label, stamp, or other markings of specified testing agency.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in 2016 NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Comply with the "Approval Guide," published by FM Global, or UL's "Fire Protection Equipment Directory" for fire-service-main products.

E. NFPA Compliance: Comply with NFPA 24 for materials, installations, tests, flushing, and valve and hydrant supervision for fire-suppression water-service piping.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Preparation for Transport: Prepare valves, according to the following:

1. Ensure that valves are dry and internally protected against rust and corrosion.
2. Protect valves against damage to threaded ends and flange faces.
3. Set valves in best position for handling. Set valves closed to prevent rattling.

B. During Storage: Use precautions for valves, according to the following:

1. Do not remove end protectors unless necessary for inspection; then reinstall for storage.

2. Protect from weather. Store indoors and maintain temperature higher than ambient dew point temperature. Support off the ground or pavement in watertight enclosures when outdoor storage is necessary.
- C. Handling: Use sling to handle valves and fire hydrants if size requires handling by crane or lift. Rig valves to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.
- D. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.
- E. Protect stored piping from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor when storing inside.
- F. Protect flanges, fittings, and specialties from moisture and dirt.

1.6 PROJECT CONDITIONS

- A. Interruption of Existing Fire-Suppression Water-Service Piping: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water-distribution service according to requirements indicated:
 1. Notify Architect no fewer than two days in advance of proposed interruption of service.
 2. Do not proceed with interruption of service without Architect's written permission.

1.7 COORDINATION

- A. Coordinate connection to water main with utility company.

PART 2 - PRODUCTS

2.1 DUCTILE-IRON PIPE AND FITTINGS

- A. Grooved-Joint, Ductile-Iron Pipe: AWWA C151, with cut, rounded-grooved ends.
- B. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, with mechanical-joint bell and plain spigot end.
- C. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, with push-on-joint bell and plain spigot end.
- D. Grooved-End, Ductile-Iron Pipe Appurtenances:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International, Inc.
 - b. Shurjoint Piping Products.

- c. Star Pipe Products.
 - d. Victaulic Company.
- 2. Grooved-End, Ductile-Iron Fittings: ASTM A 47/A 47M, malleable-iron castings or ASTM A 536, ductile-iron castings with dimensions matching pipe.
- 3. Grooved-End, Ductile-Iron-Piping Couplings: AWWA C606, for ductile-iron-pipe dimensions. Include ferrous housing sections, gasket suitable for water, and bolts and nuts.
- E. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
 - 1. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.
- F. Push-on-Joint, Ductile-Iron Fittings: AWWA C153, ductile-iron compact pattern.
 - 1. Gaskets: AWWA C111, rubber.

2.2 SPECIAL PIPE FITTINGS

A. Ductile-Iron Flexible Expansion Joints:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. EBAA Iron, Inc.
 - b. ROMAC Industries Inc.
 - c. Star Pipe Products.
- 2. Description: Compound, ductile-iron fitting with combination of flanged and mechanical-joint ends complying with AWWA C110 or AWWA C153. Include two gasketed ball-joint sections and one or more gasketed sleeve sections. Assemble components for offset and expansion indicated. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.
- 3. Pressure Rating: 250 psig minimum.

B. Ductile-Iron Deflection Fittings:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. EBAA Iron, Inc.
- 2. Description: Compound, ductile-iron coupling fitting with sleeve and one or two flexing sections for up to 15-degree deflection, gaskets, and restrained-joint ends complying with AWWA C110 or AWWA C153. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.
- 3. Pressure Rating: 250 psig minimum.

2.3 ENCASEMENT FOR PIPING

- A. Standard: ASTM A 674 or AWWA C105.
- B. Material: Linear low-density PE film of 0.008-inch or High-density, cross-laminated PE film of 0.004-inch minimum thickness.
- C. Form: Sheet or tube.
- D. Color: Black or natural.

2.4 JOINING MATERIALS

- A. Gaskets for Ferrous Piping and Copper-Alloy Tubing: ASME B16.21, asbestos free.

2.5 CURB VALVES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Amcast Industrial Corporation.
 - 2. Ford Meter Box Company, Inc. (The); Pipe Products Division.
 - 3. Jones, James Company.
 - 4. Master Meter, Inc.
 - 5. McDonald, A. Y. Mfg. Co.
 - 6. Mueller Co.; Water Products Division.
 - 7. Red Hed Manufacturing & Supply.
- B. Curb Valves: Comply with AWWA C800 for high-pressure service-line valves. Valve has bronze body, ground-key plug or ball, wide tee head, and inlet and outlet matching service piping material.
- C. Service Boxes for Curb Valves: Similar to AWWA M44 requirements for cast-iron valve boxes. Include cast-iron telescoping top section of length required for depth of burial of valve, plug with lettering "WATER," and bottom section with base that fits over curb valve and with a barrel approximately 3 inches in diameter.
 - 1. Shutoff Rods: Steel; with tee-handle with one pointed end, stem of length to operate deepest buried valve, and slotted end matching curb valve.
- D. Meter Valves: Comply with AWWA C800 for high-pressure service-line valves. Include angle- or straight-through-pattern bronze body, ground-key plug or ball, and wide tee head, with inlet and outlet matching service piping material.

2.6 GATE VALVES

- A. UL-Listed or FM-Approved Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American AVK Company; Valve & Fittings Division.
 - b. American Cast Iron Pipe Company; American Flow Control Division.
 - c. American Cast Iron Pipe Company; Waterous Company Subsidiary.
 - d. Clow Valve Company; a division of McWane, Inc.
 - e. Crane Co.; Crane Valve Group; Jenkins Valves.
 - f. Crane Co.; Crane Valve Group; Stockham Division.
 - g. East Jordan Iron Works, Inc.
 - h. Hammond Valve.
 - i. Kennedy Valve; a division of McWane, Inc.
 - j. M&H Valve Company; a division of McWane, Inc.
 - k. Milwaukee Valve Company.
 - l. Mueller Co.; Water Products Division.
 - m. NIBCO INC.
 - n. Shurjoint Piping Products.
 - o. Troy Valve; a division of Penn-Troy Manufacturing, Inc.
 - p. Tyco Fire & Building Products LP.
 - q. United Brass Works, Inc.
 - r. U.S. Pipe.
 - s. Watts Water Technologies, Inc.
2. 175-psig (1200-kPa), UL-Listed or FM-Approved, Iron, Nonrising-Stem Gate Valves:
 - a. Description: Iron body and bonnet, bronze seating material, and inside screw.
 - b. Standards: UL 262 and "Approval Guide," published by FM Global, listing.
 - c. Pressure Rating: 175 psig (1200) minimum.
 - d. End Connections: Mechanical or push-on joint.
 - e. Indicator-Post Flange: Include on valves used with indicator posts.
3. 250-psig UL-Listed or FM-Approved, Iron, Nonrising-Stem Gate Valves:
 - a. Description: Iron body and bonnet, bronze seating material, and inside screw.
 - b. Standards: UL 262 and "Approval Guide," published by FM Global, listing.
 - c. Pressure Rating: 250 psig minimum.
 - d. End Connections: Mechanical or push-on joint.
 - e. Indicator-Post Flange: Include on valves used with indicator posts.
4. 175-psig, UL-Listed or FM-Approved, Iron, OS&Y, Gate Valves:
 - a. Description: Iron body and bonnet and bronze seating material.
 - b. Standards: UL 262 and "Approval Guide," published by FM Global, listing.
 - c. Pressure Rating: 175 psig minimum.
 - d. End Connections: Flanged or grooved.
5. 250-psig, UL-Listed or FM-Approved, Iron, OS&Y Gate Valves:
 - a. Description: Iron body and bonnet and bronze seating material.
 - b. Standards: UL 262 and "Approval Guide," published by FM Global, listing.

- c. Pressure Rating: 250 psig minimum.
 - d. End Connections: Flanged or grooved.
- 6. UL-Listed or FM-Approved, OS&Y Bronze, Gate Valves:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Crane Co.; Crane Valve Group; Crane Valves.
 - 2) Crane Co.; Crane Valve Group; Stockham Division.
 - 3) Milwaukee Valve Company.
 - 4) NIBCO INC.
 - 5) United Brass Works, Inc.
 - b. Description: Bronze body and bonnet and bronze stem.
 - c. Standards: UL 262 and "Approval Guide," published by FM Global, listing.
 - d. Pressure Rating: 175 psig minimum.
 - e. End Connections: Threaded.

2.7 GATE VALVE ACCESSORIES AND SPECIALTIES

A. Tapping-Sleeve Assemblies:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Cast Iron Pipe Company; Waterous Company Subsidiary.
 - b. Clow Valve Company; a division of McWane, Inc.
 - c. East Jordan Iron Works, Inc.
 - d. Flowserve.
 - e. Kennedy Valve; a division of McWane, Inc.
 - f. M&H Valve Company; a division of McWane, Inc.
 - g. Mueller Co.; Water Products Division.
 - h. U.S. Pipe.
- 2. Description: Sleeve and valve compatible with drilling machine.
- 3. Standard: MSS SP-60.
- 4. Tapping Sleeve: Cast-iron, ductile-iron, or stainless-steel, two-piece bolted sleeve with flanged outlet for new branch connection. Sleeve shall match size and type of pipe material being tapped and have recessed flange for branch valve.
- 5. Valve: AWWA, cast-iron, nonrising-stem, metal-seated gate valve with one raised-face flange mating tapping-sleeve flange.

B. Valve Boxes: Comply with AWWA M44 for cast-iron valve boxes. Include top section, adjustable extension of length required for depth of burial of valve, plug with lettering "WATER," and bottom section with base that fits over valve and with a barrel approximately 5 inches in diameter.

- 1. Operating Wrenches: Steel; with tee-handle with one pointed end, stem of length to operate deepest buried valve, and socket matching valve operating nut.

2. Description: Vertical-type, cast-iron body with operating wrench, extension rod, and adjustable cast-iron barrel of length required for depth of burial of valve.
3. Standards: UL 789 and "Approval Guide," published by FM Global, listing.

2.8 BUTTERFLY VALVES

A. AWWA Butterfly Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. DeZurik/Copes-Vulcan; a unit of SPX Corporation.
 - b. Milliken Valve Company.
 - c. Mosser Valve; a division of Olson Technologies, Inc.
 - d. Mueller Co.; Water Products Division.
 - e. Pratt, Henry Company.
 - f. Val-Matic Valve & Manufacturing Corp.
2. Description: Rubber seated.
3. Standard: AWWA C504.
4. Body Material: Cast or ductile iron.
5. Body Type: Wafer or flanged.
6. Pressure Rating: 150 psig.

B. UL Butterfly Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Kennedy Valve; a division of McWane, Inc.
 - b. Milwaukee Valve Company.
 - c. Mueller Co.; Water Products Division.
 - d. NIBCO INC.
 - e. Pratt, Henry Company.
2. Description: Metal on resilient material seating.
3. Standards: UL 1091 and "Approval Guide," published by FM Global, listing.
4. Body Material: Cast or ductile iron.
5. Body Type: Wafer or flanged.
6. Pressure Rating: 175 psig.

2.9 CHECK VALVES

A. AWWA Check Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American AVK Company; Valves & Fittings Division.

- b. American Cast Iron Pipe Company; American Flow Control Division.
 - c. APCO Willamette Valve and Primer Corporation.
 - d. Clow Valve Company; a division of McWane, Inc.
 - e. Crane Co.; Crane Valve Group; Crane Valves.
 - f. Crane Co.; Crane Valve Group; Stockham Division.
 - g. Kennedy Valve; a division of McWane, Inc.
 - h. M&H Valve Company; a division of McWane, Inc.
 - i. Mueller Co.; Water Products Division.
 - j. NIBCO INC.
 - k. Watts Water Technologies, Inc.
 - 2. Description: Swing-check type with resilient seat; with interior coating according to AWWA C550 and ends to match piping.
 - 3. Standard: AWWA C508.
 - 4. Pressure Rating: 175 psig.
- B. UL-Listed or FM-Approved Check Valves:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Cast Iron Pipe Company; Waterous Company Subsidiary.
 - b. Clow Valve Company; a division of McWane, Inc.
 - c. Crane Co.; Crane Valve Group; Stockham Division.
 - d. Globe Fire Sprinkler Corporation.
 - e. Kennedy Valve; a division of McWane, Inc.
 - f. Kidde Fire Fighting.
 - g. Matco-Norca.
 - h. Mueller Co.; Water Products Division.
 - i. NIBCO INC.
 - j. Reliable Automatic Sprinkler Co., Inc.
 - k. Tyco Fire & Building Products LP.
 - l. United Brass Works, Inc.
 - m. Victaulic Company.
 - n. Viking Corporation.
 - o. Watts Water Technologies, Inc.
 - 2. Description: Swing-check type with pressure rating, rubber-face checks unless otherwise indicated, and ends matching piping.
 - 3. Standards: UL 312 and "Approval Guide," published by FM Global, listing.
 - 4. Pressure Rating: 175 psig.
- C. Double-Check, Detector-Assembly Backflow Preventers:
- 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings:
 - 2. Standards: ASSE 1048 and UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
 - 3. Operation: Continuous-pressure applications.
 - 4. Pressure Loss: 8 psig maximum, through middle one-third of flow range.
 - 5. Size: 6.

6. Design Flow Rate: 500 gpm.
7. Selected Unit Flow Range Limits: 750 gpm.
8. Pressure Loss at Design Flow Rate: 8 psig maximum.
9. Body Material: Ductile iron ASTM A536 grade 4.
10. End Connections: Flanged.
11. Configuration: Designed for horizontal flow.
12. Accessories:
 - a. Valves: UL 262, "Approval Guide," published by FM Global, listing, approved; OS&Y gate type with flanged ends on inlet and outlet.
 - b. Bypass: With displacement-type water meter, shutoff valves, and reduced-pressure backflow preventer.

D. Backflow Preventer Test Kits:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Conbraco Industries, Inc.; Apollo Valves.
 - b. FEBCO; SPX Valves & Controls.
 - c. Flomatic Corporation.
 - d. Watts Water Technologies, Inc.
 - e. Zurn Plumbing Products Group; Wilkins Water Control Products Division.
2. Description: Factory calibrated, with gages, fittings, hoses, and carrying case with test-procedure instructions.

2.10 FIRE-DEPARTMENT CONNECTIONS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Elkhart Brass Mfg. Company, Inc.
 2. Fire-End & Croker Corporation.
 3. Guardian Fire Equipment, Inc.
 4. Potter Roemer.
 5. Reliable Automatic Sprinkler Co., Inc.
- B. Description: Wall mount flush recessed chrome plated brass, thread inlets according to NFPA 2016 and matching local fire-department hose threads. Include lugged caps, gaskets, and chains; lugged swivel connection and drop clapper for each hose-connection inlet.
- C. Standard: UL 405.
- D. Connections: Two NPS 3 inlets and one NPS 4 outlet.
- E. Inlet Alignment: horizontal.
- F. Finish: Polished chrome plated.

- G. Escutcheon Plate Marking: "Standpipe and auto sprinkler."

2.11 ALARM DEVICES

- A. General: UL 753 and "Approval Guide," published by FM Global, listing, of types and sizes to mate and match piping and equipment.
- B. Water-Flow Indicators: Vane-type water-flow detector, rated for 250-psig working pressure; designed for horizontal or vertical installation; with two single-pole, double-throw circuit switches to provide isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal when cover is removed.
- C. Supervisory Switches: Single pole, double throw; designed to signal valve in other than fully open position.
- D. Pressure Switches: Single pole, double throw; designed to signal increase in pressure.

2.12 SLEEVES

- A. Cast-Iron Wall-Pipe Sleeves: Cast or fabricated of cast iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
- B. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, standard-weight, zinc-coated, plain ends.

2.13 SLEEVE SEALS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Advance Products & Systems, Inc.
 - 2. Calpico, Inc.
 - 3. Metraflex, Inc.
 - 4. Pipeline Seal and Insulator, Inc.
- B. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
- C. Sealing Elements: EPDM-rubber or NBR interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
- D. Pressure Plates: Carbon steel.
- E. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements.

2.14 GROUT

- A. Standard: ASTM C 1107, Grade B, posthardening and volume adjusting, dry, hydraulic-cement grout.
- B. Characteristics: Nonshrink; recommended for interior and exterior applications.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Comply with excavating, trenching, and backfilling requirements in Division 31 Section "Earth Moving."

3.2 PIPING INSTALLATION

- A. Water-Main Connection: Arrange with water utility company for tap of size and in location indicated in water main.
- B. Water-Main Connection: Tap water main according to requirements of water utility company and of size and in location indicated.
- C. Make connections larger than NPS 2 with tapping machine according to the following:
 - 1. Install tapping sleeve and tapping valve according to MSS SP-60.
 - 2. Install tapping sleeve on pipe to be tapped. Position flanged outlet for gate valve.
 - 3. Use tapping machine compatible with valve and tapping sleeve; cut hole in main. Remove tapping machine and connect water-service piping.
 - 4. Install gate valve onto tapping sleeve. Comply with MSS SP-60. Install valve with stem pointing up and with valve box.
- D. Comply with 2016 NFPA 24 for fire-service-main piping materials and installation.
- E. Install ductile-iron, water-service piping according to AWWA C600 and AWWA M41.
 - 1. Install encasement for piping according to ASTM A 674 or AWWA C105.
- F. Bury piping with depth of cover over top at least 48 inches according to the following:
 - 1. Under Driveways: With at least 48 inches of cover over top.
- G. Install piping by tunneling or jacking, or combination of both, under streets and other obstructions that cannot be disturbed.

- H. Extend fire-suppression water-service piping and connect to water-supply source and building fire-suppression water-service piping systems at locations and pipe sizes indicated.
 - 1. Terminate fire-suppression water-service piping at building floor slab until building-water-piping systems are installed. Terminate piping with caps, plugs, or flanges as required for piping material. Make connections to building's fire-suppression water-service piping systems when those systems are installed.
- I. Install underground piping with restrained joints at horizontal and vertical changes in direction. Use restrained-joint piping, thrust blocks, anchors, tie-rods and clamps, and other supports.
- J. Comply with requirements in Division 21 Sections for fire-suppression-water piping inside the building.
- K. Comply with requirements in Division 22 Section "Domestic Water Piping" for potable-water piping inside the building.

3.3 JOINT CONSTRUCTION

- A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure rating same as or higher than systems pressure rating for aboveground applications unless otherwise indicated.
- B. Install unions adjacent to each valve in tubing NPS 2 and smaller.
- C. Install flanges, flange adaptors, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.
- D. Ream ends of tubes and remove burrs.
- E. Remove scale, slag, dirt, and debris from outside and inside of pipes, tubes, and fittings before assembly.
- F. Ductile-Iron Piping, Gasketed Joints for Fire-Service-Main Piping: UL 194.
- G. Ductile-Iron Piping, Grooved Joints: Cut-groove pipe. Assemble joints with grooved-end, ductile-iron-piping couplings, gaskets, lubricant, and bolts.
- H. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with bolts according to ASME B31.9.
- I. Dissimilar Materials Piping Joints: Use adapters compatible with both piping materials, with OD, and with system working pressure.
- J. Do not use flanges or unions for underground piping.

3.4 ANCHORAGE INSTALLATION

- A. Anchorage, General: Install water-distribution piping with restrained joints. Anchorages and restrained-joint types that may be used include the following:

1. Concrete thrust blocks.
 2. Locking mechanical joints.
 3. Set-screw mechanical retainer glands.
 4. Bolted flanged joints.
 5. Heat-fused joints.
 6. Pipe clamps and tie rods.
- B. Install anchorages for tees, plugs and caps, bends, crosses and valves, in fire-suppression water-service piping according to 2016 NFPA 24 and the following:
1. Gasketed-Joint, Ductile-Iron, Water-Service Piping: According to AWWA C600.
- C. Apply full coat of asphalt or other acceptable corrosion-resistant material to surfaces of installed ferrous anchorage devices.

3.5 VALVE INSTALLATION

- A. AWWA Gate Valves: Comply with AWWA C600 and AWWA M44. Install each underground valve with stem pointing up and with valve box.
- B. AWWA Valves Other Than Gate Valves: Comply with AWWA C600 and AWWA M44.
- C. UL-Listed or FM-Approved Gate Valves: Comply with 2016 NFPA 24. Install each underground valve and valves in vaults with stem pointing up and with vertical cast-iron indicator post.
- D. UL-Listed or FM-Approved Valves Other Than Gate Valves: Comply with NFPA 24.
- E. MSS Valves: Install as component of connected piping system.
- F. Curb Valves: Install each underground curb valve with head pointed up and with service box.
- G. Support valves and piping, not direct buried, on concrete piers. Comply with requirements for concrete piers in Division 03 Section "Miscellaneous Cast-in-Place Concrete."

3.6 DOUBLE DETECTOR CHECK VALVE INSTALLATION

- A. Install in indoors or aboveground.
- B. Install for proper direction of flow. Install bypass with water meter, gate valves on each side of meter, and check valve downstream from meter.
- C. Support detector check valves and piping on concrete piers. Comply with requirements for concrete piers in Division 03 Section "Miscellaneous Cast-in-Place Concrete."

3.7 FIRE-DEPARTMENT CONNECTION INSTALLATION

- A. Install ball drip valves at each check valve for fire-department connection to mains.

3.8 ALARM DEVICE INSTALLATION

- A. General: Comply with 2016 NFPA 24 for devices and methods of valve supervision. Underground valves with valve box do not require supervision.
- B. Supervisory Switches: Supervise valves in open position.
 - 1. Valves: Grind away portion of exposed valve stem. Bolt switch, with plunger in stem depression, to OS&Y gate-valve yoke.
 - 2. Indicator Posts: Drill and thread hole in upper-barrel section at target plate. Install switch, with toggle against target plate, on barrel of indicator post.
- C. Locking and Sealing: Secure unsupervised valves as follows:
 - 1. Valves: Install chain and padlock on open OS&Y gate valve.
 - 2. Post Indicators: Install padlock on wrench on indicator post.
- D. Pressure Switches: Drill and thread hole in exposed barrel of fire hydrant. Install switch.
- E. Water-Flow Indicators: Install in water-service piping in vault. Select indicator with saddle and vane matching pipe size. Drill hole in pipe, insert vane, and bolt saddle to pipe.
- F. Connect alarm devices to building's fire-alarm system. Wiring and fire-alarm devices are specified in Division 28 Sections.

3.9 CONNECTIONS

- A. Connect fire-suppression water-service piping to existing street water main.
- B. Connect fire-suppression water-service piping to interior fire-suppression piping.

3.10 SLEEVE INSTALLATION

- A. General Requirements: Install sleeves for pipes and tubes passing through penetrations in exterior walls.
 - 1. Exception: Sleeves are not required for core-drilled holes.
- B. Cut sleeves to length for mounting flush with both surfaces.
- C. Install sleeves in new floor slabs and walls as they are constructed.
- D. For exterior wall penetrations above grade, seal annular space between sleeves and piping using joint sealants appropriate for size, depth, and location of joint. Comply with requirements for joint sealants in Division 07 Section "Joint Sealants."
- E. For exterior wall penetrations below grade, seal annular space between sleeves and piping using sleeve seals.
- F. Seal space outside of sleeves in concrete walls with grout.

G. Install the following sleeve materials:

1. Galvanized- steel pipe or steel-sheet sleeves for pipes smaller than NPS 6.
2. Cast-iron wall-pipe or galvanized-steel pipe sleeves for pipes NPS 6 and larger.

3.11 SLEEVE SEAL INSTALLATION

- A. Install sleeve seals in sleeves in exterior concrete floor slabs and walls at fire-suppression water-service piping entries into the building.
- B. Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble sleeve seal components and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.12 FIELD QUALITY CONTROL

- A. Use test procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described below.
- B. Piping Tests: Conduct piping tests before joints are covered and after concrete thrust blocks have hardened sufficiently. Fill pipeline 24 hours before testing and apply test pressure to stabilize system. Use only potable water.
- C. Hydrostatic Tests: Test at not less than one-and-one-half times the working pressure for two hours.
 1. Increase pressure in 50-psig increments and inspect each joint between increments. Hold at test pressure for one hour; decrease to 0 psig. Slowly increase again to test pressure and hold for one more hour. Maximum allowable leakage is 2 quarts per hour per 100 joints. Remake leaking joints with new materials and repeat test until leakage is within allowed limits.
- D. Prepare test and inspection reports.

3.13 IDENTIFICATION

- A. Install continuous underground detectable warning tape during backfilling of trench for underground fire-suppression water-service piping. Locate below finished grade, directly over piping. Underground warning tapes are specified in Division 31 Section "Earth Moving."

3.14 CLEANING

- A. Clean and disinfect fire-suppression water-service piping as follows:
 1. Purge new piping systems and parts of existing systems that have been altered, extended, or repaired before use.

2. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in 2016 NFPA 24 for flushing of piping. Flush piping system with clean, potable water until dirty water does not appear at points of outlet.
 3. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in AWWA C651 or do as follows:
 - a. Fill system or part of system with water/chlorine solution containing at least 50 ppm of chlorine; isolate and allow to stand for 24 hours.
 - b. Drain system or part of system of previous solution and refill with water/chlorine solution containing at least 200 ppm of chlorine; isolate and allow to stand for three hours.
 - c. After standing time, flush system with clean, potable water until no chlorine remains in water coming from system.
 - d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedure if biological examination shows evidence of contamination.
- B. Prepare reports of purging and disinfecting activities.
- C. Underground fire-suppression water-service piping NPS 6 to NPS 12 shall be one of the following:
1. Grooved-end, ductile-iron pipe; grooved-end, ductile-iron pipe appurtenances; and grooved joints.
 2. Mechanical-joint, ductile-iron pipe; mechanical-joint, ductile- or gray-iron, standard-pattern or ductile-iron, compact-pattern fittings; glands, gaskets, and bolts; and gasketed joints.
 3. Push-on-joint, ductile-iron pipe; push-on-joint, ductile-iron compact-pattern fittings; and gasketed joints.
- D. Aboveground fire-suppression water-service piping NPS 5 to NPS 12 shall be grooved-end, ductile-iron pipe; grooved-end, ductile-iron pipe appurtenances; and grooved joints.
- E. Underslab fire-suppression water-service piping NPS 6 to NPS 12 shall be one of the following:
1. Grooved-end, ductile-iron pipe; grooved-end, ductile-iron pipe appurtenances; and grooved joints.
 2. Mechanical-joint, ductile-iron pipe; mechanical-joint, ductile- or gray-iron, standard-pattern fittings; glands, gaskets, and bolts; and restrained, gasketed joints.
 3. Push-on-joint, ductile-iron pipe; push-on-joint, ductile-iron compact-pattern fittings; and restrained, gasketed joints.

3.15 VALVE SCHEDULE

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
- B. Valves shall be of pressure rating required for specific application.

- C. Underground fire-suppression water-service shutoff valves NPS 3 and larger shall be one of the following:
 - 1. 200-psig, AWWA, iron, nonrising-stem, metal-seated gate valves.
 - 2. 250-psig, AWWA, iron, nonrising-stem, resilient-seated gate valves.
 - 3. 175-psig, 250-psig, UL-listed or FM-approved, iron, nonrising-stem gate valves.
- D. Standard-pressure, aboveground fire-suppression water-service shutoff valves NPS 3 and larger shall be one of the following:
 - 1. 200-psig, AWWA, iron, OS&Y, metal-seated gate valves.
 - 2. 250-psig, AWWA, iron, OS&Y, resilient-seated gate valves.
 - 3. 175-psig, 250-psig, UL-listed or FM-approved, iron, OS&Y gate valves.
 - 4. AWWA UL-listed or FM-approved butterfly valves.
- E. Fire-suppression water-service check valves NPS 3 and larger shall be one of the following:
 - 1. AWWA UL-listed or FM-approved check valves.
 - 2. UL-listed or FM-approved detector check valves.

END OF SECTION 211100

SECTION 211200 - FIRE-SUPPRESSION STANDPIPES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Pipes, fittings, and specialties.
 - 2. Fire-protection valves.
 - 3. Hose connections.
 - 4. Hose stations.
 - 5. Fire-department connections.
 - 6. Pressure gages.

- B. Related Sections:

- 1. Division 21 Section "Wet-Pipe Sprinkler Systems" for wet-pipe sprinkler piping.
 - 2. Division 28 Section "Digital, Addressable Fire-Alarm System" for alarm devices not specified in this Section.

1.3 DEFINITIONS

- A. High-Pressure Standpipe Piping: Fire-suppression standpipe piping designed to operate at working pressure higher than standard 175 psig (1200 kPa), but not higher than 350 psig.
- B. Standard-Pressure Standpipe Piping: Fire-suppression standpipe piping designed to operate at working pressure 175 psig maximum.

1.4 SYSTEM DESCRIPTIONS

- A. Automatic Manual Dry-Type, Class I Standpipe System: Includes NPS 2-1/2 (DN 65) hose connections. Has open water-supply valve with pressure maintained and is capable of supplying water demand.
- B. Manual Dry-Type, Class II Standpipe System: Includes NPS 1-1/2 (DN 40) hose stations. Has open water-supply valve with pressure maintained and is capable of supplying water demand.
- C. Manual Dry-Type, Class III Standpipe System: Includes NPS 1-1/2 (DN 40) hose stations and NPS 2-1/2 (DN 65) hose connections. Has open water-supply valve with pressure maintained and is capable of supplying water demand.

1.5 PERFORMANCE REQUIREMENTS

- A. Standard-Pressure, Fire-Suppression Standpipe System Component: Listed for 175-psig minimum working pressure.
- B. High-Pressure, Fire-Suppression Standpipe System Component: Listed for 350-psig working pressure.
- C. Delegated Design: Design fire-suppression standpipes, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- D. Fire-suppression standpipe design shall be approved by New Rochelle Building Department.
 - 1. Minimum residual pressure at each hose-connection outlet is as follows:
 - a. NPS 2-1/2 (DN 65) Hose Connections: 100 psig 690 kPa.
 - 2. Maximum residual pressure at required flow at each hose-connection outlet is as follows unless otherwise indicated:
 - a. NPS 2-1/2 (DN 65) Hose Connections: 100 psig (1200 kPa)] <Insert value>.
- E. Seismic Performance: Fire-suppression standpipes shall withstand the effects of earthquake motions determined according to NFPA 13 and [ASCE/SEI 7] <Insert requirement>.

1.6 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: For fire-suppression standpipes. Include plans, elevations, sections, details, and attachments to other work.
- C. Delegated-Design Submittal: For standpipe systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- D. Coordination Drawings: Fire-suppression standpipes, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Plumbing piping and equipment.
 - 2. Piping.
 - 3. HVAC piping, ductwork and equipment.
 - 4. Electric conduits and equipment.
 - 5. All general construction entities
- E. Qualification Data: For qualified Installer.

- F. Approved Standpipe Drawings: Working plans, prepared according to NYS Building Code and NFPA 14, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.
- G. Welding certificates.
- H. Fire-hydrant flow test report.
- I. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NYS Building Code and NFPA 14. Include "Contractor's Material and Test Certificate for Aboveground Piping" and "Contractor's Material and Test Certificate for Underground Piping."
- J. Field quality-control reports.
- K. Operation and Maintenance Data: For fire-suppression standpipes specialties to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. Installer's responsibilities include designing, fabricating, and installing fire-suppression standpipes and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.
 - a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.
- B. Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. NFPA Standards: Fire-suppression standpipe equipment, specialties, accessories, installation, and testing shall comply with 2020 NYS Building Code and 2016 NFPA 14, "Installation of Standpipe and Hose Systems."

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, and fitting materials, and for joining methods for specific services, service locations, and pipe sizes.

2.2 STEEL PIPE AND FITTINGS

- A. Standard Weight, Galvanized-and Black-Steel Pipe: ASTM A 53/A 53M, Grade B. Pipe ends may be factory or field formed to match joining method.
- B. Schedule 10, Black-Steel Pipe: ASTM A 135 or ASTM A 795/A 795M, Schedule 10 in NPS 2.5 to NPS5; and NFPA 13-specified wall thickness in NPS 6 to NPS 10, plain end.
- C. Standard-Weight, Galvanized-and Black-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, seamless steel pipe with threaded ends.
- D. Galvanized and Uncoated, Steel Couplings: ASTM A 865, threaded.
- E. Galvanized and Uncoated, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.
- F. Malleable- or Ductile-Iron Unions: UL 860.
- G. Cast-Iron Flanges: ASME B16.1, Class 125.
- H. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.
- I. Steel Welding Fittings: ASTM A 234/A 234M and ASME B16.9.
- J. Grooved-Joint, Steel-Pipe Appurtenances:
 - 1. Manufacturers: Subject to compliance with requirements, [provide products by one of the following:
 - a. Anvil International, Inc.
 - b. Corcoran Piping System Co.
 - c. National Fittings, Inc.
 - d. Shurjoint Piping Products.
 - e. Tyco Fire & Building Products LP.
 - f. Victaulic Company.
 - 2. Pressure Rating: 175 psig (1200 kPa).
 - 3. [Galvanized] [and] [Uncoated], Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile-iron casting; with dimensions matching steel pipe.
 - 4. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213, rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

2.3 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free.

1. Class 125, Cast-Iron Flanges and Class 150, Bronze Flat-Face Flanges: Full-face gaskets.
 2. Class 250, Cast-Iron Flanges and Class 300, Steel Raised-Face Flanges: Ring-type gaskets.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- C. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.4 LISTED FIRE-PROTECTION VALVES

A. General Requirements:

1. Valves shall be UL listed or FM approved.
2. Minimum Pressure Rating for Standard-Pressure Piping: 175 psig 350.
3. Minimum Pressure Rating for High-Pressure Piping:

B. Check Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following :
 - a. AFAC Inc.
 - b. American Cast Iron Pipe Company; Waterous Company Subsidiary.
 - c. Anvil International, Inc.
 - d. Clow Valve Company; a division of McWane, Inc.
 - e. Crane Co.; Crane Valve Group; Crane Valves.
 - f. Crane Co.; Crane Valve Group; Jenkins Valves.
 - g. Crane Co.; Crane Valve Group; Stockham Division.
 - h. Fire-End & Croker Corporation.
 - i. Fire Protection Products, Inc.
 - j. Fivalco Inc.
 - k. Globe Fire Sprinkler Corporation.
 - l. Groeniger & Company.
 - m. Kennedy Valve; a division of McWane, Inc.
 - n. Matco-Norca.
 - o. Metraflex, Inc.
 - p. Milwaukee Valve Company.
 - q. Mueller Co.; Water Products Division.
 - r. NIBCO INC.
 - s. Potter Roemer.
 - t. Reliable Automatic Sprinkler Co., Inc.
 - u. Shurjoint Piping Products.
 - v. Tyco Fire & Building Products LP.
 - w. United Brass Works, Inc.
 - x. Venus Fire Protection Ltd.
 - y. Victaulic Company.
 - z. Viking Corporation.
 - aa. Watts Water Technologies, Inc.

2. Standard: UL 312.
3. Pressure Rating: 250 psig minimum.
4. Type: Swing check.
5. Body Material: Cast iron.
6. End Connections: Flanged or grooved.

C. Iron OS&Y Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Cast Iron Pipe Company; Waterous Company Subsidiary.
 - b. American Valve, Inc.
 - c. Clow Valve Company; a division of McWane, Inc.
 - d. Crane Co.; Crane Valve Group; Crane Valves.
 - e. Crane Co.; Crane Valve Group; Jenkins Valves.
 - f. Crane Co.; Crane Valve Group; Stockham Division.
 - g. Hammond Valve.
 - h. Milwaukee Valve Company.
 - i. Mueller Co.; Water Products Division.
 - j. NIBCO INC.
 - k. Shurjoint Piping Products.
 - l. Tyco Fire & Building Products LP.
 - m. United Brass Works, Inc.
 - n. Watts Water Technologies, Inc.
2. Standard: UL 262.
3. Pressure Rating: 250 psig (1725 kPa) minimum.
4. Body Material: Cast or ductile iron.
5. End Connections: Flanged or grooved.

D. NRS Gate Valves:

1. Manufacturers: Subject to compliance with requirements, [provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. American Cast Iron Pipe Company; Waterous Company Subsidiary.
 - b. American Valve, Inc.
 - c. Clow Valve Company; a division of McWane, Inc.
 - d. Crane Co.; Crane Valve Group; Stockham Division.
 - e. Kennedy Valve; a division of McWane, Inc.
 - f. Mueller Co.; Water Products Division.
 - g. NIBCO INC.
 - h. Tyco Fire & Building Products LP.
2. Standard: UL 262.
3. Pressure Rating: 250 psig (1725 kPa) minimum.
4. Body Material: Cast iron with indicator post flange.
5. Stem: Nonrising.
6. End Connections: Flanged or grooved.

2.5 SPECIALTY VALVES

A. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating:
 - a. Standard-Pressure Piping Specialty Valves: 175 psig minimum.
 - b. High-Pressure Piping Specialty Valves: 350 psig.
3. Body Material: Cast or ductile iron.
4. Size: Same as connected piping.
5. End Connections: Flanged or grooved.

B. Automatic (Ball Drip) Drain Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AFAC Inc.
 - b. Reliable Automatic Sprinkler Co., Inc.
 - c. Tyco Fire & Building Products LP.
2. Standard: UL 1726.
3. Pressure Rating: 175 psig minimum.
4. Type: Automatic draining, ball check.
5. Size: NPS 3/4 .
6. End Connections: Threaded.

2.6 HOSE CONNECTIONS

A. Adjustable-Valve Hose Connections:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AFAC Inc.
 - b. Elkhart Brass Mfg. Company, Inc.
 - c. Fire-End & Croker Corporation.
 - d. Fire Protection Products, Inc.
 - e. GMR International Equipment Corporation.
 - f. Guardian Fire Equipment, Inc.
 - g. Potter Roemer.
 - h. Tyco Fire & Building Products LP.
 - i. Wilson & Cousins Inc.
 - j. Zurn Plumbing Products Group; Wilkins Water Control Products Division.
2. Standard: UL 668 hose valve, with integral UL 1468 reducing or restricting pressure-control device, for connecting fire hose.

3. Pressure Rating: 350 psig minimum.
4. Material: Brass or bronze.
5. Size: NPS 1-1/2 or NPS 2-1/2, as indicated.
6. Inlet: Female pipe threads.
7. Outlet: Male hose threads with lugged cap, gasket, and chain. Include hose valve threads according to NFPA 1963 and matching local fire-department threads.
8. Pattern: Angle or gate.
9. Pressure-Control Device Type: Pressure reducing.
10. Design Outlet Pressure Setting: psig.
11. Finish: Rough brass or bronze.

B. Nonadjustable-Valve Hose Connections:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AFAC Inc.
 - b. Elkhart Brass Mfg. Company, Inc.
 - c. Fire-End & Croker Corporation.
 - d. Fire Protection Products, Inc.
 - e. GMR International Equipment Corporation.
 - f. Guardian Fire Equipment, Inc.
 - g. Kennedy Valve; a division of McWane, Inc.
 - h. Mueller Co.; Water Products Division.
 - i. NIBCO INC.
 - j. Potter Roemer.
 - k. Tyco Fire & Building Products LP.
 - l. Wilson & Cousins Inc.
2. Standard: UL 668 hose valve for connecting fire hose.
3. Pressure Rating: 300 psig minimum.
4. Material: Brass or bronze.
5. Size: NPS 1-1/2 or NPS 2-1/2, as indicated.
6. Inlet: Female pipe threads.
7. Outlet: Male hose threads with lugged cap, gasket, and chain. Include hose valve threads according to NFPA 1963 and matching local fire-department threads.
8. Pattern: Angle or gate.
9. Finish: Rough brass or bronze.

2.7 NPS 1-1/2 RACK-TYPE HOSE STATIONS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. AFAC Inc.
 2. American Fire Hose & Cabinet.
 3. Angus; Part of Kidde Fire Fighting Organization.
 4. Brooks Equipment Co., Inc.
 5. Elkhart Brass Mfg. Company, Inc.
 6. Fire-End & Croker Corporation.

7. GMR International Equipment Corporation.
8. Potter Roemer.
9. Wilson & Cousins Inc.

B. Hose Rack:

1. Standard: UL 47.
2. Material: Steel with red-enamel finish.
3. Type: Hose-rack assembly. Include hose valve, hose rack, water-retention device, hose pins, and hose.
4. Operation: Semiautomatic.
5. Sized to hold fire hose.

C. Hose Valve:

1. Standard: UL 668 NPS 1-1/2 , for connecting fire hose.
2. Type: Adjustable.
3. Pressure-Control Device: Pressure reducing or pressure restricting as required.
4. Design Outlet Pressure Setting: See drawings.
5. Hose Valve and Trim Finish: Rough brass or bronze.
6. Pressure Rating: 300 psig minimum.
7. Pattern: Angle.
8. Material: Brass or bronze.
9. Pressure-Control Device: UL 1468 integral or for field installation if indicated.
10. Size: NPS 1-1/2 .
11. Inlet: Female pipe threads.
12. Outlet: Male hose threads according to NFPA 1963 and matching local fire-department threads.

D. Hose:

1. Standards: NFPA 1961 and UL 219 lined fire hose with swivel inlet, coupling, gaskets, and nozzle.
2. Size: NPS 1-1/2.
3. Length: 125 feet maximum.
4. Jacket: Combination of natural and synthetic threads.
5. Lining: Rubber, plastic, or combination of rubber and plastic compounds.
6. Cover: Rubber, plastic, or combination of rubber and plastic compounds.
7. Nozzle: UL 401.
 - a. Material: Brass .
 - b. Type: Plain, for nonadjustable water stream.

2.8 NPS 1-1/2 BY NPS 2-1/2 RACK-TYPE HOSE STATIONS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. AFAC Inc.
 2. American Fire Hose & Cabinet.

3. Angus; Part of Kidde Fire Fighting Organization.
4. Brooks Equipment Co., Inc.
5. Elkhart Brass Mfg. Company, Inc.
6. Fire-End & Croker Corporation.
7. GMR International Equipment Corporation.
8. Potter Roemer.
9. Wilson & Cousins Inc.

B. Hose Rack:

1. Standard: UL 47.
2. Material: Steel with red-enamel finish.
3. Type: Hose-rack assembly. Include hose valve, reducer adapter, hose rack, water-retention device, hose pins, and hose.
4. Operation: Semiautomatic.
5. Sized to hold fire hose.

C. Hose Valve:

1. Standard: UL 668, NPS 2-1/2, for connecting fire hose.
2. Type: Adjustable.
3. Pressure-Control Device: Pressure reducing or pressure restricting.
4. Design Outlet Pressure Setting: psig.
5. Hose Valve and Trim Finish: Rough brass or bronze.
6. Pressure Rating: 300 psig minimum.
7. Pattern: Angle.
8. Material: Brass or bronze.
9. Pressure-Control Device: UL 1468, integral or for field installation if indicated.
10. Size: NPS 2-1/2.
11. Inlet: Female pipe threads.
12. Outlet: Male hose threads according to NFPA 1963 and matching local fire-department threads.
13. Reducer Adapter: NPS 2-1/2 by NPS 1-1/2.

D. Hose:

1. Standards: NFPA 1961 and UL 219, lined fire hose with swivel inlet, coupling, gaskets, and nozzle.
2. Size: NPS 1-1/2.
3. Length: 125 feet maximum.
4. Jacket: Combination of natural and synthetic threads.
5. Lining: Rubber, plastic, or combination of rubber and plastic compounds.
6. Cover: Rubber, plastic, or combination of rubber and plastic compounds.
7. Nozzle: UL 401 spray nozzle unless plain nozzle is indicated.
 - a. Material: Brass.
 - b. Type: Plain, for nonadjustable water stream.

2.9 FIRE-DEPARTMENT CONNECTIONS

A. Flush-Type, Fire-Department Connection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AFAC Inc.
 - b. Elkhart Brass Mfg. Company, Inc.
 - c. GMR International Equipment Corporation.
 - d. Guardian Fire Equipment, Inc.
 - e. Potter Roemer.
2. Standard: UL 405.
3. Type: Flush, for wall mounting.
4. Pressure Rating: 175 psig minimum.
5. Body Material: Corrosion-resistant metal.
6. Inlets: Brass with threads according to NFPA 1963 and matching local fire-department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.
7. Caps: Brass, lugged type, with gasket and chain.
8. Escutcheon Plate: Rectangular, brass, wall type.
9. Outlet: With pipe threads.
10. Body Style: Horizontal.
11. Number of Inlets: Two.
12. Outlet Location: Back Bottom Left side, Right side Top as required.
13. Escutcheon Plate Marking: Similar to "AUTO SPKR & STANDPIPE."
14. Finish: Polished chrome plated.
15. Outlet Size: NPS 4 (DN 100) NPS 5 (DN 125) NPS 6 (DN 150).

2.10 PRESSURE GAGES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. AMETEK; U.S. Gauge Division.
 2. Ashcroft Inc.
 3. Brecco Corporation.
 4. WIKA Instrument Corporation.
- B. Standard: UL 393.
- C. Dial Size: 3-1/2- to 4-1/2-inch diameter.
- D. Pressure Gage Range: 0 to 300 psig.
- E. Water System Piping Gage: Include "WATER" or "AIR/WATER" label on dial face.

2.11 ESCUTCHEONS

- A. General: Manufactured ceiling, floor, and wall escutcheons and floor plates.
- B. One-Piece, Cast-Brass Escutcheons: Polished chrome-plated finish with set-screws.
- C. One-Piece, Deep-Pattern Escutcheons: Deep-drawn, box-shaped brass with chrome-plated finish.
- D. One-Piece, Stamped-Steel Escutcheons: Chrome-plated finish with set-screw.
- E. Split-Casting, Cast-Brass Escutcheons: Polished chrome-plated finish with concealed hinge and set-screw.
- F. Split-Plate, Stamped-Steel Escutcheons: Chrome-plated finish with concealed hinge and set-screw.
- G. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.
- H. Split-Casting Floor Plates: Cast brass with concealed hinge.

2.12 SLEEVES

- A. Cast-Iron Wall-Pipe Sleeves: Cast or fabricated of cast iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
- B. Galvanized-Steel-Sheet Sleeves: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.
- C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, standard weight, zinc coated, plain ends.
- D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 - 1. Underdeck Clamp: Clamping ring with set-screws.

2.13 SLEEVE SEALS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Advance Products & Systems, Inc.
 - 2. Calpico, Inc.
 - 3. Metraflex, Inc.
 - 4. Pipeline Seal and Insulator, Inc.
- B. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
2. Pressure Plates: Carbon steel.
3. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements.

2.14 GROUT

- A. Standard: ASTM C 1107, Grade B, posthardening and volume adjusting, dry, hydraulic-cement grout.
- B. Characteristics: Nonshrink, and recommended for interior and exterior applications.
- C. Design Mix: 5000-psi , 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Perform fire-hydrant flow test according to NYS DEP NFPA 14 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Article.
- B. Report test results promptly and in writing.

3.2 EXAMINATION

- A. Examine roughing-in for hose connections and stations to verify actual locations of piping connections before installation.
- B. Examine walls and partitions for suitable thickness, fire- and smoke-rated construction, framing for hose-station cabinets, and other conditions where hose connections and stations are to be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 PIPING INSTALLATION

- A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.
 1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.

- B. Piping Standard: Comply with requirements in NYS Building Code NFPA 14 for installation of fire-suppression standpipe piping.
- C. Install seismic restraints on piping. Comply with requirements in NFPA 13 for seismic-restraint device materials and installation.
- D. Install listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
- E. Install drain valves on standpipes. Extend drain piping to outside of building.
- F. Install automatic (ball drip) drain valves to drain piping between fire-department connections and check valves. Drain to floor drain or outside building.
- G. Install alarm devices in piping systems.
- H. Install hangers and supports for standpipe system piping according to NYS Building Code and NFPA 14. Comply with requirements in NFPA 13 for hanger materials.
- I. Install pressure gages on riser or feed main and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 and with soft-metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they will not be subject to freezing.
- J. Fill wet-type standpipe system piping with water.
- K. Install electric heating cables and pipe insulation on wet-type, fire-suppression standpipe piping in areas subject to freezing. Comply with requirements for heating cables in Division 21 Section "Heat Tracing for Fire-Suppression Piping" and for piping insulation in Division 21 Section "Fire-Suppression Systems Insulation."

3.4 JOINT CONSTRUCTION

- A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.
- B. Install unions adjacent to each valve in pipes NPS 2 and smaller.
- C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.
- D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.

- G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- H. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.
- I. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.
- J. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.
 - 1. Shop weld pipe joints where welded piping is indicated. Do not use welded joints for galvanized-steel pipe.
- K. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.5 VALVE AND SPECIALTIES INSTALLATION

- A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NYS Building Code NFPA 14 and authorities having jurisdiction.
- B. Install listed fire-protection shutoff valves supervised-open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.
- C. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.
- D. Specialty Valves:
 - 1. General Requirements: Install in vertical position for proper direction of flow, in main supply to system.

3.6 HOSE-CONNECTION INSTALLATION

- A. Install hose connections adjacent to standpipes.
- B. Install freestanding hose connections for access and minimum passage restriction.
- C. Install NPS 1-1/2 hose-connection valves with flow-restricting device.

- D. Install NPS 2-1/2 hose connections with quick-disconnect NPS 2-1/2 by NPS 1-1/2 (DN 65 by DN 40) reducer adapter and flow-restricting device.
- E. Install wall-mounted-type hose connections in cabinets. Include pipe escutcheons, with finish matching valves, inside cabinet where water-supply piping penetrates cabinet. Install valves at angle required for connection of fire hose. Comply with requirements for cabinets in Division 10 Section "Fire Extinguisher Cabinets."

3.7 FIRE-DEPARTMENT CONNECTION INSTALLATION

- A. Install wall-type, fire-department connections.
- B. Install automatic (ball drip) drain valve at each check valve for fire-department connection.

3.8 ESCUTCHEON INSTALLATION

- A. Install escutcheons for penetrations of walls, ceilings, and floors.
- B. Escutcheons for New Piping:
 - 1. Piping with Fitting or Sleeve Protruding from Wall: One piece, deep pattern.
 - 2. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish.
 - 3. Bare Piping at Ceiling Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish.
 - 4. Bare Piping in Unfinished Service Spaces: One piece, stamped steel with set-screw.
 - 5. Bare Piping in Equipment Rooms: One piece, stamped steel with set-screw.
 - 6. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece floor plate.

3.9 SLEEVE INSTALLATION

- A. General Requirements: Install sleeves for pipes and tubes passing through penetrations in floors, partitions, roofs, and walls.
- B. Sleeves are not required for core-drilled holes.
- C. Permanent sleeves are not required for holes formed by removable PE sleeves.
- D. Cut sleeves to length for mounting flush with both surfaces unless otherwise indicated.
- E. Install sleeves in new partitions, slabs, and walls as they are built.
- F. For interior wall penetrations, seal annular space between sleeve and pipe or pipe insulation using joint sealants appropriate for size, depth, and location of joint. Comply with requirements for joint sealants in Division 07 Section "Joint Sealants."

- G. For exterior wall penetrations above grade, seal annular space between sleeve and pipe using joint sealants appropriate for size, depth, and location of joint. Comply with requirements for joint sealants in Division 07 Section "Joint Sealants."
- H. For exterior wall penetrations below grade, seal annular space between sleeve and pipe using sleeve seals.
- I. Seal space outside of sleeves in concrete slabs and walls with grout.
- J. Install sleeves that are large enough to provide 1 inch annular clear space between sleeve and pipe or pipe insulation unless otherwise indicated.
- K. Install sleeve materials according to the following applications:
 - 1. Sleeves for Piping Passing through Concrete Floor Slabs: Galvanized-steel pipe.
 - 2. Sleeves for Piping Passing through Concrete Floor Slabs of Mechanical Equipment Areas or Other Wet Areas: Galvanized-steel pipe.
 - a. Extend sleeves 2 inches above finished floor level.
 - b. For pipes penetrating floors with membrane waterproofing, extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Comply with requirements for flashing in Division 07 Section "Sheet Metal Flashing and Trim."
 - 3. Sleeves for Piping Passing through Gypsum-Board Partitions:
 - a. Galvanized-steel-pipe sleeves for pipes smaller than NPS 6.
 - b. Galvanized-steel-sheet sleeves for pipes NPS 6 and larger.
 - c. Exception: Sleeves are not required for water-supply tubes and waste pipes for individual plumbing fixtures if escutcheons will cover openings.
 - 4. Sleeves for Piping Passing through Concrete Roof Slabs: Galvanized-steel pipe.
 - 5. Sleeves for Piping Passing through Exterior Concrete Walls:
 - a. Galvanized-steel-pipe sleeves for pipes smaller than NPS 6.
 - b. Cast-iron wall pipe sleeves for pipes NPS 6 (DN 150) and larger.
 - c. Install sleeves that are large enough to provide 1-inch annular clear space between sleeve and pipe or pipe insulation when sleeve seals are used.
 - 6. Sleeves for Piping Passing through Interior Concrete Walls:
 - a. Galvanized-steel-pipe sleeves for pipes smaller than NPS 6.
 - b. Galvanized-steel-sheet sleeves for pipes NPS 6 and larger.
- L. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestop materials and installations in Division 07 Section "Penetration Firestopping."

3.10 SLEEVE SEAL INSTALLATION

- A. Install sleeve seals in sleeves in exterior concrete walls at water-service piping entries into building.
- B. Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble sleeve seal components and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.11 IDENTIFICATION

- A. Install labeling and pipe markers on equipment and piping according to requirements in NYS Building Code and NFPA 14.
- B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.12 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - 3. Flush, test, and inspect standpipe systems according to NYS Building Code NFPA 14, "System Acceptance" Chapter.
 - 4. Energize circuits to electrical equipment and devices.
 - 5. Start and run air compressors.
 - 6. Coordinate with fire-alarm tests. Operate as required.
 - 7. Coordinate with fire-pump tests. Operate as required.
 - 8. Verify that equipment hose threads are same as local fire-department equipment.

3.13

- A. Fire-suppression standpipe system will be considered defective if it does not pass tests and inspections.
- B. Prepare test and inspection reports.

3.14 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain specialty valves.

3.15 PIPING SCHEDULE

- A. Piping between Fire-Department Connections and Check Valves: Galvanized, standard-weight steel pipe with threaded ends; cast-iron threaded fittings; and threaded or grooved ends; grooved-end fittings; grooved-end-pipe couplings; and grooved joints.
- B. Standard-pressure, wet-type, fire-suppression standpipe piping, NPS 2.5 and smaller, shall be one of the following:
 - 1. Standard-weight, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
 - 2. Standard-weight, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
- C. Standard-pressure, wet-type, fire-suppression standpipe piping, NPS 3 and larger shall be one of the following:
 - 1. Standard-weight, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
 - 2. Standard-weight, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
 - 3. Standard-weight, black-steel pipe with cut- or roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
 - 4. Standard-weight, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
 - 5. Schedule 10, black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
- D. High-pressure, wet-type, fire-suppression standpipe piping, NPS 2.5 and smaller, shall be one of the following:
 - 1. Standard-weight, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
 - 2. Standard-weight, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
 - 3. Standard-weight, black-steel pipe with cut, cut- or roll, roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
 - 4. Standard-weight, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
- E. High-pressure, wet-type, fire-suppression standpipe piping, NPS 3 and larger shall be one of the following:
 - 1. Standard-weight, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
 - 2. Standard-weight, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
 - 3. Standard-weight, black-steel pipe with cut-or roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

4. Standard-weight, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

END OF SECTION 211200

SECTION 211313 - WET-PIPE SPRINKLER SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

1. Pipes, fittings, and specialties.
2. Fire-protection valves.
3. Fire-department connections.
4. Sprinklers.
5. Alarm devices.
6. Control panels.
7. Pressure gages.

- B. Related Sections:

1. Division 21 Section "Fire-Suppression Standpipes" for standpipe piping.
2. Division 21 Section "Electric-Drive, Centrifugal Fire Pumps Electric-Drive, Vertical-Turbine Fire Pumps" for fire pumps, pressure-maintenance pumps, and fire-pump controllers.

1.3 DEFINITIONS

- A. High-Pressure Sprinkler Piping: Wet-pipe sprinkler system piping designed to operate at working pressure higher than standard 175 psig, but not higher than 350 psig.
- B. Standard-Pressure Sprinkler Piping: Wet-pipe sprinkler system piping designed to operate at working pressure of 175 psig (1200 kPa) maximum.

1.4 SYSTEM DESCRIPTIONS

- A. Wet-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water and that is connected to water supply through a fire pump. Water discharges immediately from sprinklers when they are opened. Sprinklers open when heat melts fusible link or destroys frangible device. Hose connections are included if indicated.

1.5 PERFORMANCE REQUIREMENTS

- A. Standard-Pressure Piping System Component: Listed for 175-psig, minimum working pressure.
- B. High-Pressure Piping System Component: Listed for 350-psig minimum working pressure.
- C. Delegated Design: Design sprinkler system(s), including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- D. Sprinkler system design shall be approved by authorities having jurisdiction.
 - 1. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.
 - 2. Sprinkler Occupancy Hazard Classifications:
 - a. Building Service Areas: Ordinary Hazard, Group 1.
 - b. Electrical Equipment Rooms: Ordinary Hazard, Group 1.
 - c. General Storage Areas: Ordinary Hazard, Group 1.
 - d. Laundries: Ordinary Hazard, Group 1.
 - e. Mechanical Equipment Rooms: Ordinary Hazard, Group 1.
 - f. Office and Public Areas: Light Hazard.
 - g. Residential Living Areas: Light Hazard.
 - 3. Minimum Density for Automatic-Sprinkler Piping Design:
 - a. Residential (Dwelling) Occupancy: 0.01 gpm over largest area.
 - b. Light-Hazard Occupancy: 0.10 gpm over 1500-sq. ft. area.
 - c. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 1500-sq. ft. area.
 - d. Ordinary-Hazard, Group 2 Occupancy: 0.20 gpm over 1500-sq. ft. area.
 - 4. Maximum Protection Area per Sprinkler:
 - a. Residential Areas: 225 sq. ft.
 - b. Office Spaces: 225 sq. ft.
 - c. Storage Areas: 130 sq. ft.
 - d. Mechanical Equipment Rooms: 130 sq. ft.
 - e. Electrical Equipment Rooms: 130 sq. ft.
 - f. Other Areas: According to NFPA 13 recommendations unless otherwise indicated.
 - 5. Total Combined Hose-Stream Demand Requirement: According to NYS Building Code and NFPA 13 unless otherwise indicated:
 - a. Light-Hazard Occupancies: 100 gpm for 30 minutes.
 - b. Ordinary-Hazard Occupancies: 250 gpm for 60 to 90 minutes.

1.6 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

Environmental Sustainability Documentation: Contractor shall submit for approval, a fully completed Environmental Building Materials Certification Form and backup documentation from the manufacturer or supplier of each type used in this section. Such backup documentation shall be typewritten on the manufacturer's letterhead or product data sheet published by the manufacturer.

1. Adhesives and Sealants
 - a. Adhesives and sealants used inside the building and applied on-site shall comply with South Coast Air Quality Management District Rule #1168. Documentation shall include product data submission for each material and shall demonstrate the volatile organic compound (VOC) content of the material.
2. Paints and Coatings
 - a. All paints and coatings used inside the building and applied on-site must not exceed the VOC content limits established in Green Seal Standard GS-11, Paints, 1st Edition, May 20, 1993. All anti-corrosive and anti-rust paints applied on-site to interior ferrous metal substrates must not exceed the VOC content limit established in Green Seal Standard GC-03, Anti-Corrosive Paints, 2nd Edition, January 7, 1997. All clear wood finishes, floor coatings, stains, primers and shellacs applied on-site to interior elements must not exceed the VOC content limits established in South Coast Air Quality Management District Rule 1113, January 1, 2004.
 - b. Documentation shall include product data submission for each material and shall demonstrate the volatile organic compound (VOC) level of the material.
- B. Shop Drawings: For wet-pipe sprinkler systems. Include plans, elevations, sections, details, and attachments to other work.
 1. Wiring Diagrams: For power, signal, and control wiring.
- C. Coordination Drawings: Sprinkler systems, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 1. Domestic water piping.
 2. Sanitary Piping.
 3. HVAC hydronic piping and other conduits.
 4. Ductwork.
 5. Items penetrating finished ceiling include the following:
 - a. Lighting fixtures.
 - b. Air outlets and inlets.
 - c. Speakers.
 - d. Miscellaneous ceiling mounted devices.
- D. Qualification Data: For qualified Installer.
- E. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.

- F. Welding certificates.
- G. Fire-hydrant flow test report.
- H. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in 2020 NYS Building Code and 2016 NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."
- I. Field quality-control reports.
- J. Operation and Maintenance Data: For sprinkler specialties to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.
 - a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.
- B. Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in 2016 NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. NFPA Standards: Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:
 - 1. 2020 NYS Building Code.
 - 2. 2016 NFPA 13, "Installation of Sprinkler Systems."

1.8 COORDINATION

- A. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

1.9 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Sprinkler Cabinets: Finished, wall-mounted, steel cabinet with hinged cover, and with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of

sprinklers required by 2016 NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler used on Project.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, and fitting materials, and for joining methods for specific services, service locations, and pipe sizes.

2.2 STEEL PIPE AND FITTINGS

- A. Schedule 40, Black-Steel Pipe: ASTM A 135 or ASTM A 795/A 795M, Schedule 40 in NPS 2.5 and larger.
- B. Galvanized and Black-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, standard-weight, seamless steel pipe with threaded ends.
- C. Cast-Iron Flanges: ASME 16.1, Class 125.
- D. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.
- E. Steel Welding Fittings: ASTM A 234/A 234M and ASME B16.9.
- F. Grooved-Joint, Steel-Pipe Appurtenances:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International, Inc.
 - b. Corcoran Piping System Co.
 - c. National Fittings, Inc.
 - d. Shurjoint Piping Products.
 - e. Tyco Fire & Building Products LP.
 - f. Victaulic Company.
 - 2. Pressure Rating: 175 psig.
 - 3. Galvanized and Uncoated, Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile-iron casting; with dimensions matching steel pipe.
 - 4. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213, rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

2.3 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick and or ASME B16.21, nonmetallic and asbestos free.

1. Class 125, Cast-Iron Flanges and Class 150, Bronze Flat-Face Flanges: Full-face gaskets.
 2. Class 250, Cast-Iron Flanges and Class 300, Steel Raised-Face Flanges: Ring-type gaskets.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- C. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.4 LISTED FIRE-PROTECTION VALVES

A. General Requirements:

1. Valves shall be UL listed or FM approved.
2. Minimum Pressure Rating for Standard-Pressure Piping: 175 psig.
3. Minimum Pressure Rating for High-Pressure Piping: 350 psig.

B. Ball Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International, Inc.
 - b. Victaulic Company.
2. Standard: UL 1091 except with ball instead of disc.
3. Valves NPS 1-1/2 and Smaller: Bronze body with threaded ends.
4. Valves NPS 2 and NPS 2-1/2: Bronze body with threaded ends or ductile-iron body with grooved ends.
5. Valves NPS 3: Ductile-iron body with grooved ends.

C. Bronze Butterfly Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Fivalco Inc.
 - b. Global Safety Products, Inc.
 - c. Milwaukee Valve Company.
2. Standard: UL 1091.
3. Pressure Rating: 175 psig.
4. Body Material: Bronze.
5. End Connections: Threaded.

D. Iron Butterfly Valves:

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

- a. Anvil International, Inc.
 - b. Fivalco Inc.
 - c. Global Safety Products, Inc.
 - d. Kennedy Valve; a division of McWane, Inc.
 - e. Milwaukee Valve Company.
 - f. NIBCO INC.
 - g. Pratt, Henry Company.
 - h. Shurjoint Piping Products.
 - i. Tyco Fire & Building Products LP.
 - j. Victaulic Company.
2. Standard: UL 1091.
 3. Pressure Rating: 175 psig .
 4. Body Material: Cast or ductile iron.
 5. Style: Lug or wafer.
 6. End Connections: Grooved.

E. Check Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AFAC Inc.
 - b. American Cast Iron Pipe Company; Waterous Company Subsidiary.
 - c. Anvil International, Inc.
 - d. Clow Valve Company; a division of McWane, Inc.
 - e. Crane Co.; Crane Valve Group; Crane Valves.
 - f. Crane Co.; Crane Valve Group; Jenkins Valves.
 - g. Crane Co.; Crane Valve Group; Stockham Division.
 - h. Fire-End & Croker Corporation.
 - i. Fire Protection Products, Inc.
 - j. Fivalco Inc.
 - k. Globe Fire Sprinkler Corporation.
 - l. Groeniger & Company.
 - m. Kennedy Valve; a division of McWane, Inc.
 - n. Matco-Norca.
 - o. Metraflex, Inc.
 - p. Milwaukee Valve Company.
 - q. Mueller Co.; Water Products Division.
 - r. NIBCO INC.
 - s. Potter Roemer.
 - t. Reliable Automatic Sprinkler Co., Inc.
 - u. Shurjoint Piping Products.
 - v. Tyco Fire & Building Products LP.
 - w. United Brass Works, Inc.
 - x. Venus Fire Protection Ltd.
 - y. Victaulic Company.
 - z. Viking Corporation.
 - aa. Watts Water Technologies, Inc.
2. Standard: UL 312.

3. Pressure Rating: 250 psig minimum.
4. Type: Swing check.
5. Body Material: Cast iron.
6. End Connections: Flanged or grooved.

F. Bronze OS&Y Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Stockham Division.
 - c. Milwaukee Valve Company.
 - d. NIBCO INC.
 - e. United Brass Works, Inc.
2. Standard: UL 262.
3. Pressure Rating: 175 psig.
4. Body Material: Bronze.
5. End Connections: Threaded.

G. Iron OS&Y Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Cast Iron Pipe Company; Waterous Company Subsidiary.
 - b. American Valve, Inc.
 - c. Clow Valve Company; a division of McWane, Inc.
 - d. Crane Co.; Crane Valve Group; Crane Valves.
 - e. Crane Co.; Crane Valve Group; Jenkins Valves.
 - f. Crane Co.; Crane Valve Group; Stockham Division.
 - g. Hammond Valve.
 - h. Milwaukee Valve Company.
 - i. Mueller Co.; Water Products Division.
 - j. NIBCO INC.
 - k. Shurjoint Piping Products.
 - l. Tyco Fire & Building Products LP.
 - m. United Brass Works, Inc.
 - n. Watts Water Technologies, Inc.
2. Standard: UL 262.
3. Pressure Rating: 250 psig minimum.
4. Body Material: Cast or ductile iron.
5. End Connections: Flanged or grooved.

H. Indicating-Type Butterfly Valves:

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

- a. Anvil International, Inc.
 - b. Fivalco Inc.
 - c. Global Safety Products, Inc.
 - d. Kennedy Valve; a division of McWane, Inc.
 - e. Milwaukee Valve Company.
 - f. NIBCO INC.
 - g. Shurjoint Piping Products.
 - h. Tyco Fire & Building Products LP.
 - i. Victaulic Company.
2. Standard: UL 1091.
3. Pressure Rating: 175 psig minimum.
4. Valves NPS 2 and Smaller:
 - a. Valve Type: Ball or butterfly.
 - b. Body Material: Bronze.
 - c. End Connections: Threaded.
5. Valves NPS 2-1/2 and Larger:
 - a. Valve Type: Butterfly.
 - b. Body Material: Cast or ductile iron.
 - c. End Connections: Flanged, grooved, or wafer.
6. Valve Operation: Integral electrical, 115-V ac, prewired, single-circuit, supervisory switch electrical, 115-V ac, prewired, two-circuit, supervisory switch, visual indicating device as required by project requirements.

I. NRS Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Cast Iron Pipe Company; Waterous Company Subsidiary.
 - b. American Valve, Inc.
 - c. Clow Valve Company; a division of McWane, Inc.
 - d. Crane Co.; Crane Valve Group; Stockham Division.
 - e. Kennedy Valve; a division of McWane, Inc.
 - f. Mueller Co.; Water Products Division.
 - g. NIBCO INC.
 - h. Tyco Fire & Building Products LP.
2. Standard: UL 262.
3. Pressure Rating: 250 psig minimum.
4. Body Material: Cast iron with indicator post flange.
5. Stem: Nonrising.
6. End Connections: Flanged or grooved.

2.5 TRIM AND DRAIN VALVES

A. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating: 175 psig minimum.

B. Angle Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Fire Protection Products, Inc.
 - b. United Brass Works, Inc.

C. Ball Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Affiliated Distributors.
 - b. Anvil International, Inc.
 - c. Barnett.
 - d. Conbraco Industries, Inc.; Apollo Valves.
 - e. Fire-End & Croker Corporation.
 - f. Fire Protection Products, Inc.
 - g. Flowserve.
 - h. FNW.
 - i. Jomar International, Ltd.
 - j. Kennedy Valve; a division of McWane, Inc.
 - k. Kitz Corporation.
 - l. Legend Valve.
 - m. Metso Automation USA Inc.
 - n. Milwaukee Valve Company.
 - o. NIBCO INC.
 - p. Potter Roemer.
 - q. Red-White Valve Corporation.
 - r. Southern Manufacturing Group.
 - s. Stewart, M. A. and Sons Ltd.
 - t. Tyco Fire & Building Products LP.
 - u. Victaulic Company.
 - v. Watts Water Technologies, Inc.

D. Globe Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Fire Protection Products, Inc.
 - b. United Brass Works, Inc.

2.6 SPECIALTY VALVES

A. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating:
 - a. Standard-Pressure Piping Specialty Valves: 175 psig minimum.
 - b. High-Pressure Piping Specialty Valves: 350 psig minimum.
3. Body Material: Cast or ductile iron.
4. Size: Same as connected piping.
5. End Connections: Flanged or grooved.

B. Automatic (Ball Drip) Drain Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AFAC Inc.
 - b. Reliable Automatic Sprinkler Co., Inc.
 - c. Tyco Fire & Building Products LP.
2. Standard: UL 1726.
3. Pressure Rating: 175 psig minimum.
4. Type: Automatic draining, ball check.
5. Size: NPS 3/4.
6. End Connections: Threaded.

2.7 FIRE-DEPARTMENT CONNECTIONS

A. Flush-Type, Fire-Department Connection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AFAC Inc.
 - b. Elkhart Brass Mfg. Company, Inc.
 - c. GMR International Equipment Corporation.
 - d. Guardian Fire Equipment, Inc.
 - e. Potter Roemer.
2. Standard: UL 405.
3. Type: Flush, for wall mounting.
4. Pressure Rating: 175 psig minimum.
5. Body Material: Corrosion-resistant metal.
6. Inlets: Brass with threads according to NFPA 1963 and matching local fire-department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.

7. Caps: Brass, lugged type, with gasket and chain.
8. Escutcheon Plate: Rectangular, brass, wall type.
9. Outlet: With pipe threads.
10. Body Style: Horizontal.
11. Number of Inlets: Two.
12. Outlet Location: Back, Bottom, Left side, Right side or Top as required.
13. Escutcheon Plate Marking: Similar to "AUTO SPKR."
14. Finish: Polished chrome plated.
15. Outlet Size: As indicated on the drawings.

2.8 SPRINKLER SPECIALTY PIPE FITTINGS

A. Branch Outlet Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International, Inc.
 - b. National Fittings, Inc.
 - c. Shurjoint Piping Products.
 - d. Tyco Fire & Building Products LP.
 - e. Victaulic Company.
2. Standard: UL 213.
3. Pressure Rating: 175 psig minimum.
4. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.
5. Type: Mechanical-T and -cross fittings.
6. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.
7. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
8. Branch Outlets: Grooved or threaded.

B. Flow Detection and Test Assemblies:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AGF Manufacturing Inc.
 - b. Reliable Automatic Sprinkler Co., Inc.
 - c. Tyco Fire & Building Products LP.
 - d. Victaulic Company.
2. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
3. Pressure Rating: 175 psig minimum.
4. Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test valve.
5. Size: Same as connected piping.
6. Inlet and Outlet: Threaded.

C. Branch Line Testers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Elkhart Brass Mfg. Company, Inc.
 - b. Fire-End & Croker Corporation.
 - c. Potter Roemer.
2. Standard: UL 199.
3. Pressure Rating: 175 psig.
4. Body Material: Brass.
5. Size: Same as connected piping.
6. Inlet: Threaded.
7. Drain Outlet: Threaded and capped.
8. Branch Outlet: Threaded, for sprinkler.

D. Sprinkler Inspector's Test Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AGF Manufacturing Inc.
 - b. Triple R Specialty.
 - c. Tyco Fire & Building Products LP.
 - d. Victaulic Company.
 - e. Viking Corporation.
2. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
3. Pressure Rating: 175 psig minimum.
4. Body Material: Cast- or ductile-iron housing with sight glass.
5. Size: Same as connected piping.
6. Inlet and Outlet: Threaded.

2.9 SPRINKLERS

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

1. AFAC Inc.
2. Globe Fire Sprinkler Corporation.
3. Reliable Automatic Sprinkler Co., Inc.
4. Tyco Fire & Building Products LP.
5. Venus Fire Protection Ltd.
6. Victaulic Company.
7. Viking Corporation.

B. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating for Residential Sprinklers: 175 psig maximum.
3. Pressure Rating for Automatic Sprinklers: 175 psig minimum.

C. Automatic Sprinklers with Heat-Responsive Element:

1. Early-Suppression, Fast-Response Applications: UL 1767.
2. Nonresidential Applications: UL 199.
3. Residential Applications: UL 1626.
4. Characteristics: Nominal 1/2-inch orifice with Discharge Coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.

D. Sprinkler Finishes:

1. Chrome plated.
2. Bronze.
3. Painted.

E. Special Coatings:

1. Wax.
2. Lead.
3. Corrosion-resistant paint.

F. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.

1. Ceiling Mounting: Chrome-plated steel, one piece, flat and Chrome-plated steel, two piece, with 1-inch vertical adjustment.
2. Sidewall Mounting: Chrome-plated steel, one piece, flat.

G. Sprinkler Guards:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Reliable Automatic Sprinkler Co., Inc.
 - b. Tyco Fire & Building Products LP.
 - c. Victaulic Company.
 - d. Viking Corporation.
2. Standard: UL 199.
3. Type: Wire cage with fastening device for attaching to sprinkler.

2.10 ALARM DEVICES

- A. Alarm-device types shall match piping and equipment connections.
- B. Electrically Operated Alarm Bell:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Fire-Lite Alarms, Inc.; a Honeywell company.
 - b. Notifier; a Honeywell company.
 - c. Potter Electric Signal Company.
 - 2. Standard: UL 464.
 - 3. Type: Vibrating, metal alarm bell.
 - 4. Size: 8-inch minimum-diameter.
 - 5. Finish: Red-enamel factory finish, suitable for outdoor use.
- C. Water-Flow Indicators:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ADT Security Services, Inc.
 - b. McDonnell & Miller; ITT Industries.
 - c. Potter Electric Signal Company.
 - d. System Sensor; a Honeywell company.
 - e. Viking Corporation.
 - f. Watts Industries (Canada) Inc.
 - 2. Standard: UL 346.
 - 3. Water-Flow Detector: Electrically supervised.
 - 4. Components: Two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.
 - 5. Type: Paddle operated.
 - 6. Pressure Rating: 250 psig.
 - 7. Design Installation: Horizontal or vertical.
- D. Pressure Switches:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AFAC Inc.
 - b. Barksdale, Inc.
 - c. Detroit Switch, Inc.
 - d. Potter Electric Signal Company.
 - e. System Sensor; a Honeywell company.
 - f. Tyco Fire & Building Products LP.

- g. United Electric Controls Co.
 - h. Viking Corporation.
 - 2. Standard: UL 346.
 - 3. Type: Electrically supervised water-flow switch with retard feature.
 - 4. Components: Single-pole, double-throw switch with normally closed contacts.
 - 5. Design Operation: Rising pressure signals water flow.
- E. Valve Supervisory Switches:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Fire-Lite Alarms, Inc.; a Honeywell company.
 - b. Kennedy Valve; a division of McWane, Inc.
 - c. Potter Electric Signal Company.
 - d. System Sensor; a Honeywell company.
 - 2. Standard: UL 346.
 - 3. Type: Electrically supervised.
 - 4. Components: Single-pole, double-throw switch with normally closed contacts.
 - 5. Design: Signals that controlled valve is in other than fully open position.

2.11 PRESSURE GAGES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- 1. AMETEK; U.S. Gauge Division.
 - 2. Ashcroft, Inc.
 - 3. Brecco Corporation.
 - 4. WIKA Instrument Corporation.
- B. Standard: UL 393.
- C. Dial Size: 3-1/2- to 4-1/2-inch diameter.
- D. Pressure Gage Range: 0 to 250 psig minimum, 0-350 psig for high pressure piping.
- E. Water System Piping Gage: Include "WATER" or "AIR/WATER" label on dial face.
- F. Air System Piping Gage: Include retard feature and "AIR" or "AIR/WATER" label on dial face.

2.12 ESCUTCHEONS

- A. General: Manufactured ceiling, floor, and wall escutcheons and floor plates.
- B. One-Piece, Cast-Brass Escutcheons: Polished chrome-plated finish with set-screws.

- C. One-Piece, Deep-Pattern Escutcheons: Deep-drawn, box-shaped brass with chrome-plated finish.
- D. One-Piece, Stamped-Steel Escutcheons: Chrome-plated finish with set-screw.
- E. Split-Casting, Cast-Brass Escutcheons: Polished chrome-plated finish with concealed hinge and set-screw.
- F. Split-Plate, Stamped-Steel Escutcheons: Chrome-plated finish with concealed hinge and set-screw.
- G. One-Piece Floor Plates: Cast-iron flange[with holes for fasteners].
- H. Split-Casting Floor Plates: Cast brass with concealed hinge.

2.13 SLEEVES

- A. Cast-Iron Wall Pipe Sleeves: Cast or fabricated of cast iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
- B. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, standard weight, zinc coated, plain ends.
- D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 - 1. Underdeck Clamp: Clamping ring with set-screws.

2.14 SLEEVE SEALS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Advance Products & Systems, Inc.
 - 2. Calpico, Inc.
 - 3. Metraflex, Inc.
 - 4. Pipeline Seal and Insulator, Inc.
- B. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
 - 1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - 2. Pressure Plates: Carbon steel.
 - 3. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Perform fire-hydrant flow test according to 2016 NFPA 13 and 2016 NFPA 291. Use results for system design calculations required in "Quality Assurance" Article.
- B. Report test results promptly and in writing.

3.2 PIPING INSTALLATION

- A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.
 - 1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.
- B. Piping Standard: Comply with requirements for installation of sprinkler piping in 2016 NFPA 13.
- C. Install seismic restraints on piping. Comply with requirements for seismic-restraint device materials and installation in 2016 NFPA 13.
- D. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
- E. Install unions adjacent to each valve in pipes NPS 2 and smaller.
- F. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.
- G. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to 2016 NFPA 13.
- H. Install sprinkler piping with drains for complete system drainage.
- I. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.
- J. Install automatic (ball drip) drain valve at each check valve for fire-department connection, to drain piping between fire-department connection and check valve. Install drain piping to and spill over floor drain or to outside building.
- K. Install alarm devices in piping systems.
- L. Install hangers and supports for sprinkler system piping according to 2020 NYS Building Code and 2016 NFPA 13. Comply with requirements for hanger materials in 2020 NYS Building Code and 2016 NFPA 13.

- M. Install pressure gages on riser or feed main and at each sprinkler test connection. Include pressure gages with connection not less than NPS 1/4 and with soft metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they will not be subject to freezing.
- N. Fill sprinkler system piping with water.

3.3 JOINT CONSTRUCTION

- A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.
- B. Install unions adjacent to each valve in pipes NPS 2 and smaller.
- C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.
- D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.
- G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- H. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.
 - 1. Shop weld pipe joints where welded piping is indicated. Do not use welded joints for galvanized-steel pipe.
- I. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.
- J. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.
- K. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.4 VALVE AND SPECIALTIES INSTALLATION

- A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to 2016 NFPA 13 and authorities having jurisdiction.
- B. Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.
- C. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.
- D. Specialty Valves:
 - 1. General Requirements: Install in vertical position for proper direction of flow, in main supply to system.

3.5 SPRINKLER INSTALLATION

- A. Install sprinklers in suspended ceilings in center of narrow dimension of acoustical ceiling panels.

3.6 FIRE-DEPARTMENT CONNECTION INSTALLATION

- A. Install wall-type, fire-department connections.
- B. Install automatic (ball drip) drain valve at each check valve for fire-department connection.

3.7 ESCUTCHEON INSTALLATION

- A. Install escutcheons for penetrations of walls, ceilings, and floors.
- B. Escutcheons for New Piping:
 - 1. Piping with Fitting or Sleeve Protruding from Wall: One piece, deep pattern.
 - 2. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish stamped steel with set-screw.
 - 3. Bare Piping at Ceiling Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish. One piece, stamped steel with set-screw.
 - 4. Bare Piping in Unfinished Service Spaces: One piece, stamped steel with set-screw.
 - 5. Bare Piping in Equipment Rooms: One piece, stamped steel with set-screw.
 - 6. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece floor plate.

3.8 SLEEVE INSTALLATION

- A. General Requirements: Install sleeves for pipes and tubes passing through penetrations in floors, partitions, roofs, and walls.

- B. Sleeves are not required for core-drilled holes.
- C. Permanent sleeves are not required for holes formed by removable PE sleeves.
- D. Cut sleeves to length for mounting flush with both surfaces unless otherwise indicated.
- E. Install sleeves in new partitions, slabs, and walls as they are built.
- F. For interior wall penetrations, seal annular space between sleeve and pipe or pipe insulation using joint sealants appropriate for size, depth, and location of joint. Comply with requirements for joint sealants in Division 07 Section "Joint Sealants."
- G. For exterior wall penetrations above grade, seal annular space between sleeve and pipe using joint sealants appropriate for size, depth, and location of joint. Comply with requirements for joint sealants in Division 07 Section "Joint Sealants."
- H. For exterior wall penetrations below grade, seal annular space between sleeve and pipe using sleeve seals.
- I. Seal space outside of sleeves in concrete slabs and walls with grout.
- J. Install sleeves that are large enough to provide 1 inch annular clear space between sleeve and pipe or pipe insulation unless otherwise indicated.
- K. Install sleeve materials according to the following applications:
 - 1. Sleeves for Piping Passing through Concrete Floor Slabs: Galvanized-steel pipe.
 - 2. Sleeves for Piping Passing through Concrete Floor Slabs of Mechanical Equipment Areas or Other Wet Areas: Galvanized-steel pipe.
 - a. Extend sleeves 2 inches above finished floor level.
 - b. For pipes penetrating floors with membrane waterproofing, extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Comply with requirements for flashing in Division 07 Section "Sheet Metal Flashing and Trim."
 - 3. Sleeves for Piping Passing through Gypsum-Board Partitions:
 - a. Galvanized-steel-pipe sleeves for pipes smaller than NPS 6.
 - b. Galvanized-steel-sheet sleeves for pipes NPS 6 and larger.
 - 4. Sleeves for Piping Passing through Exterior Concrete Walls:
 - a. Galvanized-steel-pipe sleeves for pipes smaller than NPS 6.
 - b. Cast-iron wall-pipe sleeves for pipes NPS 6 and larger.
 - c. Install sleeves that are large enough to provide 1-inch annular clear space between sleeve and pipe or pipe insulation when sleeve seals are used.
 - 5. Sleeves for Piping Passing through Interior Concrete Walls:

- a. Galvanized-steel-pipe sleeves for pipes smaller than NPS 6 (DN 150).
- b. Galvanized-steel-sheet sleeves for pipes NPS 6 and larger.

- L. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestop materials and installations in Division 07 Section "Penetration Firestopping."

3.9 SLEEVE SEAL INSTALLATION

- A. Install sleeve seals in sleeves in exterior concrete walls at water-service piping entries into building.
- B. Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble sleeve seal components and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.10 IDENTIFICATION

- A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.
- B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.11 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - 3. Flush, test, and inspect sprinkler systems according to 2020 NYS Building Code and 2016 NFPA 13, "Systems Acceptance" Chapter.
 - 4. Energize circuits to electrical equipment and devices.
 - 5. Coordinate with fire-alarm tests. Operate as required.
 - 6. Coordinate with fire-pump tests. Operate as required.
 - 7. Verify that equipment hose threads are same as local fire-department equipment.
- C. Sprinkler piping system will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

3.12 CLEANING

- A. Clean dirt and debris from sprinklers.
- B. Remove and replace sprinklers with paint other than factory finish.

3.13 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain specialty valves and pressure-maintenance pumps.

3.14 PIPING SCHEDULE

- A. Piping between Fire-Department Connections and Check Valves: Galvanized, standard-weight steel pipe with threaded ends; cast-iron threaded fittings; and threaded or grooved ends; grooved-end fittings; grooved-end-pipe couplings; and grooved joints.
- B. Sprinkler specialty fittings may be used, downstream of control valves, instead of specified fittings.
- C. Standard-pressure, wet-pipe sprinkler system, NPS 2 and smaller, shall be one of the following:
 - 1. Standard-weight, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
 - 2. Standard-weight, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
- D. Standard-pressure, wet-pipe sprinkler system, NPS 2-1/2 and larger, shall be one of the following:
 - 1. Standard-weight, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
 - 2. Standard-weight, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
 - 3. Standard-weight, black-steel pipe with cut or roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
 - 4. Standard-weight, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
 - 5. Standard-weight, black-steel pipe with plain ends; steel welding fittings; and welded joints.
 - 6. Schedule 10, black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
 - 7. Schedule 10, black-steel pipe with plain ends; welding fittings; and welded joints.

3.15 SPRINKLER SCHEDULE

- A. Use sprinkler types in subparagraphs below for the following applications:

1. Rooms without Ceilings: Upright or sidewall sprinklers.
 2. Rooms with Suspended Ceilings: Pendent, recessed, flush, and concealed sprinklers as indicated.
 3. Wall Mounting: Sidewall sprinklers.
 4. Spaces Subject to Freezing: Upright, pendent, dry sprinklers; and sidewall, dry sprinklers as indicated
 5. Special Applications: Extended-coverage and quick-response sprinklers where indicated.
- B. Provide sprinkler types in subparagraphs below with finishes indicated.
1. Concealed Sprinklers: Rough brass, with factory-painted white cover plate.
 2. Flush Sprinklers: Bright chrome, with painted white escutcheon.
 3. Recessed Sprinklers: Bright chrome, with bright chrome escutcheon.
 4. Residential Sprinklers: Dull chrome.
 5. Upright Pendent and Sidewall Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; wax coated where exposed to acids, chemicals, or other corrosive fumes.

END OF SECTION 211313

SECTION 211316-1 – DRY PIPE VACUUM SYSTEM

Part 1 - GENERAL

1.1 Related work in other sections

1. A. The work listed below shall be provided by others, or under other sections.
2. Supply and install a branch circuit, 220VAC, 60Hz – 15 Amp for the vacuum pump provided inside the preaction cabinet as per local electrical code.
3. Supply and install one dedicated branch circuit, 120VAC, 60Hz to power the release control panel as per local electrical code.

1.2 Standards & rules

4. A. The design, equipment, installation, testing and maintenance of the FireFlex[®] - Vactec[®] System shall be in accordance with the applicable requirements set forth in the current edition of the following codes and standards:
 5. 1. 2016 NFPA 13 Standard for the installation of sprinkler system
 6. 2. 2016 NFPA 25 (Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems)
 7. 3. 2016 NFPA 70 National Electrical Code.
 8. 4. 2016 NFPA 72 National Fire Alarm Code.
 9. 5. 2020 New York State Building Code.
 10. 6. National Fire Code
 11. 7. New Rochelle, New York building codes
 12. 10. Requirements of authority having jurisdiction (AHJ).
13. B. The standards listed, as well as other applicable codes, standards, and good engineering practice shall be used as “minimum” design standards.

1.3 System description

14. A. The cabinet assembly shall contain a dry pipe vacuum system, pre-assembled, pre-wired and factory tested under ISO-9001 manufacturing and quality control procedures.
15. B. The integrated vacuum pre-action system shall be FM Approved as an assembled unit and all components shall be compatible.
16. C. System shall have a unique serial number for easy traceability.

1.4 Submittals

17. A. The fire protection contractor must prepare and submit for approval all installation drawings and hydraulic calculations as required by 2016 NFPA.
18. B. Submit for approval a set of equipment data sheets which will include all technical data for FireFlex® - Vactec® System.
19. C. Supply a standardized Maintenance & Operation manual for FireFlex® - Vactec® System vacuum fire protection system.
20. D. Maintenance & Operation manual shall include all necessary instructions to operate and maintain the system. Emergency procedures must be part of the manual.

PART 2 - PRODUCTS

2.1 FireFlex® - Vactec® Vacuum Sprinkler System

21. A. The cabinet shall integrate a dry pipe vacuum system and contain all hydraulic, pneumatic devices, and electrical components required for the control of self-contained dry pipe system. System shall include the following:
 22. 1. A Sturdy free-standing 14 gauge steel cabinet measuring:
 23. 46" x 25" x 77" (58.4 x 63.5 x 195.5 cm) for 3", 4" or 6" systems
 24. 54" x 31" x 77" (91.4 x 63.5 x 195.5 cm) for 8" systems
 25. 2. Textured rust proof coating, inside and outside, fire red, oven baked polyester powder on phosphate base (powder coated)
 26. 3. Two locked access doors to reduce frontal clearance required for opening
 27. 4. Individual access doors for the hydraulic section and the emergency release
 28. 5. The cabinet shall have knock-outs for hydraulic and electrical connections

B. The Integrated Dry Pipe Vacuum System shall include:

29. 1. A Viking Deluge valve model F-1 for 3" (75 mm) through 8" (200mm) diameter c/w supervised butterfly control valve, releasing trim rated at 175 psi and all the necessary accessories. Trim shall include a mechanical latching device to prevent system from resetting in case of loss of power to the release solenoid. Systems provided with solenoid only, without this mechanical latching device, shall not be accepted. Every valve shall be clearly identified as to its operation with arrows indicating all positions to facilitate system operation.
30. 2. Pressure gauges to indicate water supply and priming water pressures of the system. Each pressure gauge must be provided with its own three-way valve.

31. 3. Release trim with solenoid valve and every supervisory and alarm device required shall be Schedule 40 galvanized steel. Black pipe will not be accepted.
32. 4. Schedule 40 steel pipe header painted fire red, with grooved ends to be connected to supply water from either side.
33. 5. Schedule 40 steel pipe drain manifold of 2" diameter painted fire red, with grooved ends for drain connections from either side.
34. 6. Properly identified contractor test ports factory mounted into the trim piping to facilitate system testing and commissioning.
35. 7. Viking VFR-400 integrated control panel with emergency batteries factory-assembled inside the FireFlex® - Vactec® System cabinet.
36. 8. Integrated Releasing Circuit Disconnect Switch to allow the system to be tested without actuating the fire suppression system as required per NFPA 72, 2016 Edition. Operation of the Disconnect Switch shall cause a supervisory signal at the releasing service fire alarm control unit. The disconnect switch shall be a physical switch and not be accomplished by using software.
37. 9. Shut-off valve and sight glass. A supervised butterfly valve installed on the system riser inside the cabinet for full flow test purposes and an integrated sight glass shall be part of this arrangement for visually confirming water flow through the main drain upon system actuation.
38. 10. Field wiring terminal strips and junction box integrated with the cabinet for connection of field wiring. Standard factory-wired terminal strips to accept field installation of ARM-44 Relay Module, CA2Z Class initiating circuit module, RA-4410RC remote annunciator.

C. FireFlex® - FLX-PC®

The FireFlex® - Vactec® System unit shall include a FLX-PC® Vacuum Pressure Controller to precisely monitor and control the vacuum level in the piping network and display in real time on a LCD display, the status of the system, the vacuum pressure, the vacuum pump run time and frequency of pump operation.

The FLX-PC® Vacuum Pressure Controller shall be programmed to control the vacuum pump and maintain vacuum pressure in the piping network between -180 mbar (-2.6 psi) and -150 mbar (-2.2 psi).

The FLX-PC shall also supervise the piping network pressure within the system for vacuum pressure under normal condition. In case of a fire, it shall detect a sprinkler activation, generate an alarm and trip the system in less than 5 seconds. The FLX-PC shall also supervise the vacuum pressure for low and high level and provide supervisory signals and contacts.

39. D. Vacuum Pump

40. The FireFlex® - Vactec® System shall include a factory assembled and tested vacuum pump able to generate the required vacuum pressure within 30 minutes.

The vacuum pump shall be a 220/240VAC, 50/60Hz, 1.5 HP, 1 phase, liquid ring vacuum pump complete with all regulating devices to control flow of water and pump motor shut off electrical components.

41. E. The cabinet assembly shall be a FM Approved, pre-assembled, pre-wired and factory tested under ISO-9001 conditions, as a FireFlex® - Vactec® System, by FireFlex Systems Inc.
42. F. The system shall be complete in all ways.
43. G. The system shall incorporate all components required for complete system operation.

2.3 Integrated releasing control panel – Viking VFR-400

44. A. The release control panel shall be fully integrated to the FireFlex® - Vactec® cabinet enclosure. It shall be pre-assembled, pre-wired, programmed and tested at the factory. It shall be FM Approved and cULus listed to UL 864-9 standard. The panel shall include four programmable Class B, Style B initiating zones, two class B supervisory zones, and four programmable output circuits. Onboard, menu-driven programming with pre-installed programs for ease of set-up must also be provided. Batteries shall be sized to provide emergency power as per FM (90 hours) requirements. The control panel shall include both an LCD Annunciator and a set of yellow & red LED lamps identifying alarm, trouble, supervisory and flow conditions. Easy to operate control buttons shall also be included for the operation of the panel functions.

2.4 Control panel options (select as required)

45. ☐ Relay module: Provide an ARM-44 relay module in the VFR-400 releasing control panel to allow for eight sets of dry contacts. The relays shall connect via RS-485 and 24 VDC power and shall be rated for 3 amps at 24 VDC resistive load. There shall also be a disable switch to allow for maintenance and testing.
46. ☐ Remote Annunciator: Provide a model RA-4410RC remote annunciator module and install it on-site following the instructions provided by the manufacturer. The remote annunciator shall be mounted on a standard four gang wallbox provided by the contractor.

2.5 Notification devices and signs

47. A. Supply and install a complete notification system including conduit, wiring, and notification devices.
48. B. The NAC devices (24 Vdc bell, horn or strobe) must be compatible with the release control panel.

2.6 System operation

Under normal conditions the water supply pressure shall be trapped in the priming chamber of the deluge valve. The pressure in the priming chamber holds the deluge valve clapper closed. The vacuum pressure shall be maintained under the system piping by the operation of the integrated vacuum pump.

- 49. A. The activation of at least one automatic vacuum sprinkler OR a breach in system piping will trip the system and fill the piping network with water and discharge through all open sprinklers. This will activate alarm and water flow switch contacts connected to the building fire alarm panel and sound an alarm.
- 50. B. Loss of vacuum pressure in the piping system will activate an auxiliary contact indicating same.
- 51. F. The manual operation of the emergency release valve will depressurize the priming chamber causing the deluge valve to open and allowing water to enter the system piping and water to discharge through any open sprinklers. The alarm pressure switch will activate causing the water flow alarm to be present under this condition.

2.7 Automatic vacuum sprinklers

A. Supply and install all required glass bulb type automatic vacuum sprinklers approved for use in FM Approved vacuum dry sprinkler systems with a maximum supervisory vacuum pressure of -3 psi (-207 mbar).

- 52. B. Applicable specifications, design density and minimum pressure of automatic vacuum sprinklers shall be determined as per the manufacturer recommendations, based on the project conditions, approvals and AHJ.

2.8 Piping & Fittings

- 53. A. System piping and fittings shall be as recommended by NFPA 13.
- 54. B. Grooved fittings shall FM Approved grooved fittings type.
- 55. C. System piping and fittings installation shall be as recommended in FireFlex® - Vactec® design manual latest revision.

2.19 System drain

- 56. A. System piping drains and low points shall be installed as per 2016 NFPA 13 and FireFlex® - Vactec® design manual latest revision.
- 57. B. The single drain collector of the FireFlex® - Vactec® system shall be connected to an open drain consisting of a vertical pipe with an air gap around the drain collector pipe.
- 58. C. The drain piping shall not be restricted or reduced and shall be of the same diameter as the drain collector.

59. D. Multiple drain collectors and open drain cups inside the cabinet will not be accepted.

60.

Part 3 - EXECUTION

3.1 Installation

61. A. The installation must meet all established standards and be according to all applicable laws, regulations and codes.

62. B. The proper operation and coordination for the system's installation, including the automatic sprinkler system, detection system, signaling system and initial start-up are all under the responsibility of the fire protection contractor.

63. C. Water supply for the cabinet shall allow a grooved connection to supply manifold from the left or right-hand side only of the unit.

64. D. Drain output for the cabinet shall allow connection to the drain manifold from the left or right-hand side of the unit.

3.2 Training

65. A. The contractor must plan and organize a training session of at least two hours for the building maintenance staff, in the presence of building owner or his representative.

66. B. The training session must include normal operation, emergency procedures and system maintenance.

3.3 Tests and Verifications

67. A. Hydrostatic tests must be performed on the entire sprinkler piping system, as required by 2016 NFPA 13.

68. B. A drain test using the auxiliary drain valve fully open (drain located on water supply side, deluge valve inlet) must be performed to make sure that no back pressure in drain piping exists, which could affect the proper operation of the preaction system.

69. C. The verification of the fire alarm system must be done in accordance with the 2016 NFPA.

3.4 Report & Certificate

70. A. An inspection report and a certificate must be supplied to the engineer at the completion of the project. All test results shall be registered in a booklet to be included with the inspection report.

END OF SECTION 211316

SECTION 211316 – DRY-PIPE SPRINKLER SYSTEMS

PART 1 - GENERAL

1.1. RELATED DOCUMENTS

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract (City of New York Standard Construction Contract).
- B. LEED General Requirements:
 - 1. Refer to DDC General Conditions.
 - a. Section 01 33 00 "Submittal Procedures"
 - b. Section 01 81 13.03 "Sustainable Design Requirements for LEED v3 Buildings."
 - c. Section 01 74 19 "Construction Waste Management and Disposal"
 - d. Section 01 81 13.03 "Volatile Organic Compound (VOC) limits for Adhesives, Sealants, Paints and Coatings for LEED Buildings"
 - e. Section 01 81 19 "Indoor Air Quality Requirements for LEED Buildings"

1.2. SUMMARY

- A. Section Includes:
 - 1. Pipes, fittings, and specialties.
 - 2. Fire-protection valves.
 - 3. Sprinkler specialty pipe fittings.
 - 4. Sprinklers.
 - 5. Alarm devices.
 - 6. Manual control stations.
 - 7. Control panels.
 - 8. Pressure gages.
- B. Related Sections:
 - 1. Section 211200 "Fire-Suppression Standpipes" for standpipe piping.
 - 2. Section 211313 "Wet-Pipe Sprinkler Systems" for wet-pipe sprinkler piping.
 - 3. Section 213113 "Electric-Drive, Centrifugal Fire Pumps for fire pumps, pressure-maintenance pumps, and fire-pump controllers.
 - 4. Section 283111 "Digital, Addressable Fire-Alarm System for alarm devices not specified in this Section.

1.3. DEFINITIONS

- A. Standard-Pressure Sprinkler Piping: Dry-pipe sprinkler system piping designed to operate at working pressure 175 psig maximum.

1.4. SYSTEM DESCRIPTIONS

- A. Dry-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing compressed air. Opening of sprinklers releases compressed air and permits water pressure to open dry-pipe valve. Water then flows into piping and discharges from sprinklers that are open.

1.5. PERFORMANCE REQUIREMENTS

- A. Standard-Pressure Piping System Component: Listed for 175-psig minimum working pressure.
- B. Sprinkler system design shall be approved by the NYS Department of Buildings.
 - 1. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.
 - 2. Sprinkler Occupancy Hazard Classifications:
 - a. Automobile Parking Areas: Ordinary Hazard, Group 1
 - 3. Minimum Density for Automatic-Sprinkler Piping Design:
 - a. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 1500-sq. ft area.
 - 4. Maximum Protection Area per Sprinkler:
 - a. Automobile Parking Area: 130 sq.
 - 5. Total Combined Hose-Stream Demand Requirement: According to NFPA 13 unless otherwise indicated:
 - a. Ordinary-Hazard Occupancies: 250 gpm for 60 to 90 minutes
- C. Seismic Performance: Sprinkler piping shall withstand the effects of earthquake motions determined according to NFPA 13 and NYS building seismic code 2008 requirements.

1.6. SUBMITTALS

- A. Refer to DDC General Conditions for submittal requirements
- B. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- C. Shop Drawings: For dry-pipe sprinkler systems. Include plans, elevations, sections, details, and attachments to other work.

1. Wiring Diagrams: For power, signal, and control wiring.
- D. Engineering Data Submittal: For sprinkler systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer licensed in the State of New York who is responsible for their preparation.

1.7. INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Sprinkler systems, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 1. Domestic water piping.
 2. Compressed air piping.
 3. Items penetrating finished ceiling including the following:
 - a. Lighting Fixtures.
 - b. Air outlets and inlets.
 - c. Speakers.
 4. Miscellaneous Ceiling Mounted Devices.
- B. Qualification Data: For qualified Installer and professional Commissioner.
- C. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by the NYS Department of Buildings, including hydraulic calculations if applicable.
- D. Fire-hydrant flow test report.
- E. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."
- F. Field quality-control reports.

1.8. CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For sprinkler specialties to include in emergency, operation, and maintenance manuals.

1.9. QUALITY ASSURANCE

- A. Refer to DDC General Conditions for quality assurance requirements.

B. Installer Qualifications:

1. Installer's responsibilities include fabricating and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.
 - a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a professional engineer licensed in the State of New York.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. NFPA Standards: Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:

1. NFPA 13 2002 edition , "Installation of Sprinkler Systems" and NYS building code 2009 Appendix Q

1.10. COORDINATION

- A. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

PART 2 - PRODUCTS

2.1. GENERAL

- A. Use materials with recycled content and complete the associated LEED submittal calculator. The LEED target is a total of materials such that the sum of post-consumer recycled content plus 1/2 of the pre-consumer content constitutes at least 20%, based on cost, of the total value of the materials in the project. Refer to the DDC General Conditions and the Addendum to the General Conditions for more information.

The recycled content value of a material assembly is determined by weight. The recycled fraction of the assembly is then multiplied by the cost of assembly to determine the recycled content value.

Mechanical, electrical and plumbing components, and specialty items such as elevators and equipment cannot be included in all calculations. Include only materials permanently installed in the project.

2.2. PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, and fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.3. STEEL PIPE AND FITTINGS

- A. Standard Weight, Galvanized-Steel Pipe: ASTM A 53/A 53M, Type E. Pipe ends may be factory or field formed to match joining method.

- B. Galvanized-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, standard-weight, seamless steel pipe with threaded ends.
- C. Galvanized, Steel Couplings: ASTM A 865, threaded.
- D. Galvanized, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.
- E. Malleable- or Ductile-Iron Unions: UL 860.
- F. Cast-Iron Flanges: ASME B16.1, Class 125.
- G. Plain-End-Pipe Fittings: UL 213, ductile-iron body with retainer lugs that require one-quarter turn or screwed retainer pin to secure pipe in fitting.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International, Inc.
 - b. Shurjoint Piping Products.
 - c. National Fittings, Inc.
 - d. Or Approved Equal
- H. Grooved-Joint, Steel-Pipe Appurtenances:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following
 - a. Anvil International, Inc.
 - b. Corcoran Piping System Co.
 - c. National Fittings, Inc.
 - d. Shurjoint Piping Products.
 - e. Tyco Fire & Building Products LP.
 - f. Victaulic Company.
 - g. Or Approved Equal
 - 2. Pressure Rating: 175 psig minimum.
 - 3. Galvanized, Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile-iron casting; with dimensions matching steel pipe.
 - 4. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213, rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

2.4. COPPER TUBE AND FITTINGS

- A. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.
- B. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.
- C. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, pressure fittings.
- D. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.

- E. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

2.5. PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick
 - 1. Class 125, Cast-Iron and Class 150, Bronze Flat-Face Flanges: Full-face gaskets.
 - 2. Class 250, Cast-Iron and Class 300, Raised-Face Flanges: Ring-type gaskets.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- C. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

2.6. LISTED FIRE-PROTECTION VALVES

- A. General Requirements:
 - 1. Valves shall be UL listed or FM approved.
 - 2. Minimum Pressure Rating for Standard-Pressure Piping: 175 psig.
- B. Valves in first paragraph below are available in NPS 3 (DN 80) and smaller.
- C. Ball Valves:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International, Inc.
 - b. Victaulic Company.
 - c. National Fittings, Inc.
 - d. Or Approved Equal
 - 2. Standard: UL 1091 except with ball instead of disc.
 - 3. Valves NPS 1-1/2 and Smaller: Bronze body with threaded ends.
 - 4. Valves NPS 2 and NPS 2-1/2: Bronze body with threaded ends or ductile-iron body with grooved ends.
 - 5. Valves NPS 3: Ductile-iron body with grooved ends.
- D. Check Valves:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AFAC Inc.
 - b. American Cast Iron Pipe Company; Waterous Company Subsidiary.
 - c. Anvil International, Inc.
 - d. Clow Valve Company; a division of McWane, Inc.
 - e. Crane Co.; Crane Valve Group; Crane Valves.
 - f. Crane Co.; Crane Valve Group; Jenkins Valves.

- g. Crane Co.; Crane Valve Group; Stockham Division.
 - h. Fire-End & Croker Corporation.
 - i. Fire Protection Products, Inc.
 - j. Fivalco Inc.
 - k. Globe Fire Sprinkler Corporation.
 - l. Groeniger & Company.
 - m. Kennedy Valve; a division of McWane, Inc.
 - n. Matco-Norca.
 - o. Metraflex, Inc.
 - p. Milwaukee Valve Company.
 - q. Mueller Co.; Water Products Division.
 - r. NIBCO INC.
 - s. Potter Roemer.
 - t. Reliable Automatic Sprinkler Co., Inc.
 - u. Shurjoint Piping Products.
 - v. Tyco Fire & Building Products LP.
 - w. United Brass Works, Inc.
 - x. Venus Fire Protection Ltd.
 - y. Victaulic Company.
 - z. Viking Corporation.
 - aa. Watts Water Technologies, Inc.
 - bb. Or Approved Equal
2. Standard: UL 312
3. Pressure Rating: 250 psig minimum.
4. Type: Swing check.
5. Body Material: Cast iron.
6. End Connections: Flanged or grooved.
- E. Iron OS&Y Gate Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- a. American Cast Iron Pipe Company; Waterous Company Subsidiary.
 - b. American Valve, Inc.
 - c. Clow Valve Company; a division of McWane, Inc.
 - d. Crane Co.; Crane Valve Group; Crane Valves.
 - e. Crane Co.; Crane Valve Group; Jenkins Valves.
 - f. Crane Co.; Crane Valve Group; Stockham Division.
 - g. Hammond Valve.
 - h. Milwaukee Valve Company.
 - i. Mueller Co.; Water Products Division.
 - j. NIBCO INC.
 - k. Shurjoint Piping Products.
 - l. Tyco Fire & Building Products LP.
 - m. United Brass Works, Inc.
 - n. Watts Water Technologies, Inc.
 - o. Or Approved Equal

2. Standard: UL 262.
3. Pressure Rating: 250 psig minimum.
4. Body Material: Cast or ductile iron.
5. End Connections: Flanged or grooved.

F. Indicating-Type Butterfly Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International, Inc.
 - b. Fivalco Inc.
 - c. Global Safety Products, Inc.
 - d. Kennedy Valve; a division of McWane, Inc.
 - e. Milwaukee Valve Company.
 - f. NIBCO INC.
 - g. Shurjoint Piping Products.
 - h. Tyco Fire & Building Products LP.
 - i. Victaulic Company.
 - j. Or Approved Equal
2. Standard: UL 1091.
3. Pressure Rating: 175 psig minimum.
4. Valves NPS 2 and Smaller:
 - a. Valve Type: Ball or butterfly.
 - b. Body Material: Bronze.
 - c. End Connections: Threaded.
5. Valves NPS 2-1/2 and Larger:
 - a. Valve Type: Butterfly.
 - b. Body Material: Cast or ductile iron.
 - c. End Connections: Flanged, grooved, or wafer.
6. Valve Operation: Integral electrical, 115-V ac, prewired, two-circuit, supervisory switch indicating device.

G. General Requirements:

1. Standard: UL's "Fire Protection Equipment and "NYS MEA Approval Guide," published by FM Global, listing.
2. Pressure Rating: 175 psig minimum.

H. Ball Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Affiliated Distributors.
 - b. Anvil International, Inc.
 - c. Barnett.
 - d. Conbraco Industries, Inc.; Apollo Valves.
 - e. Fire-End & Croker Corporation.
 - f. Fire Protection Products, Inc.
 - g. Flowserve.
 - h. FNW.
 - i. Jomar International, Ltd.
 - j. Kennedy Valve; a division of McWane, Inc.
 - k. Kitz Corporation.
 - l. Legend Valve.
 - m. Metso Automation USA Inc.
 - n. Milwaukee Valve Company.
 - o. NIBCO INC.
 - p. Potter Roemer.
 - q. Red-White Valve Corporation.
 - r. Southern Manufacturing Group.
 - s. Stewart, M. A. and Sons Ltd.
 - t. Tyco Fire & Building Products LP.
 - u. Victaulic Company.
 - v. Watts Water Technologies, Inc.
 - w. Or Approved Equal

2.7. SPECIALTY VALVES

A. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating:
 - a. Standard-Pressure Piping Specialty Valves: 175 psig minimum.
3. Body Material: Cast or ductile iron.
4. Size: Same as connected piping.
5. End Connections: Flanged or grooved.

B. Dry-Pipe Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following
 - a. AFAC Inc.
 - b. Globe Fire Sprinkler Corporation.
 - c. Reliable Automatic Sprinkler Co., Inc.

- d. Tyco Fire & Building Products LP.
 - e. Venus Fire Protection Ltd.
 - f. Victaulic Company.
 - g. Viking Corporation.
 - h. Or Approved Equal
- 2. Standard: UL 260
- 3. Design: Differential-pressure type.
- 4. Include UL 1486, quick-opening devices, trim sets for air supply, drain, priming level, alarm connections, ball drip valves, pressure gages, priming chamber attachment, and fill-line attachment.
- 5. Air-Pressure Maintenance Device:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) AFAC Inc.
 - 2) Globe Fire Sprinkler Corporation.
 - 3) Reliable Automatic Sprinkler Co., Inc.
 - 4) Tyco Fire & Building Products LP.
 - 5) Venus Fire Protection Ltd.
 - 6) Victaulic Company.
 - 7) Viking Corporation.
 - 8) Or Approved Equal
 - b. Standard: UL 260.
 - c. Type: Automatic device to maintain minimum air pressure in piping.
 - d. Include shutoff valves to permit servicing without shutting down sprinkler piping, bypass valve for quick filling, pressure regulator or switch to maintain pressure, strainer, pressure ratings with 14- to 60-psig adjustable range, and 175-psig outlet pressure.
- 6. Air Compressor:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following
 - 1) Gast Manufacturing Inc.
 - 2) General Air Products, Inc,
 - 3) Viking Corporation.
 - 4) Or Approved Equal
 - b. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
 - c. Motor Horsepower: Fractional.
 - d. Power: 120-V ac, 60 Hz, single phase.

2.8. SPRINKLER SPECIALTY PIPE FITTINGS

- A. General Requirements for Dry-Pipe-System Fittings: UL listed for dry-pipe service.
- B. Branch Outlet Fittings:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International, Inc.
 - b. National Fittings, Inc.
 - c. Shurjoint Piping Products.
 - d. Tyco Fire & Building Products LP.
 - e. Victaulic Company.
 - f. Or Approved Equal
 - 2. Standard: UL 213.
 - 3. Pressure Rating: 175 psig minimum.
 - 4. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.
 - 5. Type: Mechanical-T and -cross fittings.
 - 6. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.
 - 7. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
 - 8. Branch Outlets: Grooved, plain-end pipe, or threaded.
- C. Flow Detection and Test Assemblies:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AGF Manufacturing Inc.
 - b. Reliable Automatic Sprinkler Co., Inc.
 - c. Tyco Fire & Building Products LP.
 - d. Victaulic Company.
 - e. Or Approved Equal
 - 2. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
 - 3. Pressure Rating: 175 psig minimum.
 - 4. Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test valve.
 - 5. Size: Same as connected piping.
 - 6. Inlet and Outlet: Threaded.
- D. Branch Line Testers:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following
 - a. Elkhart Brass Mfg. Company, Inc.
 - b. Fire-End & Croker Corporation.
 - c. Potter Roemer.
 - d. Or Approved Equal

2. Standard: UL 199.
3. Pressure Rating: 175 psig minimum.
4. Body Material: Brass.
5. Size: Same as connected piping.
6. Inlet: Threaded.
7. Drain Outlet: Threaded and capped.
8. Branch Outlet: Threaded, for sprinkler.

E. Sprinkler Inspector's Test Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AGF Manufacturing Inc.
 - b. Triple R Specialty.
 - c. Tyco Fire & Building Products LP.
 - d. Victaulic Company.
 - e. Viking Corporation.
 - f. Or Approved Equal
2. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
3. Pressure Rating: 175 psig minimum.
4. Body Material: Cast- or ductile-iron housing with sight glass.
5. Size: Same as connected piping.
6. Inlet and Outlet: Threaded.

2.9. SPRINKLERS

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

1. AFAC Inc.
2. Globe Fire Sprinkler Corporation.
3. Reliable Automatic Sprinkler Co., Inc.
4. Tyco Fire & Building Products LP.
5. Venus Fire Protection Ltd.
6. Victaulic Company.
7. Viking Corporation.
8. Or Approved Equal

B. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "NYS MEA Approval Guide," published by FM Global, listing.
2. Pressure Rating for Automatic Sprinklers: 175 psig minimum.
- C. Automatic Sprinklers with Heat-Responsive Element:
 1. Nonresidential Applications: UL 199.
 2. Characteristics: Nominal 1/2-inch orifice with discharge coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.
- D. Sprinkler Finishes:
 1. Bronze.
- E. Sprinkler Guards:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Reliable Automatic Sprinkler Co., Inc.
 - b. Tyco Fire & Building Products LP.
 - c. Victaulic Company.
 - d. Viking Corporation.
 - e. Or Approved Equal
 2. Standard: UL 199.
 3. Type: Wire cage with fastening device for attaching to sprinkler.

2.10. ALARM DEVICES

- A. Alarm-device types shall match piping and equipment connections.
- B. Pressure Switches:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AFAC Inc.
 - b. Barksdale, Inc.
 - c. Detroit Switch, Inc.
 - d. Potter Electric Signal Company.
 - e. System Sensor; a Honeywell company.
 - f. Tyco Fire & Building Products LP.
 - g. United Electric Controls Co.
 - h. Viking Corporation.
 - i. Or Approved Equal
 2. Standard: UL 346.
 3. Type: Electrically supervised water-flow switch with retard feature.

4. Components: Single-pole, double-throw switch with normally closed contacts.
 5. Design Operation: Rising pressure signals water flow.
- C. Valve Supervisory Switches:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Fire-Lite Alarms; a Honeywell company.
 - b. Kennedy Valve; a division of McWane, Inc.
 - c. Potter Electric Signal Company.
 - d. System Sensor; a Honeywell company.
 - e. Or Approved Equal
 2. Standard: UL 346.
 3. Type: Electrically supervised.
 4. Components: Single-pole, double-throw switch with normally closed contacts.
 5. Design: Signals that controlled valve is in other than fully open position.

2.11. MANUAL CONTROL STATIONS

- A. Description: UL listed or FM Global approved, hydraulic operation, with union, NPS 1/2 pipe nipple, and bronze ball valve. Include metal enclosure labeled "MANUAL CONTROL STATION" with operating instructions and cover held closed by breakable strut to prevent accidental opening.

2.12. PRESSURE GAGES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following
1. AMETEK, Inc.; U.S. Gauge Division.
 2. Ashcroft, Inc.
 3. Brecco Corporation.
 4. WIKA Instrument Corporation.
 5. Or Approved Equal
- B. Standard: UL 393.
- C. Dial Size: 3-1/2- to 4-1/2-inch diameter.
- D. Pressure Gage Range: 0 to 250 psig minimum
- E. Water System Piping Gage: Include "WATER" or "AIR/WATER" label on dial face.
- F. Air System Piping Gage: Include retard feature "AIR" or "AIR/WATER" label on dial face.

PART 3 - EXECUTION

3.1. EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

3.2. PREPARATION

- A. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Article.
- B. Report test results promptly and in writing.

3.3. WATER-SUPPLY CONNECTIONS

- A. Connect sprinkler piping to building's fire protection

3.4. PIPING INSTALLATION

- A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.
 - 1. Deviations from approved working plans for piping require written approval from The NYS Department of Buildings. File written approval with Commissioner before deviating from approved working plans.
- B. Piping Standard: Comply with requirements in NFPA 13 for installation of sprinkler piping.
- C. Install seismic restraints on piping. Comply with requirements in NFPA 13 for seismic-restraint device materials and installation.
- D. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
- E. Install unions adjacent to each valve in pipes NPS 2 and smaller.
- F. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.
- G. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.
- H. Install sprinkler piping with drains for complete system drainage.
- I. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.

- J. Install automatic (ball drip) drain valves to drain piping between fire-department connections and check valves. Drain to floor drain or to outside building.
- K. Connect compressed-air supply to dry-pipe sprinkler piping.
- L. Connect air compressor to the following piping and wiring:
 - 1. Pressure gages and controls.
 - 2. Electrical power system.
 - 3. Fire-alarm devices, including low-pressure alarm.
- M. Install alarm devices in piping systems.
- N. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements in NFPA 13 for hanger materials.
- O. Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 and with soft metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they will not be subject to freezing.
- P. Drain dry-pipe sprinkler piping.
- Q. Pressurize and check dry-pipe sprinkler system piping air compressors.
- R. Install sleeves for piping penetrations of walls.
- S. Install sleeve seals for piping penetrations of concrete walls.
- T. Install escutcheons for piping penetrations of walls, ceilings, and floors.

3.5. JOINT CONSTRUCTION

- A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.
- B. Install unions adjacent to each valve in pipes NPS 2 and smaller.
- C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.
- D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.

- G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- H. Twist-Locked Joints: Insert plain end of steel pipe into plain-end-pipe fitting. Rotate retainer lugs one-quarter turn or tighten retainer pin.
- I. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.
- J. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Brazed Joints" Chapter.
- K. Extruded-Tee Connections: Form tee in copper tube according to ASTM F 2144. Use tool designed for copper tube; drill pilot hole, form collar for outlet, dimple tube to form seating stop, and braze branch tube into collar.
- L. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.6. VALVE AND SPECIALTIES INSTALLATION

- A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and the New York State Building Code.
- B. Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.
- C. Specialty Valves:
 - 1. General Requirements: Install in vertical position for proper direction of flow, in main supply to system.
 - 2. Dry-Pipe Valves: Install trim sets for air supply, drain, priming level, alarm connections, ball drip valves, pressure gages, priming chamber attachment, and fill-line attachment.
 - a. Install air compressor and compressed-air supply piping.
 - b. Air-Pressure Maintenance Device: Install shutoff valves to permit servicing without shutting down sprinkler system; bypass valve for quick system filling; pressure regulator or switch to maintain system pressure; strainer; pressure ratings with 14- to 60-psig adjustable range; and 175-psig maximum inlet pressure.
 - c. Install compressed-air supply piping from building's compressed-air piping system.

3.7. SPRINKLER INSTALLATION

- A. Install upright sprinklers in parking area coordinate with all other building trades and structural conditions.

3.8. IDENTIFICATION

- A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.
- B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.9. FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. Leak Test: After installation, charge systems and test for leaks. Restore leaks and retest until no leaks exist.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - 3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
 - 4. Energize circuits to electrical equipment and devices.
 - 5. Start and run air compressors.
 - 6. Coordinate with fire-alarm tests. Operate as required.
 - 7. Coordinate with fire-pump tests. Operate as required.
- C. Sprinkler piping system will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

3.10. CLEANING

- A. Clean dirt and debris from sprinklers.
- B. Remove and replace sprinklers with paint other than factory finish.

3.11. INSTRUCTION

- A. Engage a factory-authorized service representative to instruct The City of New York's operating personnel to adjust, operate, and maintain specialty valves.

3.12. PIPING SCHEDULE

- A. Sprinkler specialty fittings may be used, downstream of control valves, instead of specified fittings.

- B. Copper-tube, extruded-tee connections may be used for tee branches in copper tubing instead of specified copper fittings. Branch-connection joints must be brazed.
- C. Standard-pressure, dry-pipe sprinkler system, NPS 2 shall be one of the following:
 - 1. Standard-weight, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
 - 2. Standard-weight, galvanized-steel pipe with plain ends; plain-end-pipe fittings; and twist-locked joints.
 - 3. Standard-weight galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
- D. Standard-pressure, dry-pipe sprinkler system, NPS 2-1/2 to NPS 4 , shall be one of the following:
 - 1. Standard-weight, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
 - 2. Standard-weight, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

3.13. SPRINKLER SCHEDULE

- A. Use sprinkler types in subparagraphs below for the following applications:
- B. Spaces Subject to Freezing: Upright sprinklers

END OF SECTION 211316

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SECTION 220500 - COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Contract Documents: The work of the section with the Contract Documents, including the General Conditions, the Supplementary Conditions and Division 1 - General Requirements.
- B. Contractor shall include cost for all fees and preparation of all required documents, forms, calculations, affidavits and etc., for the following:
 - Controlled Inspections
 - Building and Fire Department Filings
 - Filing or refiling of and gaining of all Schedule B's including final revised drawings to reflect as-built conditions.
 - Filing of and gaining approval from the Building and Fire Department to obtain permit and for entire sprinkler system as proposed and as installed including as-built drawings, hydraulic calculations riser diagrams and etc., as required.
 - RPZ test and sign off.
 - Factory mutual (as required).

1.2 SUMMARY

- A. General: Provide all plant, labor, tools, appliances, equipment, materials and services required for the work indicated on the drawings and specified in this section.
- B. Work Included: The work includes, but is not necessarily limited to, the following:
 - 1. Soil, waste, storm, leader, vent and drainage systems including connections to the utilities in the street
 - 2. House sewers and connections to existing City sewers.
 - 3. Excavation and backfill as per Section.
 - 4. A reduce pressure zone backflow device as required for new domestic cold water service.
 - 5. Drains, flashings, specialties and equipment supports.
 - 6. Hose bibs, sill cocks and wall hydrants.
 - 7. Cleaning and testing.
 - 8. Hook up of temporary water.

9. Air vents, escutcheons, specialties and appurtenances.
10. Insulation for piping and equipment.
11. Identification and color coding of all piping.
12. Sump pumps and controls, temporary and permanent.
13. Sleeves through waterproof slabs and foundation wall and waterproofing of same.
14. New water service for domestic cold water including curb valve.
15. Setting and installing new domestic meter with remote reader.
29. Installation and approval of RPZ device with New York State Department of Environmental Protection.
30. Duplex submersible sewage ejectors and elev sump pumps.
31. Circulating pumps.

1.3 QUALITY ASSURANCE

- A. The Specifications and the accompanying drawings are intended to secure the provisions of all material, labor, equipment, appliances, and services necessary to install complete, tested, and ready for operating the Systems in accordance with the Specifications and Drawings. All systems shall be complete with all necessary appurtenances and minor auxiliaries, including offsets to clear interferences and supports which are not shown but are needed to make each system complete in every respect. All work described in the Specifications and not shown on the Drawings, or vice versa, shall be furnished in complete working order. If mention has been omitted of any item of work or material, necessary for completion of the system, then such items must be and hereby are included.
- B. Sanitary, storm and water, riser diagrams, as well as schematic diagrams (when indicated), generally indicate connections to be used for various systems and equipment. Systems routing, height, and invert elevations shall be as required for the actual systems installed on this Project. Provide all work shown on diagrams whether or not it is duplicated on the plans.
- C. The Drawings show the arrangement of all piping. Should job conditions necessitate rearrangement of same, this Contractor shall prepare and submit the proposed rearrangement to the General Contractor and Architect for approval before proceeding with the work.
- D. Everything necessary for the completion and successful operation of the work, whether or not herein definitely specified or indicated on the Drawings, shall be furnished and installed as if so specified or so indicated.

- E. This Contractor shall, before installing any of his work, see that it does not interfere with clearance required for finished columns, beams, partitions, walls, etc., as shown on the Architectural Drawings. If it cannot be followed, he shall call this to the attention of the General Contractor and Architect before proceeding with the work.
- F. The complete system of plumbing and drainage shall be so installed as to secure free, noiseless operation, proper and continuous service to the complete satisfaction of Owner and local authorities having jurisdiction.
- G. Contractor is responsible for clean-out of all mains, risers and traps (waster lines) to remove debris at the end of construction.
- H. This Contractor shall ascertain that all his equipment such as valves, traps, cleanouts and other apparatus as may be necessary to be reached from time to time for operation and maintenance is made easily accessible.
- I. Standards & Codes:
 - New York State Code 2020 and New York State Plumbing Code 2020.
 - National Fire Protection Association. All Applicable Sections.
 - New York State Fuel Gas Code 2020.
 - State of NY Dept. of Health, New York State Code
 - Local Gas Utility Rules and Regulations
 - Local Municipal Rules and Regulations
 - Local Water Company Rules and Regulations
 - Other State and Local Authorities having Jurisdiction
- J. Manufacturer's Instructions: In addition to the requirements of these Specifications, comply with the manufacturer's instructions and recommendations for all phases of the work.

1.4 SUBMITTALS

- A. Submit shop drawing in accordance with requirements of this specification.
- B. The Subcontractor will submit all shop drawings in the scale as directed by the General Contractor to facilitate coordination with the shop drawings of other trades. Submission of shop drawings shall be made in ample time before the scheduled installation to allow comments by the Architect and General Contractor. Any equipment or installation ordered prior to final approval may be deemed unacceptable. Approval of the shop drawings is only an aid to the Subcontractor and does not relieve, in any way, this Subcontractor of any of its responsibilities and obligations under this Contract.
- C. This Subcontractor shall submit shop drawings and/or descriptive literature of all work and equipment including but limited to the following items for approval:
 - 1. All inside, overhead and, underground and exterior drainage systems.

2. Floor drains, roof drains, area drains, cleanouts, pit frames and covers.
3. Valves, access doors, wall hydrants, hot water heaters and accessories
4. Plumbing fixtures and supports, flush valves and fixture trim.
5. Circulating pumps required for plumbing work.
6. Pumps required for plumbing work with pump curves.
7. Motors, starters, etc.
8. Water distribution layouts.
- 9 Gas service piping, metering and layout.
10. Hose bibbs and wall hydrants.
11. Vacuum breakers, gauges and thermometers.
12. Pump control panel with wiring diagram and sequencing.

1.5 COORDINATION

- A. The work of this division shall be coordinated with the work of other trades and so arranged that there will be no inconvenience or delays in the installation and completion of any work of each trade. The Plumbing Subcontractor will check the Electrical, Sprinkler, and HVAC plans and shop drawings submitted by the Contractors of these respective divisions, so as to avoid any possibility of a conflict of the Plumbing work with the work of these or any other trades. This Subcontractor shall give all others whose work connects with its work, all necessary information required for the proper installation of their work without unnecessary delay.
- B. The Subcontractor shall fully cooperate with the Carpentry Subcontractor in the installation of the kitchen sinks and lavatory basins. Coordination of installation to be as directed by the Project Superintendent. All sinks and basins to be mounted in a waterproof and careful manner so as to avoid chipping of the fixtures and in strict accordance with Union rules.
- C. This Contractor shall give the Project Superintendent ample notice as to the size and location of any special openings desired for bringing in, removing, or handling equipment within the building.
- D. This Subcontractor shall prepare and furnish to the Owner, for distribution to the superstructure Subcontractor, drawings of the sleeves, slots and depressions required, and shall be responsible for checking the layouts of same prior to the construction of the Superstructure.

- E. Refer to the list of mechanical and electrical drawings in Schedule of Drawings. This Contractor shall also refer to the Architectural details, site plans, floor plans and elevations and Structural Drawings
- F. The Drawings and Specifications are intended to supplement each other so that any details shown on the Drawings and not mentioned in the Specifications, or vice versa, shall be executed the same as if mentioned in the Specifications and shown on the Drawings, or vice versa.

1.6 PRIOR TEST

- A. Coordinate with requirements of Section 01042 and 01700.
- B. All concealed work must remain uncovered until required tests have been completed. But, in the event that construction schedule requires it, this Contractor shall make arrangements for prior tests on portions of the plumbing work involved. The General Contractor or Architect shall be notified in advance of all prior tests and will be represented at such test. The cost of prior tests shall be paid by this contractor.

1.7 EXCAVATION AND BACKFILL

- A. This Contractor shall do all excavating and backfilling necessary for the complete installation of house drains storm and sanitary drainage, water mains, gas mains, and for all outside of building provided under this contract.
- B. Backfilling and trenching shall be done in accordance with requirements and standards set forth in Section.

1.9 PROTECTION

- A. Every soil, leader, vent, waste and gas supply opening of any character shall be closed by means of a test plug, screw cap or other appropriate fitting, and no paper, wood, brick, plaster or other substitute will be allowed. Plugs or caps shall not be removed from the pipe opening except during the time the pipe is being actually worked upon.
- B. Special care shall be taken in closing all traps in water closets, bath tubs, and plugs of sinks in lavatories so that no building debris can enter.
- C. As soon as water closets, lavatories, baths or other fixtures are set, they shall be protected to prevent use, misuse, breakage or soiling and all finished metal shall be greased or otherwise protected.
- D. This Subcontractor shall be held responsible for the protection of all plumbing fixtures against breakage or damage at all times until the final acceptance of the installation on a floor by floor basis as installed. Payment made on account of the Contract shall in no way relieve the Subcontractor from these responsibilities. Any and all portions of work liable to damage or dislocation by this or other Subcontractors must be thoroughly protected. When the removal of said protection is approved by the Owner it shall be removed from the premises and the work left in clean good condition.

- E. All work shall be protected by this Subcontractor against freezing during the course of construction, and this Subcontractor shall remove and replace any piping, equipment, etc., that was damaged due to freezing at its own cost.
- F. It is the responsibility of this Subcontractor to properly lubricate, as required by the manufacturer, all pumps motors, etc., before electrical connections are made by the Electrical Subcontractor and the equipment is put into operation. The Subcontractor will be held fully responsible for any damage to the equipment that is put into operation without previously having been lubricated.

1.10 GUARANTEE

- A. This Contractor shall guarantee all material, fixtures, equipment and workmanship, specified for this Section of the Specifications, to be free from defects for a period of one (1) year from the date of acceptance and shall replace any part of parts found to be defective within the period of guarantee with acceptable material and workmanship. Date of acceptance shall commence from date of final payment.
- B. Refer to requirements of Section and provide the most stringent terms.

END OF SECTION 220500

SECTION 220519 - METERS AND GAGES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Bimetallic-actuated thermometers.
 - 2. Liquid-in-glass thermometers.
 - 3. Thermowells.
 - 4. Dial-type pressure gages.
 - 5. Gage attachments.
 - 6. Test plugs.

- B. Related Sections:

- 1. Division 21 Section "Facility Fire-Suppression Water-Service Piping" for fire-protection water-service meters outside the building.
 - 2. Division 21 fire-suppression piping Sections for fire-protection pressure gages.
 - 3. Division 22 Section "Facility Water Distribution Piping" for domestic water meters and combined domestic and fire-protection water-service meters outside the building.
 - 4. Division 22 Section "Domestic Water Piping" for water meters inside the building.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Product Certificates: For each type of meter and gage, from manufacturer.
- C. Operation and Maintenance Data: For meters and gages to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 BIMETALLIC-ACTUATED THERMOMETERS

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

1. Ernst Flow Industries.
2. Marsh Bellofram.
3. Trerice, H. O. Co.
4. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
5. Weiss Instruments, Inc.
6. WIKA Instrument Corporation - USA.

- B. Standard: ASME B40.200.
- C. Case: Hermetically sealed type(s); stainless steel with 3-inch nominal diameter.
- D. Dial: Nonreflective aluminum with permanently etched scale markings and scales in deg F.
- E. Connector Type(s): Union joint, adjustable angle, with unified-inch screw threads.
- F. Connector Size: 1/2 inch, with ASME B1.1 screw threads.
- G. Stem: 0.25 in diameter; stainless steel.
- H. Window: Double strength glass.
- I. Ring: Stainless steel.
- J. Element: Bimetal coil.
- K. Pointer: Dark-colored metal.
- L. Accuracy: Plus or minus 1 percent of scale range.

2.2 LIQUID-IN-GLASS THERMOMETERS

A. Metal-Case, Industrial-Style, Liquid-in-Glass Thermometers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ernst Flow Industries.
 - b. Trerice, H. O. Co.
 - c. Weiss Instruments, Inc.
2. Standard: ASME B40.200.
3. Case: Cast aluminum; 9-inch nominal size unless otherwise indicated.
4. Case Form: Adjustable angle unless otherwise indicated.
5. Tube: Glass with magnifying lens and blue or red organic liquid.
6. Tube Background: Non-reflective aluminum with permanently etched scale markings graduated in deg F.
7. Window: Glass or acrylic.
8. Stem: Aluminum, brass or stainless steel and of length to suit installation.

- a. Design for Air-Duct Installation: With ventilated shroud.
 - b. Design for Thermowell Installation: Bare stem.
9. Connector: 1-1/4 inches, with ASME B1.1 screw threads.
 10. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

2.3 THERMOWELLS

A. Thermowells:

1. Standard: ASME B40.200.
2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
3. Material: Brass or stainless steel.
4. Type: Stepped shank unless straight or tapered shank is indicated.
5. External Threads: 1/2 inch, 3/4 inch, or 1 inch, ASME B1.20.1 pipe threads.
6. Internal Threads: 1/2, 3/4, and 1 inch, with ASME B1.1 screw threads.
7. Bore: Diameter required to match thermometer bulb or stem.
8. Insertion Length: Length required to match thermometer bulb or stem.
9. Lagging Extension: Include on thermowells for insulated piping and tubing.
10. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

2.4 PRESSURE GAGES

A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AMETEK, Inc.; U.S. Gauge.
 - b. Marsh Bellofram.
 - c. Trerice, H. O. Co.
 - d. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
 - e. Weiss Instruments, Inc.
 - f. WIKA Instrument Corporation - USA.
2. Standard: ASME B40.100.
3. Case: Liquid-filled type(s); stainless steel; 4-1/2-inch nominal diameter.
4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
5. Pressure Connection: 316L stainless steel, with 1/4 inch, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
6. Movement: Mechanical, with link to pressure element and connection to pointer.
7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi.
8. Pointer: Dark-colored metal.
9. Window: Glass.
10. Ring: Stainless steel.
11. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

2.5 GAGE ATTACHMENTS

- A. Snubbers: ASME B40.100, brass; with 1/4 inch ASME B1.20.1 pipe threads and surge-dampening device. Include extension for use on insulated piping.
- B. Siphons: Loop-shaped section of brass pipe with 1/4 inch pipe threads.
- C. Valves: Brass or stainless-steel needle, with 1/4 inch, ASME B1.20.1 pipe threads.

2.6 TEST PLUGS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Petersin Equipment Co. Inc., or comparable product by one of the following:
 - 1. Trerice, H. O. Co.
 - 2. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
 - 3. Weiss Instruments, Inc.
- B. Description: Test-station fitting made for insertion into piping tee fitting.
- C. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.
- D. Thread Size: 1/2 inch, ASME B1.20.1 pipe thread.
- E. Minimum Pressure and Temperature Rating: 500 psig at 240 deg F.
- F. Core Inserts: Neoprene self-sealing rubber.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install thermowells with socket extending one-third of pipe diameter and in vertical position in piping tees.
- B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.
- C. Install thermowells with extension on insulated piping.
- D. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.
- E. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.
- F. Install valve and snubber in piping for each pressure gage for fluids.

- G. Install test plugs in piping tees.
- H. Install thermometers in the following locations:
 - 1. Inlet and outlet of each water heater.
 - 2. Inlets and outlets of each domestic water heat exchanger.
 - 3. Inlet and outlet of each domestic hot-water storage tank.
- I. Install pressure gages in the following locations:
 - 1. Building water service entrance into building.
 - 2. Inlet and outlet of each pressure-reducing valve.
 - 3. Suction and discharge of each domestic water pump.

3.2 CONNECTIONS

- A. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.

3.3 ADJUSTING

- A. Adjust faces of meters and gages to proper angle for best visibility.

3.4 THERMOMETER SCHEDULE

- A. Thermometers at inlet and outlet of each domestic water heater shall be one of the following:
 - 1. Sealed, bimetallic-actuated type.
 - 2. Industrial-style, liquid-in-glass type.
- B. Thermometers at inlets and outlets of each domestic water heat exchanger shall be one of the following:
 - 1. Sealed, bimetallic-actuated type.
 - 2. Industrial-style, liquid-in-glass type.
- C. Thermometers at inlet and outlet of each domestic hot-water storage tank shall be one of the following:
 - 1. Sealed, bimetallic-actuated type.
 - 2. Industrial-style, liquid-in-glass type.
- D. Thermometer stems shall be of length to match thermowell insertion length.

3.5 THERMOMETER SCALE-RANGE SCHEDULE

- A. Scale Range for Domestic Cold-Water Piping: 0 to 100 deg F.

- B. Scale Range for Domestic Hot-Water Piping: 20 to 240 deg F.

3.6 PRESSURE-GAGE SCHEDULE

- A. Pressure gages at discharge of each water service into building shall be the following:
 - 1. Liquid-filled direct-mounted, metal case.
- B. Pressure gages at inlet and outlet of each water pressure-reducing valve shall be of the following:
 - 1. Liquid-filled direct-mounted, metal case.
- C. Pressure gages at suction and discharge of each domestic water pump shall be the following:
 - 1. Liquid-filled direct-mounted, metal case.

3.7 PRESSURE-GAGE SCALE-RANGE SCHEDULE

- A. Scale Range for Water Service Piping: 0 to 160 psi.
- B. Scale Range for Domestic Water Piping: 0 to 160 psi.

END OF SECTION 220519

SECTION 220523 - GENERAL DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Contract Documents: The work of the section with the Contract Documents, including the General Conditions, the Supplementary Conditions and Division 1 - General Requirements.

1.2 SUMMARY

- A. General: Provide all plant, labor, tools, appliances, equipment, materials and services required for the work indicated on the drawings and specified in this section.
- B. Work Included: The work includes, but is not necessarily limited to, the following:

Work under this Section of the Specifications shall consist of providing all labor, material equipment and appurtenances, unless hereinafter specifically exempted, necessary for an incidental to the execution and completion of the Plumbing Piping Systems and accessories as indicated on the drawings and specified herein.

Description of the Work:

1. Gate valves
2. Globe and angle valves
3. Swing check valves
4. Lift check valves
5. Silent check valves (pump discharge)
6. Ball valves
7. Butterfly valves
8. Pressure reducing valves
9. Solenoid valves
10. Water service valves

1.3 RELATED DOCUMENTS

- A. All work shall be subject to the General Conditions and shall comply with applicable

requirements of the Contract.

- B. Requirements of Section 15010 shall also govern work specified herein.

1.4 SUBMITTALS

- A. Furnish to the Architect for approval, manufacturers technical literature, drawings and diagrams describing each item specified or illustrated.

1.5 QUALITY ASSURANCE

- A. Provide valves of same manufacturer throughout where possible.
- B. Provide valves with manufacturer's name and pressure rating clearly marked on the outside of the body.

C. Approved Manufacturers

1. Gate, globe, angle valves, swing, lift and ball check valves

Jenkins
Stockham
Hammond
Kennedy
Crane
Flygt

2. Silent check valves

Smolensky
Williams - Hager
Mueller

3. Ball valves

Apollo
Watts
Worcester
Jamesbury
Fairbanks
Rockwell McCanna

4. Butterfly Valves

Rockwell - McCanna Co.
Jamesbury Co.
Duriron

5. Pressure reducing valves (PRV)

a. Central station

Cla-Val
Roll Seal
Gungenhauser

b. Local PRV

Ford
A.W. Cash
Watts

PART 2 - PRODUCTS

2.1 GATE VALVES

- A. Valve bodies shall be all bronze with bronze trim.
- B. Bronze valve shall have aluminum alloy hand wheels.
- C. Use rising stem gate valves where space permits.
- D. Valves six inches (6") and larger shall be equipped with valve bypass.
- E. Model numbers listed below are valves manufactured by Fairbanks. Valves unless otherwise indicated. Equal valves of approved manufacturers will also be approved.
- F. Ball valves may be substituted for gate valves in sizes three inches (3") and smaller.
- G. Valve Application:
 - 1. Domestic Water System

Sizes	Pressure Class SWP/CWP	Model No.	Valve End
2 1/2" & smaller	/300	0282	Socket
3" & larger	125/200	0405	Flange
2" & larger	250/500	0312	Flange

2. Sewage Ejection Discharge

Sizes	Pressure Class SWP/CWP	Model No.	Valve End
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All	125/200	0405	Flange
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3. Storm Water Sump Pump Discharge

Sizes	Pressure Class SWP/CWP	Model No.	Valve End
2" & 2 1/2"	150/300	0252	Screw
3" & larger	125/200	0405	Flange

2.2 GLOBE & ANGLE VALVES

- A. Valve bodies shall be all bronze with bronze trim.
- B. Provide re-grindable seats and composite discs for all globe valves and throttling nuts for globe valves used for pipe line balancing.
- C. Model numbers listed below are valves manufactured by Fairbanks Valves unless otherwise indicated. Equal valves of approved manufacturers will also be approved.
- D. Ball valves may be substituted for globe valves in sized three inches (3") and smaller.
- E. Valve Application

1. Domestic Water System

Sizes	Pressure Class SWP/CWP	Model No. Rating	Valve End
2" & smaller	/300	4502-2	Socket
2 1/2" & 3"	150/300	U-01	Screw
4" & larger	125/200	0102	Flange

2.3 SWING CHECK VALVES

- A. Valve bodies three inches (3") and smaller shall be all bronze.
- B. Valve bodies four inches (4") and larger shall be iron body bronze mounted.
- C. Swing check valves shall be provided with composite discs for sewage ejector and sump pump discharge.
- D. Model numbers listed below are valves manufactured by Fairbanks Valves unless otherwise indicated. Equal valves of approved manufacturers will also be approved.
- E. Double door check valves for compressed air shall be threaded full flange type, carbon steel body, stainless steel door and pins (type C), monel spring, and Buna-N seats.

2.4 SILENT CHECK VALVE

- A. Silent check valves for domestic water, non-potable water system pump discharges shall be flanged globe type with stainless steel (S/S) spring and Buna-N insert.
- B. Silent check valves for fire standpipe pump discharges shall be flanged water type with stainless steel spring and Buna-N insert.
- C. Valve seat and disc shall be renewable and reseated without special tools.
- D. Model numbers listed below are valves manufactured by Williams - Hager unless otherwise indicated. Equal valves of approved manufacturers will also be approved.
- E. All parts of valves in contact with deionized, demineralized, and/or process water shall be stainless steel.
- F. Valve Application

1. Domestic Water Pump Discharge

Sizes	Pressure Class & WOG Rating No.	Model	Body	Disc	Seat Ring
2 1/2" & smaller	125/175	329	Semi-Steel	Bronze	Bronze
2 1/2" & smaller	150/285	329	Cast steel	S/S	S/S
2 1/2" & smaller	250/400	329	Cast steel	S/S	S/S
3" & larger	125/175	636	Semi-Steel	Bronze	Bronze
3" & larger	150/285	636	Cast-Steel	S/S	S/S
3" & larger	250/400	636	Semi-Steel	Bronze	Bronze
3" & larger	300/740	636	Cast-Steel	S/S	S/S

2. Non-Potable Water Pump Discharge

Size	Pressure Class & WOG Rating No.	Model	Body	Disc	Seat Ring
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2 1/2" & Smaller	125/175	329	Semi-Steel	Bronze	Bronze
3" & larger	125/175	636	Semi-Steel	Bronze	Bronze

2.5 BALL VALVES

- A. Ball valves may be substituted for gate and globe valves in sizes three inches (3") and smaller.
- B. Ball valves installed in piping for balancing shall be provided with memory balancing stops.
- C. Ball valves shall have full port ball and body construction.
- D. Bronze ball valves shall be constructed of a one piece bronze casting and machined end piece retainer, rated at 600 P.S.I. CWP, with blow-out proof stem design complete with teflon seat and seals and chrome plated full port bronze ball.
- E. All ball valves shall be (100%) factory tested.
- F. Provide union end valves at equipment in lieu of one union.
- G. Provide ball valves with mounting pad where valve actuators are required.
- H. Provide "T" handle to actuate valves two inches (2") and smaller in lieu of lever handle when space limitations exist.
- I. Model numbers listed below are valves manufactured by Apollo unless otherwise indicated. Equal valves of approved manufacturers will also be approved.
- J. Valve Application

1. Domestic Water Systems

Size	Model No.	Valve End
1/2"	70-203	Socket
3/4"	77-204	Socket
1"	77-205	Socket
1 1/4"	77-206	Socket
1 1/2"	77-207	Socket
2"	77-208	Socket
2 1/2"	77-209	Screw w/adapter
3"	70-200	Screw w/adapter

2.7 RELIEF VALVES

- A. Manufacturers:

1. Watts Regulator Co.
- B. Other acceptable manufacturers offering equivalent products.
 1. Kunkle Valve Co.
 2. Taco, Inc.
 3. Bell & Gossett Co.
- C. Bronze body, Teflon seat, steel stem and springs automatic direct pressure actuated, capacities ASME certified and labeled.

2.8 STRAINERS

- A. Manufacturers:
 1. Sarco
 2. Other acceptable manufacturers offering equivalent products.
 - a. Mueller Brass Co.
 - b. Hoffman Specialty ITT.
- B. Size 2 inch and under: Screwed brass or iron body for 175 psig working pressure, Y pattern with a/32 inch stainless steel perforated screen.
- C. Size 2½ inch to 4 inch: Flanged iron body for 175 psig working pressure, Y pattern with 3/64 inch stainless steel perforated screen.
- D. Size 5 inch and larger: Flanged iron body for 175 psig working pressure, basket pattern with 1/8 inch stainless steel perforated screen.

2.9 CHAINWHEELS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the work include but are not limited to the following:
 1. Babbitt Steam Specialty co.
 2. Roto Hammer Industries.
 3. Trumbull Industries.
- B. Description: Valve actuation assembly with sprocket rim, brackets, and chain.
 1. Brackets: Type, number, size, and fasteners required to mount actuator on valve.
 2. Attachment: for connection to ball butterfly and plug valve stema.
 3. Sprocket Rim with Chain Guides: Ductile or cast iron of type and size required for valve.
 4. Chain: Hot-dip, galvanized steel of size required to fit sprocket rim.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Do not attempt to repair defective valves; replace with new valves.
- F. Ream pipe and tube ends. Remove burrs.
- G. Remove scale and dirt on inside and outside before assembly.
- H. Prepare piping connections to equipment with flanges or unions.

3.2 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.
- E. Install chainwheels on operators for valves 4 inch and larger and more than 96 inches above floor. Extend chains to 60 inches above finished floor.
- F. Install check valves for proper direction of flow and as follows:
 - 1. Swing Check Valves: In horizontal position with hinge pin level.
 - 2. Center-Guided Check Valves: In horizontal or vertical position, between flanges.
 - 3. Lift Check Valves: With stem upright and plumb.
- G. Install in accordance with manufacturer's instructions.
- H. Provide non-conducting dielectric connections wherever jointing dissimilar metals.
- I. Provide clearance for installation of insulation and access to valves and fittings.

- J. Provide access where valves and fittings are not exposed. Coordinate size and location of access doors with Section 08305.
- K. Install valves with stems upright or horizontal, not inverted.
- L. Provide one plug valve wrench for every ten plug valves sized 2 inches and smaller, minimum of one. Provide each plug valve sized 2½ inches and larger with a wrench with set screw.
- M. Pipe vents from gas pressure reducing valves to outdoors and terminate in weatherproof hood.

3.3 APPLICATION

- A. Install unions downstream of valves and at equipment or apparatus connections.
- B. Install brass male adapters each side of valves in copper piped system. Sweat solder adapters to pipe.
- C. Install gate ball or ball valves for shut-off and to isolate equipment, part of systems, or vertical risers.
- D. Install globe ball valves for throttling, bypass, or manual flow control services.
- E. Provide swing check valves on discharge of circulation pumps.
- F. Provide plug valves in natural gas systems for shut-off service.

3.4 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into services but before final adjusting and balancing. Replace valves if persistent leaking occurs.

END OF SECTION 220523

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SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following hangers and supports for plumbing system piping and equipment:
 - 1. Steel pipe hangers and supports.
 - 2. Trapeze pipe hangers.
 - 3. Metal framing systems.
 - 4. Thermal-hanger shield inserts.
 - 5. Fastener systems.
 - 6. Pipe stands.
 - 7. Pipe positioning systems.
 - 8. Equipment supports.
- B. Related Sections include the following:
 - 1. Division 05 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
 - 2. Division 22 Section "Expansion Fittings and Loops for Plumbing Piping" for pipe guides and anchors.
 - 3. Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment" for vibration isolation devices.

1.3 DEFINITIONS

- A. MSS: Manufacturers Standardization Society for The Valve and Fittings Industry Inc.
- B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.4 PERFORMANCE REQUIREMENTS

- A. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.

- B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- C. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

1.5 SUBMITTALS

- A. Product Data: For the following:
 - 1. Steel pipe hangers and supports.
 - 2. Thermal-hanger shield inserts.
 - 3. Pipe positioning systems.
- B. Shop Drawings: Show fabrication and installation details and include calculations for the following:
 - 1. Trapeze pipe hangers. Include Product Data for components.
 - 2. Metal framing systems. Include Product Data for components.
 - 3. Pipe stands. Include Product Data for components.
 - 4. Equipment supports.
- C. Welding certificates.

1.6 QUALITY ASSURANCE

- A. Welding: As applicable.
- B. Welding: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1, "Structural Welding Code--Steel."
 - 2. AWS D1.2, "Structural Welding Code--Aluminum."
 - 3. AWS D1.4, "Structural Welding Code--Reinforcing Steel."
 - 4. ASME Boiler and Pressure Vessel Code: Section IX.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 STEEL PIPE HANGERS AND SUPPORTS

- A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.
- B. Manufacturers:
 - 1. AAA Technology & Specialties Co., Inc.
 - 2. Bergen-Power Pipe Supports.
 - 3. B-Line Systems, Inc.; a division of Cooper Industries.
 - 4. Carpenter & Paterson, Inc.
 - 5. Empire Industries, Inc.
 - 6. ERICO/Michigan Hanger Co.
 - 7. Globe Pipe Hanger Products, Inc.
 - 8. Grinnell Corp.
 - 9. GS Metals Corp.
 - 10. National Pipe Hanger Corporation.
 - 11. PHD Manufacturing, Inc.
 - 12. PHS Industries, Inc.
 - 13. Piping Technology & Products, Inc.
 - 14. Tolco Inc.
- C. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.
- D. Nonmetallic Coatings: Plastic coating, jacket, or liner.
- E. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.3 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

2.4 METAL FRAMING SYSTEMS

- A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.
- B. Manufacturers:
 - 1. B-Line Systems, Inc.; a division of Cooper Industries.
 - 2. ERICO/Michigan Hanger Co.; ERISTRUT Div.
 - 3. GS Metals Corp.
 - 4. Power-Strut Div.; Tyco International, Ltd.
 - 5. Thomas & Betts Corporation.
 - 6. Tolco Inc.

7. Unistrut Corp.; Tyco International, Ltd.

C. Coatings: Manufacturer's standard finish unless bare metal surfaces are indicated.

D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

2.5 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

1. Manufacturers:

- a. Hilti, Inc.
- b. ITW Ramset/Red Head.
- c. Masterset Fastening Systems, Inc.
- d. MKT Fastening, LLC.
- e. Powers Fasteners.

B. Mechanical-Expansion Anchors: Insert-wedge-type zinc-coated steel, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

1. Manufacturers:

- a. B-Line Systems, Inc.; a division of Cooper Industries.
- b. Empire Industries, Inc.
- c. Hilti, Inc.
- d. ITW Ramset/Red Head.
- e. MKT Fastening, LLC.
- f. Powers Fasteners.

2.6 PIPE STAND FABRICATION

A. Pipe Stands, General: Shop or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.

B. Compact Pipe Stand: One-piece plastic unit with integral-rod-roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.

1. Manufacturers:

- a. ERICO/Michigan Hanger Co.
- b. MIRO Industries.

- C. Low-Type, Single-Pipe Stand: One-piece stainless-steel base unit with plastic roller, for roof installation without membrane penetration.
 - 1. Manufacturers:
 - a. MIRO Industries.
- D. High-Type, Single-Pipe Stand: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
 - 1. Manufacturers:
 - a. ERICO/Michigan Hanger Co.
 - b. MIRO Industries.
 - c. Portable Pipe Hangers.
 - 2. Base: Stainless steel.
 - 3. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.
 - 4. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.
- E. High-Type, Multiple-Pipe Stand: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
 - 1. Manufacturers:
 - a. Portable Pipe Hangers.
 - 2. Bases: One or more plastic.
 - 3. Vertical Members: Two or more protective-coated-steel channels.
 - 4. Horizontal Member: Protective-coated-steel channel.
 - 5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.
- F. Curb-Mounting-Type Pipe Stands: Shop- or field-fabricated pipe support made from structural-steel shape, continuous-thread rods, and rollers for mounting on permanent stationary roof curb.

2.7 PIPE POSITIONING SYSTEMS

- A. Description: IAPMO PS 42, system of metal brackets, clips, and straps for positioning piping in pipe spaces for plumbing fixtures for commercial applications.
- B. Manufacturers:
 - 1. C & S Mfg. Corp.
 - 2. HOLDRITE Corp.; Hubbard Enterprises.
 - 3. Samco Stamping, Inc.

2.8 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

2.9 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
 - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
 - 2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

- A. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use padded hangers for piping that is subject to scratching.
- F. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30 .
 - 2. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes, NPS 1/2 to NPS 24, if little or no insulation is required.
 - 3. Pipe Hangers (MSS Type 5): For suspension of pipes, NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
 - 4. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated stationary pipes, NPS 3/4 to NPS 8.
 - 5. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.

6. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
 7. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 2.
 8. Split Pipe-Ring with or without Turnbuckle-Adjustment Hangers (MSS Type 11): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 8.
 9. Extension Hinged or 2-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 3.
 10. U-Bolts (MSS Type 24): For support of heavy pipes, NPS 1/2 to NPS 30.
 11. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
 12. Pipe Saddle Supports (MSS Type 36): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange.
 13. Pipe Stanchion Saddles (MSS Type 37): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange and with U-bolt to retain pipe.
 14. Adjustable, Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes, NPS 2-1/2 to NPS 36, if vertical adjustment is required, with steel pipe base stanchion support and cast-iron floor flange.
- G. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20.
 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20, if longer ends are required for riser clamps.
- H. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
 3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
 4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
 5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
- I. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
 2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joint construction to attach to top flange of structural shape.
 3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.

6. C-Clamps (MSS Type 23): For structural shapes.
 7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
 8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
 9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
 10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
 11. Malleable Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
 12. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:
 - a. Light (MSS Type 31): 750 lb.
 - b. Medium (MSS Type 32): 1500 lb .
 - c. Heavy (MSS Type 33): 3000 lb.
 13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
 14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
 15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- J. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
 2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
 3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- K. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
 2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
 3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
 4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
 5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from hanger.
 6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from base support.
 7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from trapeze support.

8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
 - a. Horizontal (MSS Type 54): Mounted horizontally.
 - b. Vertical (MSS Type 55): Mounted vertically.
 - c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.
- L. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.
- M. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.
- N. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.
- O. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

3.2 HANGER AND SUPPORT INSTALLATION

- A. Steel Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- B. Trapeze Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.
 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
 2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.
- C. Fiberglass Pipe Hanger Installation: Comply with applicable portions of MSS SP-69 and MSS SP-89. Install hangers and attachments as required to properly support piping from building structure.
- D. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.
- E. Fiberglass Strut System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled fiberglass struts.
- F. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

G. Fastener System Installation:

1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

H. Pipe Stand Installation:

1. Pipe Stand Types except Curb-Mounting Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
2. Curb-Mounting-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. Refer to Division 07 Section "Roof Accessories" for curbs.

I. Pipe Positioning System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture. Refer to Division 22 Section "Plumbing Fixtures" for plumbing fixtures.

J. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.

K. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

L. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

M. Install lateral bracing with pipe hangers and supports to prevent swaying.

N. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

O. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

P. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9 (for building services piping) are not exceeded.

Q. Insulated Piping: Comply with the following:

1. Attach clamps and spacers to piping.
 - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.

- b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits according to ASME B31.9 for building services piping.
- 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
- 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
- 4. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2 : 12 inches long and 0.048 inch thick.
 - b. NPS 4: 12 inches long and 0.06 inch thick.
 - c. NPS 5 and NPS 6 : 18 inches long and 0.06 inch thick.
 - d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
 - e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
- 5. Pipes NPS 8 and Larger: Include wood inserts.
- 6. Insert Material: Length at least as long as protective shield.
- 7. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.3 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make smooth bearing surface.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.4 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

- C. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:
1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 2. Obtain fusion without undercut or overlap.
 3. Remove welding flux immediately.
 4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

3.5 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.6 PAINTING

- A. Touch Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
- B. Touch Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 painting Sections.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 220529

SECTION 220533 - HEAT TRACING FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes heat tracing with the following electric heating cables:
 - 1. Self-regulating, parallel resistance.

1.3 SUBMITTALS

- A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for each type of product indicated.
 - 1. Schedule heating capacity, length of cable, spacing, and electrical power requirement for each electric heating cable required.
- B. Field quality-control test reports.
- C. Operation and Maintenance Data: For electric heating cables to include in operation and maintenance manuals.
- D. Warranty: Special warranty specified in this Section.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. All heating-cable components shall be UL Listed, CSA Certified, or FM Approved for use as part of the system to provide pipe freeze protection.

1.5 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace electric heating cable that fails in materials or workmanship within specified warranty period.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SELF-REGULATING, PARALLEL-RESISTANCE HEATING CABLES

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 1. BH Thermal Corporation.
 2. Chromalox, Inc.; Wiegard Industrial Division; Emerson Electric Company.
 3. Delta-Therm Corporation.
 4. Easy Heat Inc.
 5. Nelson Heat Trace.
 6. Pyrotenax; a division of Tyco Thermal Controls.
 7. Raychem; a division of Tyco Thermal Controls.
 8. Thermon Manufacturing Co.
 9. Trasor Corp.
- B. Heating Element: Pair of parallel No. 16 AWG, nickel-coated] stranded copper bus wires embedded in crosslinked conductive polymer core, which varies heat output in response to temperature along its length. Terminate with waterproof, factory-assembled nonheating leads with connectors at one end, and seal the opposite end watertight. Cable shall be capable of crossing over itself once without overheating.
- C. Electrical Insulating Jacket: Flame-retardant polyolefin.
- D. Cable Cover: Tinned-copper braid[, and polyolefin outer jacket with UV inhibitor.
- E. Maximum Operating Temperature (Power On): 150 deg F.
- F. Maximum Exposure Temperature (Power Off): 185 deg F.
- G. Maximum Operating Temperature: 300 deg F .
- H. Capacities and Characteristics:
 1. Maximum Heat Output: 8 W/ft.
 2. Piping Diameter: 2-1/2"
 3. Volts: 120 V.
 4. Phase: 1
 5. Hertz: 60

2.2 CONTROLS

- A. Remote bulb unit with adjustable temperature range from 30 to 50 deg .

- B. Snap action; open-on-rise, single-pole switch with minimum current rating adequate for connected cable.
- C. Remote bulb on capillary, resistance temperature device, or thermistor for directly sensing pipe-wall temperature.
- D. Corrosion-resistant, waterproof control enclosure.

2.3 ACCESSORIES

- A. Cable Installation Accessories: Fiberglass tape, heat-conductive putty, cable ties, silicone end seals and splice kits, and installation clips all furnished by manufacturer, or as recommended in writing by manufacturer.
- B. Warning Tape: Continuously printed "Electrical Tracing"; vinyl, at least 3 mils thick, and with pressure-sensitive, permanent, waterproof, self-adhesive back.
 - 1. Width for Markers on Pipes with OD, Including Insulation, Less Than 6 Inches: 3/4 inch minimum.
 - 2. Width for Markers on Pipes with OD, Including Insulation, 6 Inches or Larger: 1-1/2 inches minimum.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces and substrates to receive electric heating cables for compliance with requirements for installation tolerances and other conditions affecting performance.
 - 1. Ensure surfaces and pipes in contact with electric heating cables are free of burrs and sharp protrusions.
 - 2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install electric heating cable across expansion joints according to manufacturer's written recommendations using slack cable to allow movement without damage to cable.
- B. Install electric heating cables after piping has been tested and before insulation is installed.
- C. Install electric heating cables according to IEEE 515.1.
- D. Install insulation over piping with electric cables according to Division 23 Section "HVAC Insulation."
- E. Install warning tape on piping insulation where piping is equipped with electric heating cables.

- F. Set field-adjustable switches and circuit-breaker trip ranges.
- G. Protect installed heating cables, including nonheating leads, from damage.

3.3 CONNECTIONS

- A. Ground equipment according to Division 26.
- B. Connect wiring according to Division 26.
- C. All branch circuits shall be connected to a GFI type circuit breaker.

3.4 FIELD QUALITY CONTROL

- A. Testing: Perform tests after cable installation but before application of coverings such as insulation, wall or ceiling construction, or concrete.
 - 1. Test cables for electrical continuity and insulation integrity before energizing.
 - 2. Test cables to verify rating and power input. Energize and measure voltage and current simultaneously.
- B. Repeat tests for continuity, insulation resistance, and input power after applying thermal insulation on pipe-mounting cables.
- C. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION 220533

SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Equipment labels.
 - 2. Warning signs and labels.
 - 3. Pipe labels.
 - 4. Stencils.
 - 5. Valve tags.
 - 6. Warning tags.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- D. Valve numbering scheme.
- E. Valve Schedules: For each piping system to include in maintenance manuals.

1.4 COORDINATION

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Material and Thickness: Brass, 0.032-inch, Stainless steel, 0.025-inch , Aluminum, 0.032-inch or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch
3. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
4. Fasteners: Stainless-steel rivets or self-tapping screws.
5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving , and having predrilled holes for attachment hardware.
2. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
3. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
4. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
5. Fasteners: Stainless-steel rivets or self-tapping screws.
6. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

C. Label Content: Include equipment's Drawing designation or unique equipment number, and drawing numbers where equipment is indicated (plans, details, and schedules).

D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules). Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, and having predrilled holes for attachment hardware.

B. Letter Color: White.

- C. Background Color: Red.
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- G. Fasteners: Stainless-steel rivets or self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
 - 2. Lettering Size: At least 1-1/2 inches high.

2.4 STENCILS

- A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; minimum letter height of 1-1/4 inches for ducts; and minimum letter height of 3/4 inch for access panel and door labels, equipment labels, and similar operational instructions.
 - 1. Stencil Material: Aluminum.
 - 2. Stencil Paint: Exterior, gloss, acrylic enamel black unless otherwise indicated. Paint may be in pressurized spray-can form.
 - 3. Identification Paint: Exterior, acrylic enamel in colors according to ASME A13.1 unless otherwise indicated.

2.5 VALVE TAGS

- A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
 - 1. Tag Material: Brass, 19 gauge minimum thickness, and having predrilled or stamped holes for attachment hardware.
 - 2. Fasteners: Brass wire-link or beaded chain; or S-hook.
- B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
 - 1. Valve-tag schedule shall be included in operation and maintenance data.

2.6 WARNING TAGS

- A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
 - 1. Size: 3 by 5-1/4 inches minimum.
 - 2. Fasteners: Brass grommet and wire.
 - 3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
 - 4. Color: Yellow background with black lettering.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

- A. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
 - 1. Near each valve and control device.
 - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 - 3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
 - 4. At access doors, manholes, and similar access points that permit view of concealed piping.
 - 5. Near major equipment items and other points of origination and termination.
 - 6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
 - 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
- B. Pipe Label Color Schedule:
 - 1. Domestic Water Piping:
 - a. Background Color: Red.
 - b. Letter Color: White.
 - 2. Sanitary Waste and Storm Drainage]Piping:
 - a. Background Color: Green.
 - b. Letter Color: White.

3.4 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:
 - 1. Valve-Tag Size and Shape:
 - a. Cold Water: 2 inches square.
 - b. Hot Water: 2 inches square.
 - 2. Valve-Tag Color:
 - a. Cold Water: Natural.
 - b. Hot Water: Green.

3. Letter Color:

- a. Cold Water: White.
- b. Hot Water: White.

3.5 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 220553

SECTION 220700 - PLUMBING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Insulation Materials:
 - a. Mineral fiber.
- 2. Adhesives.
- 3. Mastics.
- 4. Sealants.
- 5. Factory-applied jackets.
- 6. Field-applied fabric-reinforcing mesh.
- 7. Field-applied jackets.
- 8. Tapes.
- 9. Corner angles.

- B. Related Sections include the following:

- 1. Division 21 Section "Fire-Suppression Systems Insulation."
- 2. Division 23 Section "HVAC Insulation."

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, thickness, and jackets (both factory and field applied, if any).
- B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.
- C. Field quality-control reports.
- D. Environmental Sustainability Documentation: Contractor shall submit for approval, a fully completed Environmental Building Materials Certification Form (see Division 1) and backup documentation from the manufacturer or supplier of each type used in this section. Such

backup documentation shall be typewritten on the manufacturer's letterhead or product data sheet published by the manufacturer.

1. Adhesives and Sealants

a. All adhesives and sealants used inside the building and applied on-site shall supply with South Coast Air Quality Management District Rule #1168. Documentation shall include product data submission for each material and shall demonstrate the volatile organic compound (VOC) content of the material.

1.4 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.6 COORDINATION

- A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping insulation application and equipment Installer for equipment insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
- C. Coordinate installation and testing of heat tracing.

1.7 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type I. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 1. Products: Subject to compliance with requirements, provide the following:
 - a. Johns Manville; Microlite.
- G. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For equipment applications, provide insulation with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 1. Products: Subject to compliance with requirements, provide the following:
 - a. Johns Manville; 800 Series Spin-Glas. Model 814
- H. Mineral-Fiber, Preformed Pipe Insulation:
 - 1. Products: Subject to compliance with requirements, provide the following:
 - a. Johns Manville; Micro-Lok 650.
 - 2. Type I, 850 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.2 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.
- B. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products, Division of ITW; CP-82.
 - b. Foster Products Corporation, H. B. Fuller Company; 85-20.
 - c. ITW TACC, Division of Illinois Tool Works; S-90/80.
 - d. Marathon Industries, Inc.; 225.
 - e. Mon-Eco Industries, Inc.; 22-25.
 - 2. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products, Division of ITW; CP-82.
 - b. Foster Products Corporation, H. B. Fuller Company; 85-20.
 - c. ITW TACC, Division of Illinois Tool Works; S-90/80.
 - d. Marathon Industries, Inc.; 225.
 - e. Mon-Eco Industries, Inc.; 22-25.
 - 2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.3 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.
 - 1. For indoor applications, use mastics that have a VOC content of <Insert value> g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. FSK and Metal Jacket Flashing Sealants:
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products, Division of ITW; CP-76-8.
 - b. Foster Products Corporation, H. B. Fuller Company; 95-44.

- c. Marathon Industries, Inc.; 405.
 - d. Mon-Eco Industries, Inc.; 44-05.
 - e. Vimasco Corporation; 750.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
 3. Fire- and water-resistant, flexible, elastomeric sealant.
 4. Service Temperature Range: Minus 40 to plus 250 deg F.
 5. Color: Aluminum.
 6. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products, Division of ITW; CP-76.
 2. Materials shall be compatible with insulation materials, jackets, and substrates.
 3. Fire- and water-resistant, flexible, elastomeric sealant.
 4. Service Temperature Range: Minus 40 to plus 250 deg F.
 5. Color: White.
 6. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.4 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
 2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
 3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.5 FIELD-APPLIED FABRIC-REINFORCING MESH

- A. Woven Glass-Fiber Fabric for Pipe Insulation: Approximately 2 oz./sq. yd. (68 g/sq. m) with a thread count of 10 strands by 10 strands/sq. inch for covering pipe and pipe fittings.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Vimasco Corporation; Elastafab 894.

- B. Woven Glass-Fiber Fabric for Equipment Insulation: Approximately 6 oz./sq. yd. with a thread count of 5 strands by 5 strands/sq. inch for covering equipment.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products, Division of ITW; Chil-Glas No. 5.
 - b. Foster Products Corporation, H. B. Fuller Company; Mast-A-Fab.
 - c. Vimasco Corporation; Elastafab 894.

2.6 FIELD-APPLIED CLOTHS

- A. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz./sq. yd..
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Alpha Associates, Inc.; Alpha-Maritex 84215 and 84217/9485RW, Luben 59.

2.7 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. Metal Jacket:
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products, Division of ITW; Metal Jacketing Systems.
 - b. PABCO Metals Corporation; Surefit.
 - c. RPR Products, Inc.; Insul-Mate.
 2. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105 or 5005, Temper H-14.
 - a. Finish and thickness are indicated in field-applied jacket schedules.
 - b. Moisture Barrier for Indoor Applications: 1-mil- (0.025-mm-) thick, heat-bonded polyethylene and kraft paper.
 - c. Moisture Barrier for Outdoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper thick Polysurlyn.
 - d. Factory-Fabricated Fitting Covers:
 - 1) Same material, finish, and thickness as jacket.
 - 2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
 - 3) Tee covers.
 - 4) Flange and union covers.
 - 5) End caps.

- 6) Beveled collars.
 - 7) Valve covers.
 - 8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.
3. Stainless-Steel Jacket: ASTM A 167 or ASTM A 240/A 240M.
 - a. Factory cut and rolled to size.
 - b. Material, finish, and thickness are indicated in field-applied jacket schedules.
 - c. Moisture Barrier for Indoor Applications: 1-mil- (0.025-mm-) thick, heat-bonded polyethylene and kraft paper.
 - d. Moisture Barrier for Outdoor Applications: 3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper.
 - e. Factory-Fabricated Fitting Covers:
 - 1) Same material, finish, and thickness as jacket.
 - 2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
 - 3) Tee covers.
 - 4) Flange and union covers.
 - 5) End caps.
 - 6) Beveled collars.
 - 7) Valve covers.
 - 8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.
- C. Underground Direct-Buried Jacket: 125-mil- thick vapor barrier and waterproofing membrane consisting of a rubberized bituminous resin reinforced with a woven-glass fiber or polyester scrim and laminated aluminum foil.
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Pittsburgh Corning Corporation; Pittwrap.
 - b. Polyguard; Insulrap No Torch 125.

2.8 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0835.
 - b. Compac Corp.; 104 and 105.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 428 AWF ASJ.
 - d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.

2. Width: 3 inches.
 3. Thickness: 11.5 mils.
 4. Adhesion: 90 ounces force/inch in width.
 5. Elongation: 2 percent.
 6. Tensile Strength: 40 lbf/inch in width.
 7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
 - b. Compac Corp.; 110 and 111.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 491 AWF FSK.
 - d. Venture Tape; 1525 CW, 1528 CW, and 1528 CW/SQ.
 2. Width: 3 inches.
 3. Thickness: 6.5 mils.
 4. Adhesion: 90 ounces force/inch in width.
 5. Elongation: 2 percent.
 6. Tensile Strength: 40 lbf/inch in width.
 7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- C. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
 - b. Compac Corp.; 120.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 488 AWF.
 - d. Venture Tape; 3520 CW.
 2. Width: 2 inches.
 3. Thickness: 3.7 mils.
 4. Adhesion: 100 ounces force/inch in width.
 5. Elongation: 5 percent.
 6. Tensile Strength: 34 lbf/inch in width.

2.9 CORNER ANGLES

- A. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch, aluminum according to ASTM B 209, Alloy 3003, 3005, 3105 or 5005; Temper H-14.
- B. Stainless-Steel Corner Angles: 0.024 inch thick, minimum 1 by 1 inch, stainless steel according to ASTM A 167 or ASTM A 240/A 240M, Type 304 or 316.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
 - 1. Verify that systems and equipment to be insulated have been tested and are free of defects.
 - 2. Verify that surfaces to be insulated are clean and dry.
 - 3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:
- C. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment and piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment and pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.

- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
 - 1. Draw jacket tight and smooth.
 - 2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
 - 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
 - a. For below ambient services, apply vapor-barrier mastic over staples.
 - 4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
 - 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- P. For above ambient services, do not install insulation to the following:

1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Manholes.
5. Handholes.
6. Cleanouts.

3.4 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
 1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside roof flashing at least **2 inches (50 mm)** below top of roof flashing.
 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
 1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
 4. Seal jacket to wall flashing with flashing sealant.
- D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
 1. Comply with requirements in Division 07 Section "Penetration Firestopping" firestopping and fire-resistive joint sealers.
- F. Insulation Installation at Floor Penetrations:
 1. Pipe: Install insulation continuously through floor penetrations.

2. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."

3.5 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
 1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
 2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
 3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
 4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
 5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.
 6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
 7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
 8. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the

connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

- D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
 2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
 3. Construct removable valve insulation covers in same manner as for flanges except divide the two-part section on the vertical center line of valve body.
 4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.

3.6 MINERAL-FIBER INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch (25 mm), and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.7 FIELD-APPLIED JACKET INSTALLATION

A. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch (38-mm) laps at longitudinal seams and 3-inch- (75-mm-) wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

B. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches (300 mm) o.c. and at end joints.

3.8 FINISHES

A. Equipment and Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 09 painting Sections.

1. Flat Acrylic Finish: Two coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
 - a. Finish Coat Material: Interior, flat, latex-emulsion size.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless-steel jackets.

3.9 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. Tests and Inspections:
 - 1. Inspect field-insulated equipment, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.
 - 2. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.
- D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.10 EQUIPMENT INSULATION SCHEDULE

- A. Insulation materials and thicknesses are identified below. If more than one material is listed for a type of equipment, selection from materials listed is Contractor's option.
- B. Insulate indoor and outdoor equipment in paragraphs below that is not factory insulated.
- C. Heat-exchanger (water-to-water for domestic water heating service) insulation shall be the following:
 - 1. Mineral-Fiber Pipe and Tank: 2 inches thick.
- D. Domestic water, hydropneumatic tank insulation shall be the following:
 - 1. Mineral-Fiber Pipe and Tank: 1 inch thick.
- E. Domestic hot-water storage tank insulation shall be the following,:
 - 1. Mineral-fiber pipe and tank: 2 inch thick.

3.11 PIPING INSULATION SCHEDULE, GENERAL

- A. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
1. Drainage piping located in crawl spaces.
 2. Underground piping.
 3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.12 INDOOR PIPING INSULATION SCHEDULE

- A. Domestic Cold Water:
1. All sizes: Insulation shall be the following:
 - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.
 2. Service main: Insulation shall be the following:
 - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch (25 mm) thick.
- B. Domestic Hot and Recirculated Hot Water:
1. 1-1/2 inch and Smaller: Insulation shall be the following:
 - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
 2. **Larger than 1-1/2": Insulation shall be the following:**
 - a. **Mineral-Fiber, Preformed Pipe Insulation, Type I: 1-1/2 inch thick.**
- C. Stormwater and Overflow:
1. All Pipe Sizes: Insulation shall be the following at horizontal portion of roof connection:
 - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.
- D. Sanitary Waste Piping Where Heat Tracing Is Installed:
1. All Pipe Sizes: Insulation shall be the following:
 - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1-1/2 inch thick.
- E. Condensate and Equipment Drain Water below 60 Deg F:
1. All Pipe Sizes: Insulation shall be the following:
 - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

3.13 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

- A. Domestic Water Piping:
1. All Pipe Sizes: Insulation shall be the following:
 - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 3 inches thick.

- B. Domestic Hot and Recirculated Hot Water:
 - 1. All Pipe Sizes: Insulation shall be the following:
 - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 4 inches thick.

3.14 OUTDOOR, UNDERGROUND PIPING INSULATION SCHEDULE

- A. Loose-fill insulation, for belowground piping, is specified in Division 33 piping distribution Sections.
- B. Sanitary Waste Piping, All Sizes, Where Heat Tracing Is Installed: Cellular glass, 2 inches thick.

3.15 INDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Equipment, Concealed:
 - 1. Aluminum, Smooth Corrugated Stucco Embossed: 0.016 inch thick.
- D. Equipment, Exposed, up to 48 Inches in Diameter or with Flat Surfaces up to 72 Inches:
 - 1. Aluminum, Smooth: 0.016 inch (0.41 mm) thick.
- E. Equipment, Exposed, Larger Than 48 Inches in Diameter or with Flat Surfaces Larger Than 72 Inches :
 - 1. Painted Aluminum, Smooth with 1-1/4-Inch- Deep Corrugations 0.032 inch (0.81 mm) thick.
- F. Piping, Concealed:
 - 1. Aluminum, Smooth: 0.016 inch thick.
- G. Piping, Exposed:
 - 1. Aluminum, Smooth: 0.016 inch thick.

3.16 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Equipment, Concealed:
 - 1. Aluminum, Smooth 0.032 inch (0.81 mm) thick.

- D. Equipment, Exposed, up to 48 Inches in Diameter or with Flat Surfaces up to 72 Inches:
 - 1. Painted Aluminum, Smooth 0.032 inch (0.81 mm) thick.
- E. Equipment, Exposed, Larger Than 48 Inches in Diameter or with Flat Surfaces Larger Than 72 Inches:
 - 1. Painted Aluminum, Smooth Stucco Embossed with 1-1/4-Inch- (32-mm-) Deep Corrugations 0.040 inch (1.0 mm) thick.
- F. Piping, Concealed:
 - 1. None.
- G. Piping, Exposed:
 - 1. Painted Aluminum, Smooth 0.016 inch thick.

3.17 UNDERGROUND, FIELD-INSTALLED INSULATION JACKET

- A. For underground direct-buried piping applications, install underground direct-buried jacket over insulation material.

END OF SECTION 220700

SECTION 220800 – COMMISSIONING OF PLUMBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Insulation Materials:
 - a. Mineral fiber.
- 2. Adhesives.
- 3. Mastics.
- 4. Sealants.
- 5. Factory-applied jackets.
- 6. Field-applied fabric-reinforcing mesh.
- 7. Field-applied jackets.
- 8. Tapes.
- 9. Corner angles.

- B. Related Sections include the following:

- 1. Division 21 Section "Fire-Suppression Systems Insulation."
- 2. Division 23 Section "HVAC Insulation."

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, thickness, and jackets (both factory and field applied, if any).
- B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.
- C. Field quality-control reports.
- D. Environmental Sustainability Documentation: Contractor shall submit for approval, a fully completed Environmental Building Materials Certification Form (see Division 1) and backup documentation from the manufacturer or supplier of each type used in this section. Such

backup documentation shall be typewritten on the manufacturer's letterhead or product data sheet published by the manufacturer.

1. Adhesives and Sealants

a. All adhesives and sealants used inside the building and applied on-site shall supply with South Coast Air Quality Management District Rule #1168. Documentation shall include product data submission for each material and shall demonstrate the volatile organic compound (VOC) content of the material.

1.4 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.6 COORDINATION

- A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping insulation application and equipment Installer for equipment insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
- C. Coordinate installation and testing of heat tracing.

1.7 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type I. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 1. Products: Subject to compliance with requirements, provide the following:
 - a. Johns Manville; Microlite.
- G. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For equipment applications, provide insulation with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 1. Products: Subject to compliance with requirements, provide the following:
 - a. Johns Manville; 800 Series Spin-Glas. Model 814
- H. Mineral-Fiber, Preformed Pipe Insulation:
 - 1. Products: Subject to compliance with requirements, provide the following:
 - a. Johns Manville; Micro-Lok 650.
 - 2. Type I, 850 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.2 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.
- B. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products, Division of ITW; CP-82.
 - b. Foster Products Corporation, H. B. Fuller Company; 85-20.
 - c. ITW TACC, Division of Illinois Tool Works; S-90/80.
 - d. Marathon Industries, Inc.; 225.
 - e. Mon-Eco Industries, Inc.; 22-25.
 - 2. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products, Division of ITW; CP-82.
 - b. Foster Products Corporation, H. B. Fuller Company; 85-20.
 - c. ITW TACC, Division of Illinois Tool Works; S-90/80.
 - d. Marathon Industries, Inc.; 225.
 - e. Mon-Eco Industries, Inc.; 22-25.
 - 2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.3 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.
 - 1. For indoor applications, use mastics that have a VOC content of <Insert value> g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. FSK and Metal Jacket Flashing Sealants:
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products, Division of ITW; CP-76-8.
 - b. Foster Products Corporation, H. B. Fuller Company; 95-44.

- c. Marathon Industries, Inc.; 405.
 - d. Mon-Eco Industries, Inc.; 44-05.
 - e. Vimasco Corporation; 750.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
 3. Fire- and water-resistant, flexible, elastomeric sealant.
 4. Service Temperature Range: Minus 40 to plus 250 deg F.
 5. Color: Aluminum.
 6. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products, Division of ITW; CP-76.
 2. Materials shall be compatible with insulation materials, jackets, and substrates.
 3. Fire- and water-resistant, flexible, elastomeric sealant.
 4. Service Temperature Range: Minus 40 to plus 250 deg F.
 5. Color: White.
 6. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.4 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
 2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
 3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.5 FIELD-APPLIED FABRIC-REINFORCING MESH

- A. Woven Glass-Fiber Fabric for Pipe Insulation: Approximately 2 oz./sq. yd. (68 g/sq. m) with a thread count of 10 strands by 10 strands/sq. inch for covering pipe and pipe fittings.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Vimasco Corporation; Elastafab 894.

- B. Woven Glass-Fiber Fabric for Equipment Insulation: Approximately 6 oz./sq. yd. with a thread count of 5 strands by 5 strands/sq. inch for covering equipment.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products, Division of ITW; Chil-Glas No. 5.
 - b. Foster Products Corporation, H. B. Fuller Company; Mast-A-Fab.
 - c. Vimasco Corporation; Elastafab 894.

2.6 FIELD-APPLIED CLOTHS

- A. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz./sq. yd..
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Alpha Associates, Inc.; Alpha-Maritex 84215 and 84217/9485RW, Luben 59.

2.7 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. Metal Jacket:
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products, Division of ITW; Metal Jacketing Systems.
 - b. PABCO Metals Corporation; Surefit.
 - c. RPR Products, Inc.; Insul-Mate.
 - 2. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105 or 5005, Temper H-14.
 - a. Finish and thickness are indicated in field-applied jacket schedules.
 - b. Moisture Barrier for Indoor Applications: 1-mil- (0.025-mm-) thick, heat-bonded polyethylene and kraft paper.
 - c. Moisture Barrier for Outdoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper thick Polysurlyn.
 - d. Factory-Fabricated Fitting Covers:
 - 1) Same material, finish, and thickness as jacket.
 - 2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
 - 3) Tee covers.
 - 4) Flange and union covers.
 - 5) End caps.

- 6) Beveled collars.
 - 7) Valve covers.
 - 8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.
3. Stainless-Steel Jacket: ASTM A 167 or ASTM A 240/A 240M.
 - a. Factory cut and rolled to size.
 - b. Material, finish, and thickness are indicated in field-applied jacket schedules.
 - c. Moisture Barrier for Indoor Applications: 1-mil- (0.025-mm-) thick, heat-bonded polyethylene and kraft paper.
 - d. Moisture Barrier for Outdoor Applications: 3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper.
 - e. Factory-Fabricated Fitting Covers:
 - 1) Same material, finish, and thickness as jacket.
 - 2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
 - 3) Tee covers.
 - 4) Flange and union covers.
 - 5) End caps.
 - 6) Beveled collars.
 - 7) Valve covers.
 - 8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.
- C. Underground Direct-Buried Jacket: 125-mil- thick vapor barrier and waterproofing membrane consisting of a rubberized bituminous resin reinforced with a woven-glass fiber or polyester scrim and laminated aluminum foil.
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Pittsburgh Corning Corporation; Pittwrap.
 - b. Polyguard; Insulrap No Torch 125.

2.8 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0835.
 - b. Compac Corp.; 104 and 105.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 428 AWF ASJ.
 - d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.

2. Width: 3 inches.
 3. Thickness: 11.5 mils.
 4. Adhesion: 90 ounces force/inch in width.
 5. Elongation: 2 percent.
 6. Tensile Strength: 40 lbf/inch in width.
 7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
 - b. Compac Corp.; 110 and 111.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 491 AWF FSK.
 - d. Venture Tape; 1525 CW, 1528 CW, and 1528 CW/SQ.
 2. Width: 3 inches.
 3. Thickness: 6.5 mils.
 4. Adhesion: 90 ounces force/inch in width.
 5. Elongation: 2 percent.
 6. Tensile Strength: 40 lbf/inch in width.
 7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- C. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
 - b. Compac Corp.; 120.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 488 AWF.
 - d. Venture Tape; 3520 CW.
 2. Width: 2 inches.
 3. Thickness: 3.7 mils.
 4. Adhesion: 100 ounces force/inch in width.
 5. Elongation: 5 percent.
 6. Tensile Strength: 34 lbf/inch in width.

2.9 CORNER ANGLES

- A. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch, aluminum according to ASTM B 209, Alloy 3003, 3005, 3105 or 5005; Temper H-14.
- B. Stainless-Steel Corner Angles: 0.024 inch thick, minimum 1 by 1 inch, stainless steel according to ASTM A 167 or ASTM A 240/A 240M, Type 304 or 316.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
 - 1. Verify that systems and equipment to be insulated have been tested and are free of defects.
 - 2. Verify that surfaces to be insulated are clean and dry.
 - 3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:
- C. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment and piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment and pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.

- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
 - 1. Draw jacket tight and smooth.
 - 2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
 - 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
 - a. For below ambient services, apply vapor-barrier mastic over staples.
 - 4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
 - 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- P. For above ambient services, do not install insulation to the following:

1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Manholes.
5. Handholes.
6. Cleanouts.

3.4 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
 1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside roof flashing at least **2 inches (50 mm)** below top of roof flashing.
 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
 1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
 4. Seal jacket to wall flashing with flashing sealant.
- D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
 1. Comply with requirements in Division 07 Section "Penetration Firestopping" firestopping and fire-resistive joint sealers.
- F. Insulation Installation at Floor Penetrations:
 1. Pipe: Install insulation continuously through floor penetrations.

2. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."

3.5 EQUIPMENT, TANK, AND VESSEL INSULATION INSTALLATION

- A. Mineral Fiber, Pipe and Tank Insulation Installation for Tanks and Vessels: Secure insulation with adhesive and anchor pins and speed washers.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for percent coverage of tank and vessel surfaces as recommended by manufacturer.
2. Groove and score insulation materials to fit as closely as possible to equipment, including contours. Bevel insulation edges for cylindrical surfaces for tight joints. Stagger end joints.
3. Protect exposed corners with secured corner angles.
4. Install adhesively attached or self-sticking insulation hangers and speed washers on sides of tanks and vessels as follows:
 - a. Do not weld anchor pins to ASME-labeled pressure vessels.
 - b. Select insulation hangers and adhesive that are compatible with service temperature and with substrate.
 - c. On tanks and vessels, maximum anchor-pin spacing is 3 inches from insulation end joints, and 16 inches o.c. in both directions.
 - d. Do not overcompress insulation during installation.
 - e. Cut and miter insulation segments to fit curved sides and domed heads of tanks and vessels.
 - f. Impale insulation over anchor pins and attach speed washers.
 - g. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
5. Secure each layer of insulation with stainless-steel or aluminum bands. Select band material compatible with insulation materials.
6. Where insulation hangers on equipment and vessels are not permitted or practical and where insulation support rings are not provided, install a girdle network for securing insulation. Stretch prestressed aircraft cable around the diameter of vessel and make taut with clamps, turnbuckles, or breather springs. Place one circumferential girdle around equipment approximately 6 inches from each end. Install wire or cable between two circumferential girdles 12 inches o.c. Install a wire ring around each end and around outer periphery of center openings, and stretch prestressed aircraft cable radially from the wire ring to nearest circumferential girdle. Install additional circumferential girdles along the body of equipment or tank at a minimum spacing of 48 inches o.c. Use this network for securing insulation with tie wire or bands.
7. Stagger joints between insulation layers at least 3 inches.
8. Install insulation in removable segments on equipment access doors, manholes, handholes, and other elements that require frequent removal for service and inspection.
9. Bevel and seal insulation ends around manholes, handholes, ASME stamps, and nameplates.
10. For equipment with surface temperatures below ambient, apply mastic to open ends, joints, seams, breaks, and punctures in insulation.

3.6 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
 - 1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
 - 2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
 - 3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
 - 4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
 - 5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.
 - 6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
 - 7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
 - 8. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. Install removable insulation covers at locations indicated. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.

3.7 MINERAL-FIBER INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch (25 mm), and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.8 FIELD-APPLIED JACKET INSTALLATION

A. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch (38-mm) laps at longitudinal seams and 3-inch- (75-mm-) wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

B. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches (300 mm) o.c. and at end joints.

3.9 FINISHES

A. Equipment and Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 09 painting Sections.

1. Flat Acrylic Finish: Two coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.

a. Finish Coat Material: Interior, flat, latex-emulsion size.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless-steel jackets.

3.10 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

- B. Perform tests and inspections.
- C. Tests and Inspections:
 - 1. Inspect field-insulated equipment, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.
 - 2. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.
- D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.11 EQUIPMENT INSULATION SCHEDULE

- A. Insulation materials and thicknesses are identified below. If more than one material is listed for a type of equipment, selection from materials listed is Contractor's option.
- B. Insulate indoor and outdoor equipment in paragraphs below that is not factory insulated.
- C. Heat-exchanger (water-to-water for domestic water heating service) insulation shall be the following:
 - 1. Mineral-Fiber Pipe and Tank: 2 inches thick.
- D. Domestic water, hydropneumatic tank insulation shall be the following:
 - 1. Mineral-Fiber Pipe and Tank: 1 inch thick.
- E. Domestic hot-water storage tank insulation shall be the following,,:
 - 1. Mineral-fiber pipe and tank: 2 inch thick.

3.12 PIPING INSULATION SCHEDULE, GENERAL

- A. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
 - 1. Drainage piping located in crawl spaces.
 - 2. Underground piping.
 - 3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.13 INDOOR PIPING INSULATION SCHEDULE

A. Domestic Cold Water:

1. All sizes: Insulation shall be the following:
 - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.
2. Service main: Insulation shall be the following:
 - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch (25 mm) thick.

B. Domestic Hot and Recirculated Hot Water:

1. 1-1/2 inch and Smaller: Insulation shall be the following:
 - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
2. **Larger than 1-1/2": Insulation shall be the following:**
 - a. **Mineral-Fiber, Preformed Pipe Insulation, Type I: 1-1/2 inch thick.**

C. Stormwater and Overflow:

1. All Pipe Sizes: Insulation shall be the following at horizontal portion of roof connection:
 - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.

D. Sanitary Waste Piping Where Heat Tracing Is Installed:

1. All Pipe Sizes: Insulation shall be the following:
 - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1-1/2 inch thick.

E. Condensate and Equipment Drain Water below 60 Deg F:

1. All Pipe Sizes: Insulation shall be the following:
 - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

3.14 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

A. Domestic Water Piping:

1. All Pipe Sizes: Insulation shall be the following:
 - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 3 inches thick.

B. Domestic Hot and Recirculated Hot Water:

1. All Pipe Sizes: Insulation shall be the following:
 - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 4 inches thick.

3.15 OUTDOOR, UNDERGROUND PIPING INSULATION SCHEDULE

- A. Loose-fill insulation, for belowground piping, is specified in Division 33 piping distribution Sections.
- B. Sanitary Waste Piping, All Sizes, Where Heat Tracing Is Installed: Cellular glass, 2 inches thick.

3.16 INDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Equipment, Concealed:
 - 1. Aluminum, Smooth Corrugated Stucco Embossed: 0.016 inch thick.
- D. Equipment, Exposed, up to 48 Inches in Diameter or with Flat Surfaces up to 72 Inches:
 - 1. Aluminum, Smooth: 0.016 inch (0.41 mm) thick.
- E. Equipment, Exposed, Larger Than 48 Inches in Diameter or with Flat Surfaces Larger Than 72 Inches :
 - 1. Painted Aluminum, Smooth with 1-1/4-Inch- Deep Corrugations 0.032 inch (0.81 mm) thick.
- F. Piping, Concealed:
 - 1. Aluminum, Smooth: 0.016 inch thick.
- G. Piping, Exposed:
 - 1. Aluminum, Smooth: 0.016 inch thick.

3.17 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Equipment, Concealed:
 - 1. Aluminum, Smooth 0.032 inch (0.81 mm) thick.
- D. Equipment, Exposed, up to 48 Inches in Diameter or with Flat Surfaces up to 72 Inches:
 - 1. Painted Aluminum, Smooth 0.032 inch (0.81 mm) thick.
- E. Equipment, Exposed, Larger Than 48 Inches in Diameter or with Flat Surfaces Larger Than 72 Inches:

1. Painted Aluminum, Smooth Stucco Embossed with 1-1/4-Inch- (32-mm-) Deep Corrugations 0.040 inch (1.0 mm) thick.

F. Piping, Concealed:

1. None.

G. Piping, Exposed:

1. Painted Aluminum, Smooth 0.016 inch thick.

3.18 UNDERGROUND, FIELD-INSTALLED INSULATION JACKET

- A. For underground direct-buried piping applications, install underground direct-buried jacket over insulation material.

END OF SECTION 220800

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SECTION 221113 - FACILITY WATER DISTRIBUTION PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes water-distribution piping and related components outside the building for water service.
- B. Utility-furnished products include water meters that will be furnished to the site, ready for installation.

1.3 DEFINITIONS

- A. EPDM: Ethylene propylene diene terpolymer rubber.
- B. LLDPE: Linear, low-density polyethylene plastic.
- C. PA: Polyamide (nylon) plastic.
- D. PE: Polyethylene plastic.
- E. PP: Polypropylene plastic.
- F. PVC: Polyvinyl chloride plastic.
- G. RTRF: Reinforced thermosetting resin (fiberglass) fittings.
- H. RTRP: Reinforced thermosetting resin (fiberglass) pipe.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Coordination Drawings: For piping and specialties including relation to other services in same area, drawn to scale. Show piping and specialty sizes and valves, meter and specialty locations, and elevations.
- C. Field quality-control test reports.

- D. Operation and Maintenance Data: For water valves and specialties to include in emergency, operation, and maintenance manuals.
- E. Environmental Sustainability Documentation: Contractor shall submit for approval, a fully completed Environmental Building Materials Certification Form and backup documentation from the manufacturer or supplier of each type used in this section. Such backup documentation shall be typewritten on the manufacturer's letterhead or product data sheet published by the manufacture.
 - 1. Adhesives and Sealants
 - a. All adhesives and sealants used inside the building shall comply with South Coast Air Quality Management District Rule #1168. Documentation shall include product data submission for each material and shall demonstrate the volatile organic compound (VOC) content of the material.
 - 2. Paints and Coatings
 - a. All paints and coatings used inside the building must not exceed the VOC content limits established in Green Seal Standard GS-11, Paints, 1st Edition, May 20, 1993 and Green Seal Standard GC-03, Anti-Corrosive Paints, 2nd Edition, January 7, 1997. Documentation shall include product data submission for each material and shall demonstrate the volatile organic compound (VOC) level of the material.

1.5 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Comply with requirements of utility company supplying water. Include tapping of water mains and backflow prevention.
 - 2. Comply with standards of authorities having jurisdiction for potable-water-service piping, including materials, installation, testing, and disinfection.
 - 3. Comply with standards of authorities having jurisdiction for fire-suppression water-service piping, including materials, hose threads, installation, and testing.
- B. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. NSF Compliance:
 - 1. Comply with NSF 61 for materials for water-service piping and specialties for domestic water.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Preparation for Transport: Prepare valves, including fire hydrants, according to the following:
 - 1. Ensure that valves are dry and internally protected against rust and corrosion.

2. Protect valves against damage to threaded ends and flange faces.
 3. Set valves in best position for handling. Set valves closed to prevent rattling.
- B. During Storage: Use precautions for valves, according to the following:
1. Do not remove end protectors unless necessary for inspection; then reinstall for storage.
 2. Protect from weather. Store indoors and maintain temperature higher than ambient dew-point temperature. Support off the ground or pavement in watertight enclosures when outdoor storage is necessary.
- C. Handling: Use sling to handle valves and fire hydrants if size requires handling by crane or lift. Rig valves to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.
- D. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.
- E. Protect stored piping from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor when storing inside.
- F. Protect flanges, fittings, and specialties from moisture and dirt.
- G. Store plastic piping protected from direct sunlight. Support to prevent sagging and bending.

1.7 COORDINATION

- A. Coordinate connection to water main with utility company.

PART 2 - PRODUCTS

2.1 DUCTILE-IRON PIPE AND FITTINGS

- A. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.
1. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
 2. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.
- B. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, with push-on-joint bell and plain spigot end unless grooved or flanged ends are indicated.
1. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
 2. Gaskets: AWWA C111, rubber.
- C. Grooved-Joint, Ductile-Iron Pipe: AWWA C151, with cut, rounded-grooved ends.

1. Grooved-End, Ductile-Iron Pipe Appurtenances:

- a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- b. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Anvil International, Inc.
 - 2) Victaulic Company of America.
- c. Grooved-End, Ductile-Iron Fittings: ASTM A 47/A 47M, malleable-iron castings or ASTM A 536, ductile-iron castings with dimensions matching pipe.
- d. Grooved-End, Ductile-Iron-Piping Couplings: AWWA C606, for ductile-iron-pipe dimensions. Include ferrous housing sections, gasket suitable for water, and bolts and nuts.

D. Flanges: ASME 16.1, Class 125, cast iron.

2.2 SPECIAL PIPE FITTINGS

A. Ductile-Iron Rigid Expansion Joints:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. EBAA Iron, Inc.
 - b. U.S. Pipe and Foundry Company.
2. Description: Three-piece, ductile-iron assembly consisting of telescoping sleeve with gaskets and restrained-type, ductile-iron, bell-and-spigot end sections complying with AWWA C110 or AWWA C153. Select and assemble components for expansion indicated. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.
 - a. Pressure Rating: 250 psig (1725 kPa) minimum.

B. Ductile-Iron Flexible Expansion Joints:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. EBAA Iron, Inc.
 - b. Hays Fluid Controls; a division of ROMAC Industries Inc.
 - c. Star Pipe Products.
2. Description: Compound, ductile-iron fitting with combination of flanged and mechanical-joint ends complying with AWWA C110 or AWWA C153. Include two gasketed ball-joint sections and one or more gasketed sleeve sections. Assemble components for offset and expansion indicated. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.

- a. Pressure Rating: 250 psig minimum.

C. Ductile-Iron Deflection Fittings:

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

- a. EBAA Iron, Inc.

- 2. Description: Compound, ductile-iron coupling fitting with sleeve and 1 or 2 flexing sections for up to 15-degree deflection, gaskets, and restrained-joint ends complying with AWWA C110 or AWWA C153. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.

- a. Pressure Rating: 250 psig minimum.

2.3 JOINING MATERIALS

- A. Refer to Division 22 Section "Common Work Results for Plumbing" for commonly used joining materials.

2.4 PIPING SPECIALTIES

- A. Transition Fittings: Manufactured fitting or coupling same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.

B. Tubular-Sleeve Pipe Couplings:

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

- a. Cascade Waterworks Manufacturing.
- b. Dresser, Inc.; Dresser Piping Specialties.
- c. Ford Meter Box Company, Inc. (The); Pipe Products Div.
- d. Hays Fluid Controls; a division of ROMAC Industries Inc.
- e. JCM Industries.
- f. Smith-Blair, Inc.
- g. Viking Johnson.

- 2. Description: Metal, bolted, sleeve-type, reducing or transition coupling, with center sleeve, gaskets, end rings, and bolt fasteners and with ends of same sizes as piping to be joined.

- a. Standard: AWWA C219.
- b. Center-Sleeve Material: Manufacturer's standard.
- c. Gasket Material: Natural or synthetic rubber.
- d. Pressure Rating: 200 psig minimum.
- e. Metal Component Finish: Corrosion-resistant coating or material.

C. Split-Sleeve Pipe Couplings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Victaulic Depend-O-Lok.
2. Description: Metal, bolted, split-sleeve-type, reducing or transition coupling with sealing pad and closure plates, O-ring gaskets, and bolt fasteners.
 - a. Standard: AWWA C219.
 - b. Sleeve Material: Manufacturer's standard.
 - c. Sleeve Dimensions: Of thickness and width required to provide pressure rating.
 - d. Gasket Material: O-rings made of EPDM rubber, unless otherwise indicated.
 - e. Pressure Rating: 200 psig (1380 kPa) minimum.
 - f. Metal Component Finish: Corrosion-resistant coating or material.

D. Flexible Connectors:

1. Nonferrous-Metal Piping: Bronze hose covered with bronze wire braid; with copper-tube, pressure-type, solder-joint ends or bronze flanged ends brazed to hose.
2. Ferrous-Metal Piping: Stainless-steel hose covered with stainless-steel wire braid; with ASME B1.20.1, threaded steel pipe nipples or ASME B16.5, steel pipe flanges welded to hose.

E. Dielectric Fittings: Combination of copper alloy and ferrous; threaded, solder, or plain end types; and matching piping system materials.

1. Dielectric Unions: Factory-fabricated union assembly, designed for 250-psig minimum working pressure at 180 deg F. Include insulating material that isolates dissimilar metals and ends with inside threads according to ASME B1.20.1.
2. Dielectric Flanges: Factory-fabricated companion-flange assembly, for 150- or 300-psig minimum working pressure to suit system pressures.
3. Dielectric-Flange Insulation Kits: Field-assembled companion-flange assembly, full-face or ring type. Components include neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
 - a. Provide separate companion flanges and steel bolts and nuts for 150- or 300-psig minimum working pressure to suit system pressures.
4. Dielectric Couplings: Galvanized-steel couplings with inert and noncorrosive thermoplastic lining, with threaded ends and 300-psig minimum working pressure at 225 deg F.
5. Dielectric Nipples: Electroplated steel nipples with inert and noncorrosive thermoplastic lining, with combination of plain, threaded, or grooved end types, and 300-psig minimum working pressure at 225 deg F.

2.5 GATE VALVES

A. AWWA, Cast-Iron Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American AVK Co.; Valves & Fittings Div.
 - b. American Cast Iron Pipe Co.; American Flow Control Div.
 - c. American Cast Iron Pipe Co.; Waterous Co. Subsidiary.
 - d. Crane Co.; Crane Valve Group; Stockham Div.
 - e. East Jordan Iron Works, Inc.
 - f. McWane, Inc.; Clow Valve Co. Div. (Oskaloosa).
 - g. McWane, Inc.; Kennedy Valve Div.
 - h. McWane, Inc.; M & H Valve Company Div.
 - i. McWane, Inc.; Tyler Pipe Div.; Utilities Div.
 - j. Mueller Co.; Water Products Div.
 - k. NIBCO INC.
 - l. U.S. Pipe and Foundry Company.
2. Nonrising-Stem, Metal-Seated Gate Valves:
 - a. Description: Gray- or ductile-iron body and bonnet; with cast-iron or bronze double-disc gate, bronze gate rings, bronze stem, and stem nut.
 - 1) Standard: AWWA C500.
 - 2) Minimum Pressure Rating: 200 psig .
 - 3) End Connections: Mechanical joint.
 - 4) Interior Coating: Complying with AWWA C550.
3. Nonrising-Stem, Resilient-Seated Gate Valves:
 - a. Description: Gray- or ductile-iron body and bonnet; with bronze or gray- or ductile-iron gate, resilient seats, bronze stem, and stem nut.
 - 1) Standard: AWWA C509.
 - 2) Minimum Pressure Rating: 200 psig.
 - 3) End Connections: Mechanical joint.
 - 4) Interior Coating: Complying with AWWA C550.
4. OS&Y, Rising-Stem, Metal-Seated Gate Valves:
 - a. Description: Cast- or ductile-iron body and bonnet, with cast-iron double disc, bronze disc and seat rings, and bronze stem.
 - 1) Standard: AWWA C500.
 - 2) Minimum Pressure Rating: 200 psig.
 - 3) End Connections: Flanged.
5. OS&Y, Rising-Stem, Resilient-Seated Gate Valves:
 - a. Description: Cast- or ductile-iron body and bonnet, with bronze or gray- or ductile-iron gate, resilient seats, and bronze stem.

- 1) Standard: AWWA C509.
- 2) Minimum Pressure Rating: 200 psig.
- 3) End Connections: Flanged.

B. UL/FMG, Cast-Iron Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Cast Iron Pipe Co.; American Flow Control Div.
 - b. American Cast Iron Pipe Co.; Waterous Co. Subsidiary.
 - c. Crane Co.; Crane Valve Group; Stockham Div.
 - d. McWane, Inc.; Clow Valve Co. Div. (Oskaloosa).
 - e. McWane, Inc.; Kennedy Valve Div.
 - f. McWane, Inc.; M & H Valve Company Div.
 - g. Mueller Co.; Water Products Div.
 - h. NIBCO INC.
 - i. U.S. Pipe and Foundry Company.
2. OS&Y, Rising-Stem Gate Valves:
 - a. Description: Iron body and bonnet and bronze seating material.
 - 1) Standards: UL 262 and FMG approved.
 - 2) Minimum Pressure Rating: 175 psig .
 - 3) End Connections: Flanged.

C. Bronze Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Crane Co.; Crane Valve Group; Stockham Div.
 - d. Hammond Valve.
 - e. Milwaukee Valve Company.
 - f. NIBCO INC.
 - g. Red-White Valve Corporation.
2. OS&Y, Rising-Stem Gate Valves:
 - a. Description: Bronze body and bonnet and bronze stem.
 - 1) Standards: UL 262 and FMG approved.
 - 2) Minimum Pressure Rating: 175 psig.
 - 3) End Connections: Threaded.
3. Nonrising-Stem Gate Valves:
 - a. Description: Class 125, Type 1, bronze with solid wedge, threaded ends, and malleable-iron handwheel.

- 1) Standard: MSS SP-80.

2.6 GATE VALVE ACCESSORIES AND SPECIALTIES

A. Tapping-Sleeve Assemblies:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Cast Iron Pipe Co.; Waterous Co. Subsidiary.
 - b. East Jordan Iron Works, Inc.
 - c. Flowserve.
 - d. McWane, Inc.; Clow Valve Co. Div. (Oskaloosa).
 - e. McWane, Inc.; Kennedy Valve Div.
 - f. McWane, Inc.; M & H Valve Company Div.
 - g. Mueller Co.; Water Products Div.
 - h. U.S. Pipe and Foundry Company.
2. Description: Sleeve and valve compatible with drilling machine.
 - a. Standard: MSS SP-60.
 - b. Tapping Sleeve: Cast- or ductile-iron or stainless-steel, two-piece bolted sleeve with flanged outlet for new branch connection. Include sleeve matching size and type of pipe material being tapped and with recessed flange for branch valve.
 - c. Valve: AWWA, cast-iron, nonrising-stem, resilient-seated gate valve with one raised face flange mating tapping-sleeve flange.

B. Valve Boxes: Comply with AWWA M44 for cast-iron valve boxes. Include top section, adjustable extension of length required for depth of burial of valve, plug with lettering "WATER," and bottom section with base that fits over valve and with a barrel approximately 5 inches in diameter.

1. Operating Wrenches: Steel, tee-handle with one pointed end, stem of length to operate deepest buried valve, and socket matching valve operating nut.

2.7 CURB VALVES

A. Manufacturers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Amcast Industrial Corporation; Lee Brass Co.
 - b. Ford Meter Box Company, Inc. (The); Pipe Products Div.
 - c. Jones, James Company.
 - d. Master Meter, Inc.
 - e. McDonald, A. Y. Mfg. Co.
 - f. Mueller Co.; Water Products Div.
 - g. Red Hed Manufacturing & Supply.

- B. Service-Saddle Assemblies: Comply with AWWA C800. Include saddle and valve compatible with tapping machine.
 - 1. Service Saddle: Copper alloy with seal and AWWA C800, threaded outlet for corporation valve.
 - 2. Corporation Valve: Bronze body and ground-key plug, with AWWA C800, threaded inlet and outlet matching service piping material.
 - 3. Manifold: Copper fitting with two to four inlets as required, with ends matching corporation valves and outlet matching service piping material.
- C. Curb Valves: Comply with AWWA C800. Include bronze body, ground-key plug or ball, and wide tee head, with inlet and outlet matching service piping material.
- D. Service Boxes for Curb Valves: Similar to AWWA M44 requirements for cast-iron valve boxes. Include cast-iron telescoping top section of length required for depth of burial of valve, plug with lettering "WATER," and bottom section with base that fits over curb valve and with a barrel approximately 3 inches in diameter.
 - 1. Shutoff Rods: Steel, tee-handle with one pointed end, stem of length to operate deepest buried valve, and slotted end matching curb valve.

2.8 WATER METERS

- A. Water meters will be furnished by utility company.
- B. Manufacturers:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AMCO Water Metering Systems.
 - b. Badger Meter, Inc.
 - c. Carlon Meter.
 - d. Hays Fluid Controls; a division of ROMAC Industries Inc.
 - e. McCrometer.
 - f. Mueller Co.; Hersey Meters.
 - g. Neptune Technology Group Inc.
 - h. Sensus Metering Systems.
- C. Compound-Type Water Meters:
 - 1. Description:
 - a. Standard: AWWA C702.
 - b. Registration: Flow in gallons .
- D. Remote Registration System:

1. Description: Utility company standard; encoder type. Include meter modified with signal-transmitting assembly, low-voltage connecting wiring, and remote register assembly.
 - a. Standard: AWWA C707.
 - b. Registration: Flow in gallons.
 - c. Data-Acquisition Units: Comply with utility company requirements for type and quantity.
 - d. Visible Display Units: Comply with utility company requirements for type and quantity.

2.9 BACKFLOW PREVENTERS

- A. Double-Check, Backflow-Prevention Assemblies:
 1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings
 2. Standard: NYS DEP.
 3. Operation: Continuous-pressure applications, unless otherwise indicated.
 4. Pressure Loss: 5 psig maximum, through middle 1/3 of flow range.
 5. Size: See drawings.
 6. Design Flow Rate: See drawings.
 7. Pressure Loss at Design Flow Rate: 8 psi maximum.
 8. Configuration: Designed for horizontal, flow.
 9. Accessories: Ball valves with threaded ends on inlet and outlet of NPS 2 and smaller; OS&Y gate valves with flanged ends on inlet and outlet of NPS 2-1/2 and larger.
- B. Backflow Preventer Test Kits:
 1. Basis-of-Design Product: Subject to compliance with requirements, provide the product for the device indicated on Drawings:
 2. Description: Factory calibrated, with gages, fittings, hoses, and carrying case with test-procedure instructions.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Refer to Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING APPLICATIONS

- A. General: Use pipe, fittings, and joining methods for piping systems according to the following applications.

- B. Transition couplings and special fittings with pressure ratings at least equal to piping pressure rating may be used, unless otherwise indicated.
- C. Do not use flanges or unions for underground piping.
- D. Flanges, unions, grooved-end-pipe couplings, and special fittings may be used, instead of joints indicated, on aboveground piping and piping in vaults.
- E. Underground water-service piping NPS 3 to NPS 8 shall be the following:
 - 1. Ductile-iron, mechanical-joint pipe; ductile-iron, mechanical-joint fittings; and mechanical.
- F. Aboveground water-service piping NPS 3 to NPS 8 shall be the following:
 - 1. Ductile-iron, grooved-end pipe; ductile-iron, grooved-end appurtenances; and grooved joints.

3.3 VALVE APPLICATIONS

- A. General Application: Use mechanical-joint-end valves for NPS 3 and larger underground installation. Use threaded- or flanged-end valves for installation in vaults or above ground.
- B. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
 - 1. Underground Valves, NPS 3 and Larger: AWWA, cast-iron, nonrising-stem, metal or resilient-seated gate valves with valve box.
 - 2. Use the following for valves in vaults and aboveground:
 - a. Gate Valves, NPS 3 (DN 80) and Larger: AWWA, cast iron, OS&Y rising stem, metal seated or AWWA, cast iron, OS&Y rising stem, resilient seated.
 - 3. Detector Check Valves: Use for water-service piping in vaults and aboveground to detect unauthorized use of water.

3.4 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. See Division 22 Section "Common Work Results for Plumbing" for piping-system common requirements.

3.5 PIPING INSTALLATION

- A. Water-Main Connection: Tap water main according to requirements of water utility company and of size and in location indicated.
- B. Make connections larger than NPS 2 with tapping machine according to the following:
 - 1. Install tapping sleeve and tapping valve according to MSS SP-60.
 - 2. Install tapping sleeve on pipe to be tapped. Position flanged outlet for gate valve.

3. Use tapping machine compatible with valve and tapping sleeve; cut hole in main. Remove tapping machine and connect water-service piping.
 4. Install gate valve onto tapping sleeve. Comply with MSS SP-60. Install valve with stem pointing up and with valve box.
- C. Make connections NPS 2 and smaller with drilling machine according to the following:
1. Install service-saddle assemblies and corporation valves in size, quantity, and arrangement required by utility company standards.
 2. Install service-saddle assemblies on water-service pipe to be tapped. Position outlets for corporation valves.
 3. Use drilling machine compatible with service-saddle assemblies and corporation valves. Drill hole in main. Remove drilling machine and connect water-service piping.
 4. Install corporation valves into service-saddle assemblies.
 5. Install manifold for multiple taps in water main.
 6. Install curb valve in water-service piping with head pointing up and with service box.
- D. Install ductile-iron, water-service piping according to AWWA C600 and AWWA M41.
- E. Bury piping with depth of cover over top at least 48 inches below level of maximum frost penetration, and according to the following:
- F. Install piping by tunneling or jacking, or combination of both, under streets and other obstructions that cannot be disturbed.
- G. Extend water-service piping and connect to water-supply source and building-water-piping systems at outside face of building wall in locations and pipe sizes indicated.
1. Terminate water-service piping at building wall until building-water-piping systems are installed. Terminate piping with caps, plugs, or flanges as required for piping material. Make connections to building-water-piping systems when those systems are installed.
- H. Sleeves are specified in Division 22 Section "Common Work Results for Plumbing."
- I. Mechanical sleeve seals are specified in Division 22 Section "Common Work Results for Plumbing."
- J. Install underground piping with restrained joints at horizontal and vertical changes in direction. Use restrained-joint piping, thrust blocks, anchors, tie-rods and clamps, and other supports.
- K. See Division 22 Section "Domestic Water Piping" for potable-water piping inside the building.

3.6 JOINT CONSTRUCTION

- A. See Division 22 Section "Common Work Results for Plumbing" for basic piping joint construction.
- B. Make pipe joints according to the following:

1. Ductile-Iron Piping, Gasketed Joints for Water-Service Piping: AWWA C600 and AWWA M41.
2. Ductile-Iron Piping, Gasketed Joints for Fire-Service-Main Piping: UL 194.
3. Ductile-Iron Piping, Grooved Joints: Cut-groove pipe. Assemble joints with grooved-end, ductile-iron-piping couplings, gaskets, lubricant, and bolts according to coupling manufacturer's written instructions.
4. Dissimilar Materials Piping Joints: Use adapters compatible with both piping materials, with OD, and with system working pressure. Refer to Division 22 Section "Common Work Results for Plumbing" for joining piping of dissimilar metals.

3.7 ANCHORAGE INSTALLATION

- A. Anchorage, General: Install water-distribution piping with restrained joints. Anchorages and restrained-joint types that may be used include the following:
 1. Concrete thrust blocks.
 2. Locking mechanical joints.
 3. Set-screw mechanical retainer glands.
 4. Bolted flanged joints.
 5. Heat-fused joints.
 6. Pipe clamps and tie rods.
- B. Install anchorages for tees, plugs and caps, bends, crosses, valves, and hydrant branches. Include anchorages for the following piping systems:
 1. Gasketed-Joint, Ductile-Iron, Water-Service Piping: According to AWWA C600.
- C. Apply full coat of asphalt or other acceptable corrosion-resistant material to surfaces of installed ferrous anchorage devices.

3.8 VALVE INSTALLATION

- A. AWWA Gate Valves: Comply with AWWA C600 and AWWA M44. Install each underground valve with stem pointing up and with valve box.
- B. AWWA Valves Other Than Gate Valves: Comply with AWWA C600 and AWWA M44.
- C. MSS Valves: Install as component of connected piping system.
- D. Corporation Valves and Curb Valves: Install each underground curb valve with head pointed up and with service box.

3.9 WATER METER INSTALLATION

- A. Install water meters, piping, and specialties according to utility company's written instructions.

- B. Water Meters: Install compound-type water meters, NPS 3 (DN 80) and larger, in meter vaults. Include shutoff valves on water meter inlets and outlets and valved bypass around meters. Support meters, valves, and piping on brick or concrete piers.
- C. Water Meters: Install detector-type water meters in meter vault according to AWWA M6. Include shutoff valves on water meter inlets and outlets and full-size valved bypass around meters. Support meters, valves, and piping on brick or concrete piers.

3.10 ROUGHING-IN FOR WATER METERS

- A. Rough-in piping and specialties for water meter installation according to utility company's written instructions.

3.11 BACKFLOW PREVENTER INSTALLATION

- A. Install backflow preventers of type, size, and capacity indicated. Include valves and test cocks. Install according to requirements of plumbing and health department and authorities having jurisdiction.
- B. Do not install backflow preventers that have relief drain in vault or in other spaces subject to flooding.
- C. Do not install bypass piping around backflow preventers.
- D. Support NPS 2-1/2 and larger backflow preventers, valves, and piping near floor and on brick or concrete piers.

3.12 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. See Division 22 Section "Common Work Results for Plumbing" for piping connections to valves and equipment.
- C. Connect water-distribution piping to existing street water main.
- D. Connect water-distribution piping to interior domestic water piping.
- E. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- F. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.13 FIELD QUALITY CONTROL

- A. Piping Tests: Conduct piping tests before joints are covered and after concrete thrust blocks have hardened sufficiently. Fill pipeline 24 hours before testing and apply test pressure to stabilize system. Use only potable water.
- B. Hydrostatic Tests: Test at not less than one-and-one-half times working pressure for two hours.
 - 1. Increase pressure in 50-psig increments and inspect each joint between increments. Hold at test pressure for 1 hour; decrease to 0 psig. Slowly increase again to test pressure and hold for 1 more hour. Maximum allowable leakage is 2 quarts (1.89 L) per hour per 100 joints. Remake leaking joints with new materials and repeat test until leakage is within allowed limits.
- C. Prepare reports of testing activities.

3.14 IDENTIFICATION

- A. Install continuous underground[detectable] warning tape during backfilling of trench for underground water-distribution piping. Locate below finished grade, directly over piping. Underground warning tapes are specified in Division 31 Section "Earth Moving."

3.15 CLEANING

- A. Clean and disinfect water-distribution piping as follows:
 - 1. Purge new water-distribution piping systems and parts of existing systems that have been altered, extended, or repaired before use.
 - 2. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in AWWA C651 or do as follows:
 - a. Fill system or part of system with water/chlorine solution containing at least 50 ppm of chlorine; isolate and allow to stand for 24 hours.
 - b. Drain system or part of system of previous solution and refill with water/chlorine solution containing at least 200 ppm of chlorine; isolate and allow to stand for 3 hours.
 - c. After standing time, flush system with clean, potable water until no chlorine remains in water coming from system.
 - d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedure if biological examination shows evidence of contamination.
- B. Prepare reports of purging and disinfecting activities.

END OF SECTION 221113

SECTION 221116 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Under-building slab and aboveground domestic water pipes, tubes, fittings, and specialties inside the building.
 - 2. Specialty valves.
 - 3. Flexible connectors.
 - 4. Escutcheons.
 - 5. Sleeves and sleeve seals.
 - 6. Wall penetration systems.

- B. Related Section:

- 1. Division 22 Section "Facility Water Distribution Piping" for water-service piping and water meters outside the building from source to the point where water-service piping enters the building.

1.3 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Domestic water piping and support and installation shall withstand effects of earthquake motions determined according to ASCE/SEI 7.

1.4 SUBMITTALS

- A. Product Data: For the following products:

- 1. Specialty valves.
 - 2. Transition fittings.
 - 3. Dielectric fittings.
 - 4. Water meters.
 - 5. Escutcheons.
 - 6. Sleeves and sleeve seals.
 - 7. Water penetration systems.

- B. Water Samples: Specified in "Cleaning" Article.
- C. Coordination Drawings: For piping in equipment rooms and other congested areas, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:
 - 1. Fire-suppression-water piping.
 - 2. Domestic water piping.
- D. Field quality-control reports.
- E. Environmental Sustainability Documentation: Contractor shall submit for approval, a fully completed Environmental Building Materials Certification Form and backup documentation from the manufacturer or supplier of each type used in this section. Such backup documentation shall be typewritten on the manufacturer's letterhead or product data sheet published by the manufacturer.
 - 1. Adhesives and Sealants
 - a. All adhesives and sealants used inside the building shall comply with South Coast Air Quality Management District Rule #1168. Documentation shall include product data submission for each material and shall demonstrate the volatile organic compound (VOC) content of the material.
 - 2. Paints and Coatings
 - a. All paints and coatings used inside the building must not exceed the VOC content limits established in Green Seal Standard GS-11, Paints, 1st Edition, May 20, 1993 and Green Seal Standard GC-03, Anti-Corrosive Paints, 2nd Edition, January 7, 1997. Documentation shall include product data submission for each material and shall demonstrate the volatile organic compound (VOC) level of the material.

1.5 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 61 for potable domestic water piping and components.

1.6 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 COPPER TUBE AND FITTINGS

- A. Hard Copper Tube: ASTM B 88, Type L (ASTM B 88M, Type B) water tube, drawn temper.
 - 1. Cast-Copper Solder-Joint Fittings: ASME B16.18, pressure fittings.
 - 2. Wrought-Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
 - 3. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.
 - 4. Grooved-Joint Copper-Tube Appurtenances:
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Anvil International.
 - 2) Shurjoint Piping Products.
 - 3) Victaulic Company.
 - b. Copper Grooved-End Fittings: ASTM B 75 copper tube or ASTM B 584 bronze castings.
 - c. Grooved-End-Tube Couplings: Copper-tube dimensions and design similar to AWWA C606. Include ferrous housing sections, EPDM-rubber gaskets suitable for hot and cold water, and bolts and nuts.
- B. Soft Copper Tube: ASTM B 88, Type K and ASTM B 88, Type L water tube, annealed temper.
 - 1. Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.

2.3 DUCTILE-IRON PIPE AND FITTINGS

- A. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.
- B. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, with push-on-joint bell and plain spigot end unless grooved or flanged ends are indicated.

2.4 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free, unless otherwise indicated; full-face or ring type unless otherwise indicated.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- D. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

2.5 TRANSITION FITTINGS

- A. General Requirements:
 - 1. Same size as pipes to be joined.
 - 2. Pressure rating at least equal to pipes to be joined.
 - 3. End connections compatible with pipes to be joined.
- B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
- C. Sleeve-Type Transition Coupling: AWWA C219.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Cascade Waterworks Manufacturing.
 - b. Dresser, Inc.; Dresser Piping Specialties.
 - c. Ford Meter Box Company, Inc. (The).
 - d. JCM Industries.
 - e. Romac Industries, Inc.
 - f. Smith-Blair, Inc; a Sensus company.
 - g. Viking Johnson; c/o Mueller Co.

2.6 DIELECTRIC FITTINGS

- A. General Requirements: Assembly of copper alloy and ferrous materials or ferrous material body with separating nonconductive insulating material suitable for system fluid, pressure, and temperature.
- B. Dielectric Unions:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Capitol Manufacturing Company.
 - b. EPCO Sales, Inc.
 - c. Hart Industries International, Inc.
 - d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - e. Zurn Plumbing Products Group; Wilkins Water Control Products.
 2. Description:
 - a. Pressure Rating: 250 psig at 180 deg F (82 deg C).
 - b. End Connections: Solder-joint copper alloy and threaded ferrous.
- C. Dielectric Flanges:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Capitol Manufacturing Company.
 - b. EPCO Sales, Inc.
 - c. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 2. Description:
 - a. Factory-fabricated, bolted, companion-flange assembly.
 - b. Pressure Rating: 175 psig minimum.
 - c. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
- D. Dielectric-Flange Kits:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Pipeline Seal and Insulator, Inc.
 2. Description:
 - a. Nonconducting materials for field assembly of companion flanges.
 - b. Pressure Rating: 175 psig
 - c. Gasket: Neoprene or phenolic.
 - d. Bolt Sleeves: Phenolic or polyethylene.
 - e. Washers: Phenolic with steel backing washers.

E. Dielectric Couplings:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Calpico, Inc.
 - b. Lochinvar Corporation.
2. Description:
 - a. Galvanized-steel coupling.
 - b. Pressure Rating: 300 psig at 225 deg F.
 - c. End Connections: Female threaded.
 - d. Lining: Inert and noncorrosive, thermoplastic.

F. Dielectric Nipples:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Perfection Corporation; a subsidiary of American Meter Company.
 - b. Precision Plumbing Products, Inc.
 - c. Victaulic Company.
2. Description:
 - a. Electroplated steel nipple complying with ASTM F 1545.
 - b. Pressure Rating: 300 psig at 225 deg F.
 - c. End Connections: Male threaded or grooved.
 - d. Lining: Inert and noncorrosive, propylene.

2.7 ESCUTCHEONS

- A. General: Manufactured ceiling, floor, and wall escutcheons and floor plates.
- B. One Piece, Cast Brass: Polished, chrome-plated finish with setscrews.
- C. One Piece, Deep Pattern: Deep-drawn, box-shaped brass with chrome-plated finish.
- D. One Piece, Stamped Steel: Chrome-plated finish with setscrew or spring clips.
- E. Split Casting, Cast Brass: Polished, chrome-plated finish with concealed hinge and setscrew.
- F. Split Plate, Stamped Steel: Chrome-plated finish with concealed hinge, setscrew or spring clips.
- G. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.
- H. Split-Casting Floor Plates: Cast brass with concealed hinge.

2.8 SLEEVES

- A. Cast-Iron Wall Pipes: Fabricated of cast iron, and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
- B. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc-coated, with plain ends.
- D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 - 1. Underdeck Clamp: Clamping ring with setscrews.

2.9 SLEEVE SEALS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Advance Products & Systems, Inc.
 - 2. Calpico, Inc.
 - 3. Metraflex, Inc.
 - 4. Pipeline Seal and Insulator, Inc.
- B. Description: Modular sealing element unit, designed for field assembly, used to fill annular space between pipe and sleeve.
 - 1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - 2. Pressure Plates: Stainless steel.
 - 3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

2.10 WALL PENETRATION SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. SIGMA.
- B. Description: Wall-sleeve assembly, consisting of housing and gland, gaskets, and pipe sleeve.
 - 1. Carrier-Pipe Deflection: Up to 5 percent without leakage.
 - 2. Housing: Ductile-iron casting with hub, waterstop, anchor ring, and locking devices. Include gland, bolts, and nuts.
 - 3. Housing-to-Sleeve Gasket: EPDM rubber.

4. Housing-to-Carrier-Pipe Gasket: AWWA C111, EPDM rubber.
5. Pipe Sleeve: AWWA C151, ductile-iron pipe.

2.11 GROUT

- A. Standard: ASTM C 1107, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- B. Characteristics: Nonshrink; recommended for interior and exterior applications.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Comply with requirements in Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."
- C. Install ductile-iron piping under building slab with restrained joints according to AWWA C600 and AWWA M41.
- D. Install underground copper tube in PE encasement according to ASTM A 674 or AWWA C105.
- E. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve, inside the building at each domestic water service entrance. Comply with requirements in Division 22 Section "Meters and Gages for Plumbing Piping" for pressure gages and Division 22 Section "Domestic Water Piping Specialties" for drain valves and strainers.
- F. Install shutoff valve immediately upstream of each dielectric fitting.
- G. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for pressure-reducing valves.
- H. Install domestic water piping level without pitch and plumb.

- I. Rough-in domestic water piping for water-meter installation according to utility company's requirements.
- J. Install seismic restraints on piping. Comply with requirements in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment" for seismic-restraint devices.
- K. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- L. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- M. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- N. Install piping adjacent to equipment and specialties to allow service and maintenance.
- O. Install piping to permit valve servicing.
- P. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than system pressure rating used in applications below unless otherwise indicated.
- Q. Install piping free of sags and bends.
- R. Install fittings for changes in direction and branch connections.
- S. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
- T. Install pressure gages on suction and discharge piping from each plumbing pump and packaged booster pump. Comply with requirements in Division 22 Section "Meters and Gages for Plumbing Piping" for pressure gages.
- U. Install thermostats in hot-water circulation piping. Comply with requirements in Division 22 Section "Domestic Water Pumps" for thermostats.
- V. Install thermometers on inlet and outlet piping from each water heater. Comply with requirements in Division 22 Section "Meters and Gages for Plumbing Piping" for thermometers.

3.3 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

- C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- D. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Brazed Joints" Chapter.
- E. Soldered Joints: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."
- F. Extruded-Tee Connections: Form tee in copper tube according to ASTM F 2014. Use tool designed for copper tube; drill pilot hole, form collar for outlet, dimple tube to form seating stop, and braze branch tube into collar.
- G. Copper-Tubing Grooved Joints: Roll groove end of tube. Assemble coupling with housing, gasket, lubricant, and bolts. Join copper tube and grooved-end fittings according to AWWA C606 for roll-grooved joints.
- H. Ductile-Iron-Piping Grooved Joints: Cut groove end of pipe. Assemble coupling with housing, gasket, lubricant, and bolts. Join ductile-iron pipe and grooved-end fittings according to AWWA C606 for ductile-iron-pipe, cut-grooved joints.
- I. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.
- J. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.4 VALVE INSTALLATION

- A. General-Duty Valves: Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping" for valve installations.
- B. Install shutoff valve close to water main on each branch and riser serving plumbing fixtures or equipment, on each water supply to equipment, and on each water supply to plumbing fixtures that do not have supply stops. Use ball or gate valves for piping NPS 2 and smaller. Use butterfly or gate valves for piping NPS 2-1/2 and larger.
- C. Install drain valves for equipment at base of each water riser, at low points in horizontal piping, and where required to drain water piping. Drain valves are specified in Division 22 Section "Domestic Water Piping Specialties."
 - 1. Hose-End Drain Valves: At low points in water mains, risers, and branches.
 - 2. Stop-and-Waste Drain Valves: Instead of hose-end drain valves where indicated.

- D. Install balancing valve in each hot-water circulation return branch and discharge side of each pump and circulator. Set balancing valves partly open to restrict but not stop flow. Use ball valves for piping NPS 2 and smaller and butterfly valves for piping NPS 2-1/2 and larger. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for balancing valves.
- E. Install calibrated balancing valves in each hot-water circulation return branch and discharge side of each pump and circulator. Set calibrated balancing valves partly open to restrict but not stop flow. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for calibrated balancing valves.

3.5 TRANSITION FITTING INSTALLATION

- A. Install transition couplings at joints of dissimilar piping.
- B. Transition Fittings in Underground Domestic Water Piping:
 - 1. NPS 1-1/2 and Smaller: Fitting-type coupling.
 - 2. NPS 2 and Larger: Sleeve-type coupling.
- C. Transition Fittings in Aboveground Domestic Water Piping NPS 2 (DN 50) and Smaller: Plastic-to-metal transition fittings or unions.

3.6 DIELECTRIC FITTING INSTALLATION

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric unions.
- C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges.
- D. Dielectric Fittings for NPS 5 and Larger: Use dielectric flange kits.

3.7 WATER METER INSTALLATION

- A. Rough-in domestic water piping for water meter installation, and install water meters according to utility company's requirements.

3.8 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment" for seismic-restraint devices.
- B. Comply with requirements in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support products and installation.
 - 1. Vertical Piping: MSS Type 8 or 42, clamps.

2. Individual, Straight, Horizontal Piping Runs:
 - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Feet : MSS Type 43, adjustable roller hangers.
 - c. Longer Than 100 Feet If Indicated: MSS Type 49, spring cushion rolls.
 3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 4. Base of Vertical Piping: MSS Type 52, spring hangers.
- C. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.
- E. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.
 2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
 3. NPS 1-1/2 and NPS 2 : 96 inches with 3/8-inch rod.
 4. NPS 2-1/2: 108 inches with 1/2-inch rod.
 5. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
 6. NPS 6: 10 feet with 5/8-inch rod.
 7. NPS 8: 10 feet with 3/4-inch rod.
- F. Install supports for vertical copper tubing every 10 feet.
- G. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.
- 3.9 CONNECTIONS
- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment and machines to allow service and maintenance.
- C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.
- D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:
1. Domestic Water Booster Pumps: Cold-water suction and discharge piping.
 2. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
 3. Plumbing Fixtures: Cold- and hot-water supply piping in sizes indicated, but not smaller than required by plumbing code. Comply with requirements in Division 22 plumbing fixture Sections for connection sizes.

4. Equipment: Cold- and hot-water supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

3.10 ESCUTCHEON INSTALLATION

- A. Install escutcheons for penetrations of walls, ceilings, and floors.
- B. Escutcheons for New Piping:
 1. Piping with Fitting or Sleeve Protruding from Wall: One piece, deep pattern.
 2. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish.
 3. Bare Piping at Ceiling Penetrations in Finished Spaces: One piece or split casting, cast brass with polished chrome-plated finish.
 4. Bare Piping in Unfinished Service Spaces: One piece, cast brass with rough-brass finish.
 5. Bare Piping in Equipment Rooms: One piece, cast brass.
 6. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece floor plate.
 7. Bare Piping at Floor Penetrations in Equipment Rooms: Split-casting floor plate.

3.11 SLEEVE INSTALLATION

- A. General Requirements: Install sleeves for pipes and tubes passing through penetrations in floors, partitions, roofs, and walls.
- B. Sleeves are not required for core-drilled holes.
- C. Permanent sleeves are not required for holes formed by removable PE sleeves.
- D. Cut sleeves to length for mounting flush with both surfaces unless otherwise indicated.
- E. Install sleeves in new partitions, slabs, and walls as they are built.
- F. For interior wall penetrations, seal annular space between sleeve and pipe or pipe insulation using joint sealants appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants" for joint sealants.
- G. For exterior wall penetrations above grade, seal annular space between sleeve and pipe using joint sealants appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants" for joint sealants.
- H. For exterior wall penetrations below grade, seal annular space between sleeve and pipe using wall penetration systems specified in this Section.
- I. Seal space outside of sleeves in concrete slabs and walls with grout.
- J. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation unless otherwise indicated.

K. Install sleeve materials according to the following applications:

1. Sleeves for Piping Passing through Concrete Floor Slabs: Steel pipe.
2. Sleeves for Piping Passing through Concrete Floor Slabs of Mechanical Equipment Areas or Other Wet Areas: Steel pipe.
 - a. Extend sleeves 2 inches above finished floor level.
 - b. For pipes penetrating floors with membrane waterproofing, extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Comply with requirements in Division 07 Section "Sheet Metal Flashing and Trim" for flashing.
3. Sleeves for Piping Passing through Gypsum-Board Partitions:
 - a. Steel pipe sleeves for pipes smaller than NPS 6.
 - b. Galvanized-steel sheet sleeves for pipes NPS 6 and larger.
 - c. Exception: Sleeves are not required for water supply tubes and waste pipes for individual plumbing fixtures if escutcheons will cover openings.
4. Sleeves for Piping Passing through Concrete Roof Slabs: Steel pipe.
5. Sleeves for Piping Passing through Exterior Concrete Walls:
 - a. Steel pipe sleeves for pipes smaller than NPS 6.
 - b. Cast-iron wall pipe sleeves for pipes NPS 6 and larger.
 - c. Install sleeves that are large enough to provide [1-inch (25-mm)] <Insert dimension> annular clear space between sleeve and pipe or pipe insulation when sleeve seals are used.
 - d. Do not use sleeves when wall penetration systems are used.
6. Sleeves for Piping Passing through Interior Concrete Walls:
 - a. Steel pipe sleeves for pipes smaller than NPS 6.
 - b. Galvanized-steel sheet sleeves for pipes NPS 6 and larger.

- L. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping" for firestop materials and installations.

3.12 SLEEVE SEAL INSTALLATION

- A. Install sleeve seals in sleeves in exterior concrete walls at water-service piping entries into building.
- B. Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble sleeve seal components and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.13 WALL PENETRATION SYSTEM INSTALLATION

- A. Install wall penetration systems in new, exterior concrete walls.
- B. Assemble wall penetration system components with sleeve pipe. Install so that end of sleeve pipe and face of housing are flush with wall. Adjust locking devices to secure sleeve pipe in housing.

3.14 IDENTIFICATION

- A. Identify system components. Comply with requirements in Division 22 Section "Identification for Plumbing Piping and Equipment" for identification materials and installation.
- B. Label pressure piping with system operating pressure.

3.15 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Piping Inspections:
 - 1. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
 - 2. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
 - a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 - b. Final Inspection: Arrange final inspection for authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
 - 3. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
 - 4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- C. Piping Tests:
 - 1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
 - 2. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.

3. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 4. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials but not less than 150 psig . Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
 5. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
 6. Prepare reports for tests and for corrective action required.
- D. Domestic water piping will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

3.16 ADJUSTING

- A. Perform the following adjustments before operation:
1. Close drain valves, hydrants, and hose bibbs.
 2. Open shutoff valves to fully open position.
 3. Open throttling valves to proper setting.
 4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
 - a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide flow of hot water in each branch.
 - b. Adjust calibrated balancing valves to flows indicated.
 5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
 6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
 7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
 8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.17 CLEANING

- A. Clean and disinfect potable and non-potable domestic water piping as follows:
1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
 2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652:
- B. Clean non-potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging procedures prescribed by authorities having jurisdiction or; if methods are not prescribed, follow procedures described below:
 - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - b. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.
- C. Prepare and submit reports of purging and disinfecting activities.
- D. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.18 PIPING SCHEDULE

- A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
- B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.
- C. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.
- D. Under-building-slab, domestic water, building service piping, NPS 3 (DN 80) and smaller shall be the following:
 1. Soft copper tube, ASTM B 88, Type K wrought-copper solder-joint fittings; and brazed joints.
- E. Under-building-slab, domestic water, building-service piping, NPS 4 to NPS 8 and larger] shall be the following:
 1. Soft copper tube, ASTM B 88, Type K; wrought-copper solder-joint fittings; and brazed joints.
- F. Under-building-slab, domestic water piping, NPS 2 and smaller, shall be the following:
 1. Hard copper tube, ASTM B 88, Type L wrought-copper solder-joint fittings; and brazed joints.
- G. Aboveground domestic water piping, NPS 2 and smaller, shall be the following:
 1. Hard copper tube, ASTM B 88, Type L cast-or wrought- copper solder-joint fittings; and soldered joints.
- H. Aboveground domestic water piping, NPS 2-1/2 to NPS 4, shall be one of the following:
 1. Hard copper tube, ASTM B 88, Type L cast- or wrought- copper solder-joint fittings; and soldered joints.

2. Hard copper tube, ASTM B 88, Type L grooved-joint copper-tube appurtenances; and grooved joints.
- I. Aboveground domestic water piping, NPS 5 to NPS 8, shall be one of the following:
 1. Hard copper tube, ASTM B 88, Type L cast- or wrought- copper solder-joint fittings; and brazed joints.
 2. Hard copper tube, ASTM B 88, Type L; grooved-joint copper-tube appurtenances; and grooved joints.

3.19 VALVE SCHEDULE

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
 1. Shutoff Duty: Use ball or gate valves for piping NPS 2 and smaller. Use butterfly, ball, or gate valves with flanged ends for piping NPS 2-1/2 and larger.
 2. Throttling Duty: Use ball or globe valves for piping NPS 2 and smaller. Use butterfly or ball valves with flanged ends for piping NPS 2-1/2 and larger.
 3. Drain Duty: Hose-end drain valves.
- B. Use check valves to maintain correct direction of domestic water flow to and from equipment.
- C. Iron grooved-end valves may be used with grooved-end piping.

END OF SECTION 221116

SECTION 221119 - DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following domestic water piping specialties:
 - 1. Vacuum breakers.
 - 2. Backflow preventers.
 - 3. Strainers.
 - 4. Outlet boxes.
 - 5. Hose stations.
 - 6. Hose bibbs.
 - 7. Wall hydrants.
 - 8. Drain valves.
 - 9. Water hammer arresters.
 - 10. Air vents.
- B. Related Sections include the following:
 - 1. Division 22 Section "Meters and Gages for Plumbing Piping" for thermometers, pressure gages, and flow meters in domestic water piping.
 - 2. Division 22 Section "Domestic Water Piping" for water meters.

1.3 PERFORMANCE REQUIREMENTS

- A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig, unless otherwise indicated.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Field quality-control test reports.
- D. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. NSF Compliance:
 - 1. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic domestic water piping components.
 - 2. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9."

PART 2 - PRODUCTS

2.1 VACUUM BREAKERS

- A. Pipe-Applied, Atmospheric-Type Vacuum Breakers :
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Ames Co.
 - b. Cash Acme.
 - c. Conbraco Industries, Inc.
 - d. FEBCO; SPX Valves & Controls.
 - e. Rain Bird Corporation.
 - f. Toro Company (The); Irrigation Div.
 - g. Watts Industries, Inc.; Water Products Div.
 - h. Zurn Plumbing Products Group; Wilkins Div.
 - 2. Standard: ASSE 1001.
 - 3. Size: NPS 1/4 to NPS 3, as required to match connected piping.
 - 4. Body: Bronze.
 - 5. Inlet and Outlet Connections: Threaded.
 - 6. Finish: Chrome plated.
- B. Hose-Connection Vacuum Breakers :
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Arrowhead Brass Products, Inc.
 - b. Cash Acme.
 - c. Conbraco Industries, Inc.
 - d. Legend Valve.

- e. MIFAB, Inc.
 - f. Prier Products, Inc.
 - g. Watts Industries, Inc.; Water Products Div.
 - h. Woodford Manufacturing Company.
 - i. Zurn Plumbing Products Group; Light Commercial Operation.
 - j. Zurn Plumbing Products Group; Wilkins Div.
- 2. Standard: ASSE 1011.
 - 3. Body: Bronze, nonremovable, with manual drain.
 - 4. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
 - 5. Finish: Chrome or nickel plated.

C. Pressure Vacuum Breakers:

- 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Ames Co.
 - b. Conbraco Industries, Inc.
 - c. FEBCO; SPX Valves & Controls.
 - d. Flomatic Corporation.
 - e. Toro Company (The); Irrigation Div.
 - f. Watts Industries, Inc.; Water Products Div.
 - g. Zurn Plumbing Products Group; Wilkins Div.
- 2. Standard: ASSE 1020.
- 3. Operation: Continuous-pressure applications.
- 4. Pressure Loss: 5 psig maximum, through middle 1/3 of flow range.
- 5. Accessories:
 - a. Valves: Ball type, on inlet and outlet.

2.2 BACKFLOW PREVENTERS

A. Double-Check Backflow-Prevention Assemblies:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Zurn Plumbing Products Group; Wilkins Div. Model 350A.
- 2. Standard: ASSE 1015 and NYS MEA.
- 3. Operation: Continuous-pressure applications, unless otherwise indicated.
- 4. Pressure Loss: 5 psig maximum, through middle 1/3 of flow range.
- 5. Body: Ductile iron ASTM A536 Grade 4.
- 6. End Connections: flanged.
- 7. Configuration: Designed for horizontal, straight through flow.
- 8. Accessories:
 - a. Valves: outside screw and yoke gate-type with flanged ends on inlet and outlet.

- B. Double-Check, Detector-Assembly Backflow Preventers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Zurn Plumbing Products Group; Wilkins Div. Model 350 ADA.
 2. Standard: ASSE 1048 and FMG approved UL listed and NYS MEA.
 3. Operation: Continuous-pressure applications.
 4. Pressure Loss: 5 psig maximum, through middle 1/3 of flow range.
 5. Body: Ductile iron ASTM A 536 Grade 4.
 6. End Connections: Flanged.
 7. Configuration: Designed for horizontal, straight through flow.
 8. Accessories:
 - a. Valves: Outside screw and yoke gate-type with flanged ends on inlet and outlet.
 - b. Bypass: With displacement-type water meter, shutoff valves, and reduced-pressure backflow preventer.

2.3 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers :

1. Pressure Rating: 125 psig minimum, unless otherwise indicated.
2. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or FDA-approved, epoxy coating and for NPS 2-1/2 and larger.
3. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
4. Screen: Stainless steel with round perforations, unless otherwise indicated.
5. Perforation Size:
 - a. Strainers NPS 2 and Smaller: 0.020 inch (0.51 mm) 0.033 inch (0.84 mm) 0.062 inch (1.57 mm).
 - b. Strainers NPS 2-1/2 to NPS 4: 0.045 inch (1.14 mm) 0.062 inch (1.57 mm) 0.125 inch (3.18 mm).
 - c. Strainers NPS 5 (DN 125) and Larger: 0.10 inch (2.54 mm) 0.125 inch (3.18 mm) 0.25 inch (6.35 mm).
6. Drain: Pipe plug Factory-installed, hose-end drain valve.

2.4 HOSE BIBBS

A. Hose Bibbs :

1. Standard: ASME A112.18.1 for sediment faucets.
2. Body Material: Bronze.
3. Seat: Bronze, replaceable.
4. Supply Connections: NPS 3/4 threaded or solder-joint inlet.
5. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
6. Pressure Rating: 125 psig.

7. Vacuum Breaker: Integral nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
8. Finish for Equipment Rooms: Rough bronze, or chrome or nickel plated.
9. Finish for Service Areas: Chrome or nickel plated.
10. Finish for Finished Rooms: Chrome or nickel plated.
11. Operation for Equipment Rooms: Wheel handle or operating key.
12. Operation for Service Areas: Wheel handle.
13. Operation for Finished Rooms: Operating key.
14. Include operating key with each operating-key hose bibb.
15. Include[integral] wall flange with each chrome- or nickel-plated hose bibb.

2.5 WALL HYDRANTS

A. Nonfreeze Wall Hydrants :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - d. Zurn Plumbing Products Group.
2. Standard: ASME A112.21.3M for concealed-outlet, self-draining wall hydrants.
3. Pressure Rating: 125 psig (860 kPa).
4. Operation: Loose key.
5. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
6. Inlet: NPS 3/4 .
7. Outlet: Concealed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
8. Box: Deep, flush mounting with cover.
9. Box and Cover Finish: Polished nickel bronze.
10. Outlet: Exposed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
11. Nozzle and Wall-Plate Finish: Polished nickel bronze.
12. Operating Keys(s): One with each wall hydrant.

B. Nonfreeze, Hot- and Cold-Water Wall Hydrants:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company.
 - b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - c. Zurn Plumbing Products Group.

3. Standard: ASME A112.21.3M for concealed-outlet, self-draining wall hydrants.
4. Pressure Rating: 125 psig.
5. Operation: Loose key.
6. Casings and Operating Rods: Of length required to match wall thickness. Include wall clamps.
7. Inlets: NPS 3/4.
8. Outlet: Concealed.
9. Box: Deep, flush mounting with cover.
10. Box and Cover Finish: Polished nickel bronze.
11. Vacuum Breaker: Nonremovable, manual-drain-type, hose-connection vacuum breaker complying with ASSE 1011 and with garden-hose thread complying with ASME B1.20.7 on outlet.
12. Operating Keys(s): One with each wall hydrant.

C. Vacuum Breaker Wall Hydrants :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Smith, Jay. R. Mfg. Co.; Division of Smith Industries, Inc.
 - b. Zurn Plumbing Products Group.
2. Standard: ASSE 1019, Type A or Type B.
3. Type: Freeze-resistant, automatic draining with integral air-inlet valve.
4. Classification: Type B, for automatic draining with hose removed or with hose attached and nozzle closed.
5. Pressure Rating: 125 psig.
6. Operation: Loose key or wheel handle.
7. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
8. Inlet: NPS 3/4.
9. Outlet: Exposed with garden-hose thread complying with ASME B1.20.7.

2.6 DRAIN VALVES

A. Ball-Valve-Type, Hose-End Drain Valves :

1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
2. Pressure Rating: 400-psig minimum CWP.
3. Size: NPS 3/4.
4. Body: Copper alloy.
5. Ball: Chrome-plated brass.
6. Seats and Seals: Replaceable.
7. Handle: Vinyl-covered steel.
8. Inlet: Threaded or solder joint.
9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

B. Gate-Valve-Type, Hose-End Drain Valves :

1. Standard: MSS SP-80 for gate valves.

2. Pressure Rating: Class 125.
3. Size: NPS 3/4.
4. Body: ASTM B 62 bronze.
5. Inlet: NPS 3/4 threaded or solder joint.
6. Outlet: Garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

C. Stop-and-Waste Drain Valves :

1. Standard: MSS SP-110 for ball valves or MSS SP-80 for gate valves.
2. Pressure Rating: 200-psig minimum CWP or Class 125.
3. Size: NPS 3/4.
4. Body: Copper alloy or ASTM B 62 bronze.
5. Drain: NPS 1/8 side outlet with cap.

2.7 WATER HAMMER ARRESTERS

A. Water Hammer Arresters :

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AMTROL, Inc.
 - b. Josam Company.
 - c. MIFAB, Inc.
 - d. Sioux Chief Manufacturing Company, Inc.
 - e. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - f. Tyler Pipe; Wade Div.
 - g. Watts Drainage Products Inc.
 - h. Zurn Plumbing Products Group; Specification Drainage Operation.
3. Standard: ASSE 1010 or PDI-WH 201.
4. Type: Copper tube with piston.
5. Size: ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.

2.8 AIR VENTS

A. Bolted-Construction Automatic Air Vents :

1. Body: Bronze.
2. Pressure Rating: 125-psig minimum pressure rating at 140 deg F.
3. Float: Replaceable, corrosion-resistant metal.
4. Mechanism and Seat: Stainless steel.
5. Size: NPS 1/2 minimum inlet.
6. Inlet and Vent Outlet End Connections: Threaded.

B. Welded-Construction Automatic Air Vents :

1. Body: Stainless steel.
2. Pressure Rating: 150-psig minimum pressure rating.
3. Float: Replaceable, corrosion-resistant metal.
4. Mechanism and Seat: Stainless steel.
5. Size: NPS 3/8 minimum inlet.
6. Inlet and Vent Outlet End Connections: Threaded.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.
- B. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.
1. Locate backflow preventers in same room as connected equipment or system.
 2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe to floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are not acceptable for this application.
 3. Do not install bypass piping around backflow preventers.
- C. Install water regulators with inlet and outlet shutoff valves. Install pressure gages on inlet and outlet.
- D. Install water control valves with inlet and outlet shutoff valves. Install pressure gages on inlet and outlet.
- E. Install Y-pattern strainers for water on supply side of each control valve, water pressure-reducing valve, solenoid valve, and pump.
- F. Install water hammer arresters in water piping according to PDI-WH 201 and New York State Plumbing Code.
- G. Install air vents at high points of water piping.

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping and specialties.

- B. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- C. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 LABELING AND IDENTIFYING

- A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
 - 1. Double-check backflow-prevention assemblies.
 - 2. Double-check, detector-assembly backflow preventers.
 - 3. Calibrated balancing valves.
 - 4. Primary, thermostatic, water mixing valves.
 - 5. Primary water tempering valves.
- B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and prepare test reports:
 - 1. Test each pressure vacuum breaker double-check backflow-prevention assembly and double-check, detector-assembly backflow preventer according to authorities having jurisdiction and the device's reference standard.
- B. Remove and replace malfunctioning domestic water piping specialties and retest as specified above.

3.5 ADJUSTING

- A. Set field-adjustable pressure set points of water pressure-reducing valves.
- B. Set field-adjustable flow set points of balancing valves.
- C. Set field-adjustable temperature set points of temperature-actuated water mixing valves.

END OF SECTION 221119

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SECTION 221316 - SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following for soil, waste, and vent piping inside the building:
 - 1. Pipe, tube, and fittings.
- B. Related Sections include the following:
 - 1. Division 22 Section "Sanitary Sewerage Pumps."

1.3 DEFINITIONS

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

1.4 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working pressure, unless otherwise indicated:
 - 1. Soil, Waste, and Vent Piping: 25-foot head of water.
- B. Seismic Performance: Soil, waste, and vent piping and support and installation shall be capable of withstanding the effects of seismic events determined according New York State Building Code

1.5 SUBMITTALS

- A. Product Data: For pipe, tube, fittings, and couplings.
- B. Field quality-control inspection and test reports.

1.6 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2.2 PIPING MATERIALS

- A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

2.3 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 74, Service and Extra-Heavy class(es).
- B. Gaskets: ASTM C 564, rubber.
- C. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

2.4 HUBLESS CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 888 or CISPI 301.
- B. Shielded Couplings: ASTM C 1277 assembly of metal shield or housing, corrosion-resistant fasteners, and rubber sleeve with integral, center pipe stop.
 - 1. Standard, Shielded, Stainless-Steel Couplings: CISPI 310, with stainless-steel corrugated shield; stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve.
 - a. Available Manufacturers:
 - 1) ANACO.
 - 2) Fernco, Inc.
 - 3) Ideal Div.; Stant Corp.
 - 4) Mission Rubber Co.
 - 5) Tyler Pipe; Soil Pipe Div.

2. Heavy-Duty, Shielded, Stainless-Steel Couplings: With stainless-steel shield, stainless-steel bands and tightening devices, and ASTM C 564, rubber sleeve.
 - a. Available Manufacturers:
 - 1) ANACO.
 - 2) Clamp-All Corp.
 - 3) Ideal Div.; Stant Corp.
 - 4) Mission Rubber Co.
 - 5) Tyler Pipe; Soil Pipe Div.
3. Heavy-Duty, Shielded, Cast-Iron Couplings: ASTM A 48/A 48M, two-piece, cast-iron housing; stainless-steel bolts and nuts; and ASTM C 564, rubber sleeve.
 - a. Available Manufacturers:
 - 1) MG Piping Products Co.
- C. Rigid, Unshielded Couplings: ASTM C 1461, sleeve-type, reducing- or transition-type mechanical coupling molded from ASTM C 1440, TPE material with corrosion-resistant-metal tension band and tightening mechanism on each end.
 1. Available Manufacturers:
 - a. ANACO.

PART 3 - EXECUTION

3.1 EXCAVATION

- A. Refer to Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING APPLICATIONS

- A. Flanges and unions may be used on aboveground pressure piping, unless otherwise indicated.
- B. Aboveground, soil and waste piping 10 inches and smaller shall be the following:
 1. Hubless cast-iron soil pipe and fittings; standard, shielded, stainless-steel couplings; and hubless-coupling joints.
- C. Aboveground, vent piping 10 inches and smaller shall be the following:
 1. Hubless cast-iron soil pipe and fittings; standard, shielded, stainless-steel couplings; and hubless-coupling joints.
- D. Underground, soil, waste, and vent piping shall be the following:

1. Service class, cast-iron soil piping; gaskets; and gasketed joints.

3.3 PIPING INSTALLATION

- A. Basic piping installation requirements are specified in Division 22 Section "Common Work Results for Plumbing."
- B. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.
- C. Install cleanout fitting with closure plug inside the building in sanitary force-main piping.
- D. Install underground, ductile-iron, special pipe fittings according to AWWA C600.
 1. Install encasement on piping according to ASTM A 674 or AWWA C105.
- E. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Sleeves and mechanical sleeve seals are specified in Division 22 Section "Common Work Results for Plumbing."
- F. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
 1. Install encasement on underground piping according to ASTM A 674 or AWWA C105.
- G. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if 2 fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
- H. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.
- I. Install soil and waste drainage and vent piping at the following minimum slopes, unless otherwise indicated:
 1. Building Sanitary Drain: 1/8 inch per 100ft downward in direction of flow for piping.
 2. Horizontal Sanitary Drainage Piping: 1/8 inch per 100ft downward in direction of flow.
 3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.

- J. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.
- K. Install ABS soil and waste drainage and vent piping according to ASTM D 2661.
- L. Install PVC soil and waste drainage and vent piping according to ASTM D 2665.
- M. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

3.4 JOINT CONSTRUCTION

- A. Basic piping joint construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."
- B. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
- C. Join hub-and-spigot, cast-iron soil piping with calked joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead and oakum calked joints.
- D. Join hubless cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.

3.5 HANGER AND SUPPORT INSTALLATION

- A. Seismic-restraint devices are specified in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- B. Pipe hangers and supports are specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment." Install the following:
 - 1. Vertical Piping: MSS Type 8 or Type 42, clamps.
 - 2. Install individual, straight, horizontal piping runs according to the following:
 - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
 - c. Longer Than 100 Feet, if Indicated: MSS Type 49, spring cushion rolls.
 - 3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 - 4. Base of Vertical Piping: MSS Type 52, spring hangers.
- C. Install supports according to Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."
- D. Support vertical piping and tubing at base and at each floor.
- E. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.

- F. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. 1-1/2 and 2 inches: 60 inches with 3/8-inch rod.
 - 2. 3 inches: 60 inches with 1/2-inch rod.
 - 3. 4 and 5 inches: 60 inches with 5/8-inch rod.
 - 4. 6 inches: 60 inches with 3/4-inch rod.
 - 5. 8 to 12 inches: 60 inches with 7/8-inch rod.
- G. Install supports for vertical cast-iron soil piping at base and every 15 feet.
- H. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. 1-1/4 inches: 84 inches with 3/8-inch rod.
 - 2. 1-1/2 inches: 108 inches with 3/8-inch rod.
 - 3. 2 inches: 10 feet with 3/8-inch rod.
 - 4. 2-1/2 inches: 11 feet with 1/2-inch rod.
 - 5. 3 inches: 12 feet with 1/2-inch rod.
 - 6. 4 and 5 inches: 12 feet with 5/8-inch rod.
 - 7. 6 inches: 12 feet with 3/4-inch rod.
 - 8. 8 to 12 inches: 12 feet with 7/8-inch rod.
- I. Install supports for vertical steel piping every story height.
- J. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.6 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect drainage and vent piping to the following:
 - 1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
 - 2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
 - 3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
 - 4. Equipment: Connect drainage piping as indicated. Provide shutoff valve, if indicated, and union for each connection. Use flanges instead of unions for connections 2-1/2 inches and larger.

3.7 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
 - 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 - 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction.

3.8 CLEANING

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.

END OF SECTION 221316

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SECTION 221319 - SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following sanitary drainage piping specialties:
 - 1. Cleanouts.
 - 2. Floor drains.
 - 3. Trench drains.
- B. Related Sections include the following:
 - 1. Division 22 Section "Storm Drainage Piping Specialties" for trench drains for storm water, channel drainage systems for storm water, roof drains, and catch basins.
 - 2. Division 22 Section "Plumbing Fixtures" for hair interceptors.

1.3 DEFINITIONS

- A. HDPE: High-density polyethylene plastic.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Operation and Maintenance Data: For drainage piping specialties to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

- C. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic sanitary piping specialty components.

1.6 COORDINATION

- A. Coordinate size and location of roof penetrations.

PART 2 - PRODUCTS

2.1 CLEANOUTS

A. Exposed Metal Cleanouts

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products Inc.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.36.2M for cast iron for cleanout test tee.
3. Size: Same as connected drainage piping
4. Body Material: Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Bronze plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

B. Metal Floor Cleanouts <Insert drawing designation if any>:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Josam Company; Josam Div.
 - b. Sioux Chief Manufacturing Company, Inc.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products Inc.
 - f. Zurn Plumbing Products Group; Light Commercial Operation.
 - g. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.36.2M for adjustable housing cleanout.
3. Size: Same as connected branch.

4. Type: Adjustable housing.
5. Body or Ferrule: Cast iron.
6. Clamping Device: Required.
7. Outlet Connection: Inside calk.
8. Closure: Bronze Plug.
9. Adjustable Housing Material: Cast iron with set-screws or other device.
10. Frame and Cover Material and Finish: Galvanized Cast Iron.
11. Frame and Cover Shape: Round.
12. Top Loading Classification: Medium Duty.
13. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.

2.2 FLOOR DRAINS

A. Cast-Iron Floor Drains, Moderate Traffic:

1. Basis-of-Design Product: Subject to compliance with requirements, provide JR Smith Model 2360 or a comparable product by one of the following:
 - a. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Tyler Pipe; Wade Div.
 - d. Watts Drainage Products Inc.
 - e. Zurn Plumbing Products Group; Light Commercial Operation.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.6.3.
3. Pattern: Floor drain.
4. Body Material: Cast Iron.
5. Outlet: Bottom.
6. Backwater Valve: Not required.
7. Sediment Bucket: Required.
8. Top or Strainer Material: Nickel bronze in finished areas, cast iron all other.
9. Top of Body and Strainer Finish: Nickel bronze in finished areas, cast iron all other.
10. Top Shape: Round.
11. Dimensions of Top or Strainer: 12 inches.
12. Top Loading Classification: Medium Duty.

B. Cast-Iron Floor Drains, General Areas:

1. Basis-of-Design Product: Subject to compliance with requirements, provide JR Smith Model 2350 or a comparable product by one of the following:
 - a. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Tyler Pipe; Wade Div.
 - d. Watts Drainage Products Inc.
 - e. Zurn Plumbing Products Group; Light Commercial Operation.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.6.3.
3. Pattern: Floor drain.
4. Body Material: Cast Iron.
5. Outlet: Bottom.
6. Backwater Valve: Not required.
7. Sediment Bucket: Required.
8. Top or Strainer Material: Nickel bronze in finished areas, cast iron all other.
9. Top of Body and Strainer Finish: Nickel bronze in finished areas, cast iron all other.
10. Top Shape: Round.
11. Dimensions of Top or Strainer: 8 inches.
12. Top Loading Classification: General Service.

2.3 TRENCH DRAINS

A. Trench Drains :

1. Basis-of-Design Product: Subject to compliance with requirements, provide JR Smith 2710-U-M or a comparable product by one of the following:
 - a. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Tyler Pipe; Wade Div.
 - d. Watts Drainage Products Inc.
 - e. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.6.3 for trench drains.
3. Material: Ductile or gray iron.
4. Outlet: Bottom.
5. Grate Material: Ductile iron.
6. Grate Finish: Not required.
7. Dimensions of Frame and Grate: 24 inches wide by 12 inches deep by 12 inches long.
8. Top Loading Classification: Heavy Duty.

2.4 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Air-Gap Fittings:

1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
2. Body: Bronze or cast iron.
3. Inlet: Opening in top of body.
4. Outlet: Larger than inlet.
5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

B. Sleeve Flashing Device:

1. Description: Manufactured, cast-iron fitting, with clamping device, that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 2 inches above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
2. Size: As required for close fit to riser or stack piping.

C. Vent Caps:

1. Description: Cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and setscrews to secure to vent pipe.
2. Size: Same as connected stack vent or vent stack.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.
- B. Install backwater valves in building drain piping. For interior installation, provide cleanout deck plate flush with floor and centered over backwater valve cover, and of adequate size to remove valve cover for servicing.
- C. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
 1. Size same as drainage piping up to 4 inch. Use 4 inch for larger drainage piping unless larger cleanout is indicated.
 2. Locate at each change in direction of piping greater than 45 degrees.
 3. Locate at minimum intervals of 50 feet for piping.
 4. Locate at base of each vertical soil and waste stack.
- D. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- E. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- F. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
 1. Position floor drains for easy access and maintenance.
 2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:
 - a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
 - b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.

- c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch total depression.
- 3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
- 4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.
- G. Install trench drains at low points of surface areas to be drained. Set grates of drains flush with finished surface, unless otherwise indicated.
- H. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.
- I. Install through-penetration firestop assemblies in plastic stacks at floor penetrations.
- J. Install deep-seal traps on floor drains and other waste outlets, if indicated.
- K. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.
 - 1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
 - 2. Size: Same as floor drain inlet.
- L. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.
- M. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.
- N. Install vent caps on each vent pipe passing through roof.
- O. Install frost-resistant vent terminals on each vent pipe passing through roof. Maintain 1-inch clearance between vent pipe and roof substrate.
- P. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.
- Q. Install frost-proof vent caps on each vent pipe passing through roof. Maintain 1-inch clearance between vent pipe and roof substrate.
- R. Install wood-blocking reinforcement for wall-mounting-type specialties.
- S. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.
- T. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.
- C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 FLASHING INSTALLATION

- A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:
- B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
- C. Set flashing on floors and roofs in solid coating of bituminous cement.
- D. Secure flashing into sleeve and specialty clamping ring or device.
- E. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Division 07 Section "Sheet Metal Flashing and Trim."
- F. Fabricate and install flashing and pans, sumps, and other drainage shapes.

3.4 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 221316

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SECTION 221413 - FACILITY STORM DRAINAGE PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following storm drainage piping inside the building:
 - 1. Pipe, tube, and fittings.
 - 2. Special pipe fittings.
 - 3. Encasement for underground metal piping.
- B. Related Sections include the following:
 - 1. Division 22 Section "Sump Pumps."

1.3 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working-pressure, unless otherwise indicated:
 - 1. Storm Drainage Piping: 25-foot head of water.
- B. Seismic Performance: Soil, waste, and vent piping and support and installation shall be capable of withstanding the effects of seismic events determined according to New York State Building Code.

1.4 SUBMITTALS

- A. Product Data: For pipe, tube, fittings, and couplings.
- B. Shop Drawings:
 - 1. Piping layouts for all piping systems drawn at same scale as ductwork shop drawings; where such piping is completely shown on coordination drawings, separate piping shop drawings for the same area or areas are not required.
 - 2. Piping shop drawings shall show all hangers and supports (type and location), fittings, valves, strainers and accessories. They shall show all sections necessary to establish pipe

elevations, shall identify hanger types and loads, and show all tie-ins to HVAC piping, all equipment underground piping, support equipment, and all miscellaneous accessories

- C. Field quality-control inspection and test reports.

1.5 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 PIPING MATERIALS

- A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.
 - 1. Manufacturers:
 - a. Tyler Pipe
 - b. Charlotte Pipe and Foundry Company.

2.3 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 74, Service and Extra-Heavy class(es).
- B. Gaskets: ASTM C 564, rubber.
- C. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

2.4 HUBLESS CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 888 or CISPI 301.
- B. Shielded Couplings: ASTM C 1277 assembly of metal shield or housing, corrosion-resistant fasteners, and rubber sleeve with integral, center pipe stop.

- C. Rigid, Unshielded Couplings: ASTM C 1461, sleeve-type, reducing- or transition-type mechanical coupling molded from ASTM C 1440, TPE material with corrosion-resistant-metal tension band and tightening mechanism on each end.

PART 3 - EXECUTION

3.1 EXCAVATION

- A. Refer to Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING APPLICATIONS

- A. Flanges and unions may be used on aboveground pressure piping, unless otherwise indicated.
- B. Aboveground, storm drainage piping 3 inches to 10 inches shall be the following:
 - 1. Hubless cast-iron soil pipe and fittings; [standard,] [and] [heavy-duty] shielded, stainless-steel couplings; and coupled joints.
- C. Underground storm drainage piping all sizes shall be the following:
 - 1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.

3.3 PIPING INSTALLATION

- A. Storm sewer and drainage piping outside the building are specified in Division 33 Section "Storm Utility Drainage Piping."
- B. Basic piping installation requirements are specified in Division 22 Section "Common Work Results for Plumbing."
- C. Install seismic restraints on piping. Seismic-restraint devices are specified in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- D. Install cleanouts at grade and extend to where building storm drains connect to building storm sewers. Cleanouts are specified in Division 22 Section "Storm Drainage Piping Specialties."
- E. Install cleanout fitting with closure plug inside the building in storm drainage force-main piping.
- F. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Sleeves and mechanical sleeve seals are specified in Division 22 Section "Common Work Results for Plumbing."
- G. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

1. Install encasement on underground piping according to ASTM A 674 or AWWA C105.
- H. Make changes in direction for storm drainage piping using appropriate branches, bends, and long-sweep bends. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
- I. Lay buried building storm drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.
- J. Install storm drainage piping at the following minimum slopes, unless otherwise indicated:
 1. Building Storm Drain: 1 percent downward in direction of flow
 2. Horizontal Storm-Drainage Piping: 1 percent downward in direction of flow.
- K. Install engineered controlled-flow storm drainage piping in locations indicated.
- L. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.
- M. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

3.4 JOINT CONSTRUCTION

- A. Basic piping joint construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."
- B. Hub-and-Spigot, Cast-Iron Soil Piping Gasketed Joints: Join according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
- C. Hub-and-Spigot, Cast-Iron Soil Piping Calked Joints: Join according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead and oakum calked joints.
- D. Hubless Cast-Iron Soil Piping Coupled Joints: Join according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.

3.5 VALVE INSTALLATION

- A. General valve installation requirements are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."
- B. Shutoff Valves: Install shutoff valve on each sump pump discharge.
 1. Install gate valve for piping.

3.6 HANGER AND SUPPORT INSTALLATION

- A. Seismic-restraint devices are specified in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- B. Pipe hangers and supports are specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment." Install the following:
 - 1. Vertical Piping: MSS Type 8 or Type 42, clamps.
 - 2. Individual, Straight, Horizontal Piping Runs: According to the following:
 - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
 - c. Longer Than 100 Feet, if Indicated: MSS Type 49, spring cushion rolls.
 - 3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 - 4. Base of Vertical Piping: MSS Type 52, spring hangers.
- C. Install supports according to Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."
- D. Support vertical piping and tubing at base and at each floor.
- E. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.
- F. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. 6 inches and smaller: 12 inches within each fitting and coupling with 5/8-inch rod.
 - 2. 8 inches and larger: 12 inches within each fitting and coupling with 7/8-inch rod.
- G. Install supports for vertical cast-iron soil piping every 30 feet.
- H. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.7 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect interior storm drainage piping to exterior storm drainage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect storm drainage piping to roof drains and storm drainage specialties.

3.8 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
 - 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in.
 - 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test storm drainage piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
 - 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
 - 2. Leave uncovered and unconcealed new, altered, extended, or replaced storm drainage piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 - 3. Test Procedure: Test storm drainage piping, except outside leaders, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
 - 4. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
 - 5. Prepare reports for tests and required corrective action.
- E. Test force-main piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
 - 1. Leave uncovered and unconcealed new, altered, extended, or replaced force-main piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 - 2. Cap and subject piping to static-water pressure of 50 psig (345 kPa) above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
 - 3. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
 - 4. Prepare reports for tests and required corrective action.

3.9 CLEANING

- A. Clean interior of piping. Remove dirt and debris as work progresses.

- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.

END OF SECTION 221413

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SECTION 221423 - STORM DRAINAGE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following storm drainage piping specialties:
 - 1. Cleanouts.
 - 2. Garage drains.
 - 3. Miscellaneous storm drainage piping specialties.
 - 4. Flashing materials.
- B. Related Sections include the following:
 - 1. Division 22 Section "Sanitary Waste Piping Specialties" for floor drains, connected to sanitary sewer, grease interceptors and removal devices, oil interceptors, and solid interceptors.

1.3 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. FOG: Fats, oils, and greases.
- C. FRP: Fiberglass-reinforced plastic.
- D. HDPE: High-density polyethylene plastic.
- E. PE: Polyethylene plastic.
- F. PP: Polypropylene plastic.
- G. PUR: Polyurethane plastic.
- H. PVC: Polyvinyl chloride plastic.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.

1.5 QUALITY ASSURANCE

- A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

1.6 COORDINATION

- A. Coordinate size and location of roof penetrations.

PART 2 - PRODUCTS

2.1 CLEANOUTS

A. Exposed Metal Cleanouts

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products Inc.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.36.2M for cast iron for cleanout test tee.
3. Size: Same as connected drainage piping
4. Body Material: Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Bronze plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

B. Metal Floor Cleanouts <Insert drawing designation if any>:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Josam Company; Josam Div.
 - b. Sioux Chief Manufacturing Company, Inc.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products Inc.
 - f. Zurn Plumbing Products Group; Light Commercial Operation.
 - g. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.36.2M for adjustable housing cleanout.
3. Size: Same as connected branch.
4. Type: Adjustable housing.
5. Body or Ferrule: Cast iron.
6. Clamping Device: Required.
7. Outlet Connection: Inside calk.
8. Closure: Bronze Plug.
9. Adjustable Housing Material: Cast iron with set-screws or other device.
10. Frame and Cover Material and Finish: Galvanized Cast Iron.
11. Frame and Cover Shape: Round.
12. Top Loading Classification: Medium Duty.
13. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.

2.2 GARAGE DRAINS

A. Metal Garage Drains:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products Inc.
 - f. Zurn Plumbing Products Group; Light Commercial Operation.
 - g. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.21.2M.
3. Pattern: Roof drain.
4. Body Material: Cast iron.
5. Combination Flashing Ring and Gravel Stop: Required.
6. Flow-Control Weirs: Not required.
7. Outlet: Bottom.
8. Dome Material: Galvanized Cast iron.
9. Extension Collars: Required.
10. Underdeck Clamp: Required.
11. Sump Receiver: Not required
12. Options:

2.3 MISCELLANEOUS STORM DRAINAGE PIPING SPECIALTIES

A. Expansion Joints:

1. Standard: ASME A112.21.2M.
2. Body: Cast iron with bronze sleeve, packing, and gland.
3. End Connections: Matching connected piping.

4. Size: Same as connected piping.

2.4 FLASHING MATERIALS

- A. Copper Sheet: ASTM B 152/B 152M, 12 oz./sq. ft. thickness.
- B. Zinc-Coated Steel Sheet: ASTM A 653/A 653M, with 0.20 percent copper content and 0.04-inch minimum thickness, unless otherwise indicated. Include G90 hot-dip galvanized, mill-phosphatized finish for painting if indicated.
- C. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil minimum thickness.
- D. Fasteners: Metal compatible with material and substrate being fastened.
- E. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.
- F. Solder: ASTM B 32, lead-free alloy.
- G. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.
- B. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
 1. Size same as drainage piping up to 4 inch. Use 4 inch for larger drainage piping unless larger cleanout is indicated.
 2. Locate at each change in direction of piping greater than 45 degrees.
 3. Locate at minimum intervals of not more than 100 feet.
 4. Locate at base of each vertical soil and waste stack.
- C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- E. Install garage drains at locations indicated on the plans and per manufacturer's written installation instructions. Garage drains specified on drain schedule.

1. Install garage roof-drain so that there will be no leakage between drain and adjoining floor. Maintain integrity of waterproof membranes where penetrated.
2. Position garage drains for easy access and maintenance.

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

3.3 FLASHING INSTALLATION

- A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:
 1. Copper Sheets: Solder joints of copper sheets.
- B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in garage.
 1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe.
 2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
 3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.
- C. Set flashing on floors and roofs in solid coating of bituminous cement.
- D. Secure flashing into sleeve and specialty clamping ring or device.
- E. Fabricate and install flashing and pans, sumps, and other drainage shapes.

3.4 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 221423

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SECTION 221429 - SUMP PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following sump pumps and accessories, inside the building, for building storm drainage systems:
 - 1. Submersible sump pumps.
- B. Related Sections include the following:
 - 1. Division 22 Section "Sanitary Sewerage Pumps" for application in sanitary drainage systems.

1.3 SUBMITTALS

- A. Product Data: For each type and size of sump pump specified. Include certified performance curves with operating points plotted on curves, and rated capacities of selected models, furnished specialties, and accessories.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Operation and Maintenance Data: For each sump pump to include in emergency, operation, and maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Product Options: Drawings indicate size, profiles, and dimensional requirements of sump pumps and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Retain shipping flange protective covers and protective coatings during storage.
- B. Protect bearings and couplings against damage.
- C. Comply with pump manufacturer's written rigging instructions for handling.

1.6 COORDINATION

- A. Coordinate size and location of concrete pits. Concrete, reinforcement, and formwork requirements are specified in Division 03.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2.2 SUBMERSIBLE SUMP PUMPS

- A. Available Manufacturers:
 - 1. Bell & Gossett Domestic Pump; ITT Industries.
 - 2. Federal Pump Corp.
 - 3. Goulds Pumps; ITT Industries.
 - 4. Grundfos Pumps Corp.
 - 5. Stancor, Inc.
 - 6. Weil Pump Company, Inc.
 - 7. Weinman Div.; Crane Pumps & Systems.
- B. Description: Factory-assembled and -tested, simplex, single-stage, centrifugal, end-suction, submersible, direct-connected sump pumps complying with UL 778 and HI 1.1-1.2 and HI 1.3 for submersible sump pumps.
- C. Casing and Impeller: Cast-iron casing with inlet strainer and metal impeller.
- D. Pump and Motor Shaft: Steel, with factory-sealed, grease-lubricated ball bearings and double-mechanical seals.

- E. Motor: Hermetically sealed, capacitor-start type, with built-in overload protection; three-conductor waterproof power cable of length required, and with grounding plug and cable-sealing assembly for connection at pump. Comply with requirements in Division 22 Section "Common Motor Requirements for Plumbing Equipment."
- F. Pump Discharge Piping: Factory or field fabricated, ASTM A 53/A 53M, Schedule 40, galvanized-steel pipe.
- G. Controls: NEMA 250, Type 6, 120-V ac, float switch, mounted on discharge piping.

2.3 FLEXIBLE CONNECTORS

- A. Available Manufacturers:
 - 1. Flex-Hose Co., Inc.
 - 2. Hyspan Precision Products, Inc.
 - 3. Metraflex, Inc.
- B. Description: 125-psig minimum working-pressure rating and ends matching pump connection:
 - 1. Bronze Flexible Connectors: Corrugated, bronze inner tubing covered with bronze wire braid. Include copper-tube ends or bronze flanged ends, braze welded to tubing.
 - 2. Stainless-Steel Flexible Connectors: Corrugated, stainless-steel inner tubing covered with stainless-steel wire braid. Include stainless-steel nipples or flanges, welded to tubing.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in of plumbing piping to verify actual locations of storm drainage piping connections before sump pump installation.

3.2 SUMP PUMP INSTALLATION

- A. Excavating, trenching, and backfilling are specified in Division 31 Section "Earth Moving."
- B. Install sump pumps according to applicable requirements in HI 1.4.
- C. Install pumps and arrange to provide access for maintenance including removal of motors, impellers, couplings, and accessories.
- D. Set submersible sump pumps on basin or pit floor. Make direct connections to storm drainage piping.

- E. Install sump pump basins and connect to drainage piping. Brace interior of basins according to manufacturer's written instructions to prevent distortion or collapse during concrete placement. Set basin cover and fasten to basin top flange. Install cover so top surface is flush with finished floor.
- F. Construct sump pump pits and connect to drainage piping. Set pit curb frame recessed in and anchored to concrete. Fasten pit cover to pit curb flange. Install cover so top surface is flush with finished floor.
- G. Install packaged, submersible, drainage pump unit basins on floor or concrete base unless recessed installation is indicated. Make direct connections to storm drainage piping.
- H. Support piping so weight of piping is not supported by pumps.

3.3 CONNECTIONS

- A. Piping installation requirements are specified in Division 22 Section "Facility Storm Drainage Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to sump pumps to allow service and maintenance.
- C. Connect storm drainage piping to pumps. Install discharge piping equal to or greater than size of pump discharge piping. Refer to Division 22 Section "Facility Storm Drainage Piping."
 - 1. Install flexible connectors adjacent to pumps in discharge piping.
 - 2. Install check and shutoff valves on discharge piping from each pump. Install unions on pumps having threaded pipe connections. Install valves same size as connected piping. Refer to Division 22 Section "General-Duty Valves for Plumbing Piping" for general-duty valves for drainage piping.
- D. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- E. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 STARTUP SERVICE

- A. Start pumps without exceeding safe motor power:
 - 1. Start motors.
 - 2. Open discharge valves slowly.
 - 3. Check general mechanical operation of pumps and motors.
- B. Test and adjust controls and safeties.
- C. Remove and replace damaged and malfunctioning components.

1. Pump Controls: Set pump controls for automatic start, stop, and alarm operation as required for system application.
 2. Set field-adjustable switches and circuit-breaker trip ranges as indicated, or if not indicated, for normal operation.
- D. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project outside normal occupancy hours for this purpose.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain controls and pumps. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 221429

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SECTION 230500 - COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Some items of common work results repeated in this section, is intended to qualify or to call particular attention to them; it is not intended that any other part of general common work results be assumed to be omitted if not repeated herein.
- B. Apply provisions of this division equally and specifically to Sections supplying labor and/or equipment and/or materials as required under Heating, Ventilating and Air Conditioning, Plumbing, Fire Protections and Electrical Sections of the project specifications.
- C. Contractor to include cost for all fees and preparations of all required documents, forms, calculations, affidavits, etc., for the following:
 - 1. Controlled Inspections
 - 2. Boiler Filings with local jurisdiction and equipment installation approvals from Building Department Boiler Division.
 - 3. Building and Fire Department Filings (as needed and for any substitution he may make).
 - 4. Equipment Use/Permit Applications (as applicable).
 - 5. Building Department Technical Report (TR-1) forms.
 - 6. Plan work forms for Heating & Combustion Equipment (PW1C Schedule C)
 - 7. Permits and Inspection Certificates for completion of work.
 - 8. Progress Inspections and Technical Report (TR-8) forms.
- D. Fees, permits, taxes, Controlled Inspections, or certificates required by governing bodies, Board of Fire Underwriters, B.S.A, M.E.A., D.A.R. or other agencies affecting work as specified herein, or required for Certificates of Occupancy, shall be obtained and paid for by this Contractor as part of basic contract.
- E. This Section includes the following:
 - 1. Piping materials and installation instructions common to most piping systems.
 - 2. Transition fittings.
 - 3. Dielectric fittings.
 - 4. Mechanical sleeve seals.
 - 5. Sleeves.
 - 6. Escutcheons.
 - 7. Grout.

8. HVAC demolition.
9. Equipment installation requirements common to equipment sections.
10. Painting and finishing.
11. Concrete bases.
12. Supports and anchorages.

- F. Specifications and Drawings intend to call for finished work, tested, and ready for operation, with new and first-class quality materials, equipment, and apparatus.
- G. Apparatus, appliance, material, incidental accessories, minor details, or work not shown on Drawings, but mentioned in Specifications, or vice versa, necessary to make work complete and perfect in all respects, ready for operation, shall be provided without additional expense to Owner.

1.3 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspace, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- F. The following are industry abbreviations for plastic materials:
1. CPVC: Chlorinated polyvinyl chloride plastic.
- G. The following are industry abbreviations for rubber materials:
1. EPDM: Ethylene-propylene-diene terpolymer rubber.
 2. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

- A. Product Data: For the following:
1. Transition fittings.
 2. Dielectric fittings.

3. Mechanical sleeve seals.
4. Escutcheons.

1.5 QUALITY ASSURANCE

- A. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.
- B. Codes, Regulations, Fees, Permits, Certificates and Standards:
 1. ASME American Society of Mechanical Engineers.
 2. ANSI American National Standards Institute.
 3. ASTM American Society for Testing Materials.
 4. AWWA American Water Works Association.
 5. NEMA National Electrical Manufacturers Association
 6. ASHRAE American Society of Heating, Refrigeration and Air Conditioning Engineers.
 7. SMACNA Sheet Metal and Air Conditioning Contractors National Association, Inc.
 8. ARI Air Conditioning and Refrigeration Institute.
 9. UL Underwriter's Laboratories.
 10. AMCA Air Moving and Conditioning Association.
 11. ADC Air Diffusion Council.
 12. AABC Associated Air Balance Council.
 13. Local Water Company Rules and Regulations.
 14. I.B.R.
 15. ASA Code for Pressure
 16. IEEE Institute of Electrical and Electronic Engineers.
 17. OSHA Occupational Safety and Health Administration.
 18. National Electrical Safety Code.
 19. ICEA Insulated Cable Engineers Association.
 20. Factory Mutual.
 21. FIA Factory Insurance Association.
 22. NECA National Electrical Contractors Association.
 23. New York State Building Code.
 24. New York State Mechanical Code.
 25. New York State Fuel Gas Code.
 26. New York State Energy Conservation Construction Code.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.7 COORDINATION

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for HVAC installations.
- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- C. Coordinate requirements for access panels and doors for HVAC items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

1.8 GUARANTEES

- A. Work performed and materials installed to be free from inherent defects and keep same in repair replace defective material or workmanship, free of cost to owner, for a period of one year from date of acceptance, upon notice from owner's representative.
- B. Equipment installed in connection with this Contract to meet performance requirements set forth by Architect or Engineer.
- C. Non-durable replaceable items such as air filter media are to be replaced within one week of date of acceptance.
- D. Date of acceptance is the date of certificate of occupancy or final payment by Owner whichever is the earlier.
- E. Submit certification attesting that specified performance criteria are met by systems installed.

1.9 CONTROLLED INSPECTIONS

- A. Provide materials and testing, carry out methods of construction subject to testing and inspections as require by "The Building Code of the State of New York", as amended to date under the direct supervision of a Professional Engineer licensed by the State of New York.
- B. Include in contract price costs for such required tests, inspections and filing of forms with Building Department.
- C. Prepare and submit to an approved independent testing laboratory for testing, materials requiring testing as set forth in these specifications or as ordered by Engineer, in addition to that mandated by the Building Codes. Tests shall be made without any additional expense to Owner.
- D. Ascertain that preliminary and final tests to prove satisfactory operation, rotation, switching, grounds, etc., in a manner specified by Owner's Representative and in his presence.

- E. Provide complete technical reports of laboratory test results in acceptable form showing all information necessary to establish quality of performance of work tested, and a statement on whether mixes, tests, etc., conform to specification requirements.
- F. Instruments, equipment, materials, etc., used in conjunction with testing and quality control work as specified herein and in applicable sections of this specification be of a first class quality. Verify that testing products, equipment, etc., are in good operating condition and are within tolerances stated by their manufacturer.
- G. Upon completion of work and prior to final payment, tests as hereinafter specified may be made by Engineer or his representative of materials, mechanical equipment and appliances installed hereunder. Provide labor and materials require for such tests. Should tests show that any of the materials, appliances of workmanship are not first class or not in compliance with specifications, Contractor, on written notice shall remove same and promptly replace with other materials or appliances in conformity with specifications.
- H. Provide necessary instruments and personnel for tests. If in the opinion of Engineer results of such tests show that work has not complied with requirements for specifications, make changes, replacements, modifications or additions necessary to put work in proper working conditions and shall pay for expense of subsequent tests.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.

2.2 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 23 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

- A. Refer to individual Division 23 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
 - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
 - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- E. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- F. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.
- G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- H. Solvent Cements for Joining Plastic Piping:
 1. CPVC Piping: ASTM F 493.
 2. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
- I. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

2.4 TRANSITION FITTINGS

- A. Plastic-to-Metal Transition Fittings: CPVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
 1. Available Manufacturers:
 - a. Esdon Thermoplastics.
- B. Plastic-to-Metal Transition Adaptors: One-piece fitting with manufacturer's SDR 11 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
 1. Available Manufacturers:
 - a. Thompson Plastics, Inc.
- C. Plastic-to-Metal Transition Unions: MSS SP-107, CPVC four-part union. Include brass end, solvent-cement-joint end, rubber O-ring, and union nut.

1. Available Manufacturers:
 - a. NIBCO INC.
 - b. NIBCO, Inc.; Chemtrol Div.

2.5 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.

1. Available Manufacturers:
 - a. Hart Industries, International, Inc.
 - b. Watts Industries, Inc.; Water Products Div.
 - c. Zurn Industries, Inc.; Wilkins Div.

- D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.

1. Available Manufacturers:
 - a. Watts Industries, Inc.; Water Products Div.

- E. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.

1. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig minimum working pressure where required to suit system pressures.

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

1. Available Manufacturers:
 - a. Calpico, Inc.
 - b. Lochinvar Corp.

- G. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.

1. Available Manufacturers:
 - a. Sioux Chief Manufacturing Co., Inc.
 - b. Victaulic Co. of America.

2.6 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
 - 1. Available Manufacturers:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Metraflex Co.
 - d. Pipeline Seal and Insulator, Inc.
 - 2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - 3. Pressure Plates: Stainless steel. Include two for each sealing element.
 - 4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.7 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 - 1. Underdeck Clamp: Clamping ring with set screws.

2.8 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Cast-Brass Type: With set screw.
 - 1. Finish: Polished chrome-plated.
- D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
 - 1. Finish: Polished chrome-plated.

- E. One-Piece, Stamped-Steel Type: With set screw or spring clips and chrome-plated finish.
- F. Split-Plate, Stamped-Steel Type: With concealed hinge, set screw or spring clips, and chrome-plated finish.
- G. One-Piece, Floor-Plate Type: Cast-iron floor plate.
- H. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

2.9 GROUT

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
 - 1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.
 - 3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 HVAC DEMOLITION

- A. Refer to Division 01 Section "Cutting and Patching" and Division 02 Section "Selective Structure Demolition" for general demolition requirements and procedures.
- B. Disconnect, demolish, and remove HVAC systems, equipment, and components indicated to be removed.
 - 1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 - 2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
 - 3. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
 - 4. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.
 - 5. Equipment to Be Removed: Disconnect and cap services and remove equipment.
 - 6. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
 - 7. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
- C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.2 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 23 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.
- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
 - 1. New Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
 - b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
 - c. Insulated Piping: One-piece, stamped-steel type with spring clips.
 - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
 - e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece or split-casting, cast-brass type with polished chrome-plated finish.
 - f. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type with concealed or exposed-rivet hinge and set screw or spring clips.
 - g. Bare Piping in Equipment Rooms: One-piece, stamped-steel type with set screw or spring clips.
 - h. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.

- M. Sleeves are not required for core-drilled holes.
- N. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.
1. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
 2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
 3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
 - a. Steel Pipe Sleeves: For pipes smaller than NPS 6 (DN 150).
 - b. Steel Sheet Sleeves: For pipes NPS 6 (DN 150) and larger, penetrating gypsum-board partitions.
 - c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches (50 mm) above finished floor level. Refer to Division 07 Section "Sheet Metal Flashing and Trim" for flashing.
 - 1) Seal space outside of sleeve fittings with grout.
 4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.
- O. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
1. Install steel pipe for sleeves smaller than 6 inches in diameter.
 2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
 3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- P. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

- Q. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.
- R. Verify final equipment locations for roughing-in.
- S. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.3 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.4 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
 - 1. Install unions, in piping 2-inch and smaller, adjacent to each valve and at final connection to each piece of equipment.

2. Install flanges, in piping 2-1/2-inch and larger, adjacent to flanged valves and at final connection to each piece of equipment.
3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.5 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install HVAC equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

3.6 PAINTING

- A. Painting of HVAC systems, equipment, and components is specified in Division 09 Sections "Interior Painting" and "Exterior Painting."
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.7 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
 1. Construct concrete bases of dimensions indicated, but not less than 6 inches larger in both directions than supported unit.
 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
 3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
 4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 5. Install anchor bolts to elevations required for proper attachment to supported equipment.
 6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
 7. Use 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section "Miscellaneous Cast-in-Place Concrete."

3.8 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 05 Section "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

3.9 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor HVAC materials and equipment.
- B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.
- C. Attach to substrates as required to support applied loads.

3.10 GROUTING

- A. Mix and install grout for HVAC equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

END OF SECTION 230500

SECTION 230513 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.3 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
 - 1. Motor controllers.
 - 2. Torque, speed, and horsepower requirements of the load.
 - 3. Ratings and characteristics of supply circuit and required control sequence.
 - 4. Ambient and environmental conditions of installation location.

1.4 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of motors and motor controls of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Codes and Standards:
 - 1. UL Compliance: Construct motors and motor controls in compliance with UL Standards. All electrical components shall be UL listed or labeled.
 - 2. NEMA: All electrical devices shall conform to NEMA standards. Motors shall conform to NEMA standards for premium efficiency.
 - 3. NEC: All wiring shall conform to the NEC.
 - 4. CEE: All motors shall conform to CEE (Consortium for Energy Efficiency) specifications for premium efficiency.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Handle motors and controls carefully to prevent damage, breaking, denting and scoring. Do not install damaged units or components; replace with new.
- B. Store motor controls units in clean dry place. Protect from weather, dirt, fumes, water, construction debris and physical damage.
- C. Comply with manufacturer's installation instructions.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

- A. Comply with requirements in this Section except when stricter requirements are specified in HVAC equipment schedules or Sections.
- B. Comply with NEMA MG 1 unless otherwise indicated.
- C. Each motor shall have capacity to start and operate machine it drives without exceeding motor nameplates rating at the speed specified or at any speed and load which may be obtained by drive provided.
- D. Each motor that is provided with automatic control shall be capable of making as frequent starts as control device demands without damage and without exceeding the maximum permissible hot spot temperature. Motors not provided with automatic control shall be capable of making not less than 4 starts per hour without damage and without exceeding the maximum permissible hot spot temperature.
- E. All belt-connected motors shall be equipped with shafts and bearings that will withstand both the belt pull of drive furnished and momentary or continuous overloads due to acceleration or incorrect belt tension.
- F. All motors 1 HP and larger shall be NEMA premium efficiency.

2.2 MOTOR CHARACTERISTICS

- A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.
- B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.
- C. Enclosure for motors shall be as follows:
 - 1. Dry, indoor locations, open drip proof.

2. Outdoor, 1/2 through 20 horsepower - totally enclosed.

2.3 POLYPHASE MOTORS

- A. Description: NEMA MG 1, Design B, medium induction motor.
- B. Efficiency: Premium Energy efficient, as defined in NEMA MG 1.
- C. Multispeed Motors: Variable torque.
 1. For motors with other than 2:1 speed ratio, separate winding for each speed.
- D. Multispeed Motors: Separate winding for each speed.
- E. Rotor: Random-wound, squirrel cage.
- F. Temperature Rise: Match insulation rating.
- G. Insulation: Class F.
- H. Code Letter Designation:
 1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
 2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.

2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

- A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.
- B. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
 1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
 2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
 3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
 4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

2.5 SINGLE-PHASE MOTORS

- A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:

1. Permanent-split capacitor.
 2. Split phase.
 3. Capacitor start, inductor run.
 4. Capacitor start, capacitor run.
- B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
- C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
- D. Motors 1/20 HP and Smaller: Shaded-pole type.
- E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 230513

SECTION 230548 - VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Isolation pads.
 - 2. Isolation mounts.
 - 3. Restrained elastomeric isolation mounts.
 - 4. Freestanding and restrained spring isolators.
 - 5. Housed spring mounts.
 - 6. Elastomeric hangers.
 - 7. Spring hangers.
 - 8. Spring hangers with vertical-limit stops.
 - 9. Pipe riser resilient supports.
 - 10. Resilient pipe guides.
 - 11. Restrained vibration isolation roof-curb rails.
 - 12. Seismic snubbers.
 - 13. Restraining braces and cables.
 - 14. Steel and inertia, vibration isolation equipment bases.

1.3 DEFINITIONS

- A. IBC: International Building Code.
- B. ICC-ES: ICC-Evaluation Service.
- C. OSHPD: Office of Statewide Health Planning and Development for the State of California.
- D. Life Safety Systems:
 - 1. All systems involved with fire protection including sprinkler piping, fire pumps, jockey pumps, fire pump control panels, service water supply piping, water tanks, fire dampers and smoke exhaust systems.
 - 2. All systems involved with and/or connected to emergency power supply transformers and all flow paths to fire protection and/or emergency lighting systems.

3. Fresh air relief systems on emergency control sequence including air handlers, conduit, duct, dampers, etc.

E. Positive Attachment:

1. A positive attachment is defined as a cast-in anchor, a drill-in wedge anchor, a double-sided beam clamp loaded perpendicular to a beam, or a welded or bolted connection to structure. Single sided "C" type beam clamps for support rods of overhead piping, ductwork, fire protection, electrical conduit, bus duct, or cable trays, or any other equipment are not acceptable on this project as seismic anchor points.

F. Transverse Bracing:

1. Restraint(s) applied to limit motion perpendicular to the centerline of the pipe, duct or conduit.

G. Longitudinal Bracing:

1. Restraint(s) applied to limit motion parallel to the centerline of the pipe, duct or conduit.

1.4 GENERAL

A. Seismic Bracing - Applies to all trades as applicable (to withstand 6 forces in shear).

1. The following life safety items shall be seismically braced in accordance with the New York State Code requirements. (This specification applies only to items as furnished for this project)
2. Fire standpipe system piping throughout.
3. Constant pressure pumps (which fill fire reserve tanks) or fire reserve tank fill pumps solidly anchored to base and with seismic vibration isolation to concrete pad.
4. Tank fill line seismically braced. (From pump to roof tank)
5. Fire water service all piping seismically braced & anchored.
6. Entire sprinkler system seismically braced in accordance with NFPA13, Section 4-14.4.3
7. Roof House tank (and/or suction tank for fire reserve) anchored and internally braced.
8. Emergency lighting fixtures - seismically braced or anchored
9. All fire alarm equipment - solid anchored
10. All emergency conduit and systems.
11. All seismic mounts and bracing shall be in accordance with VMC or Mason East standards or approved equal.
12. All other life safety equipment - seismically braced and/or anchored.
13. Electric feeders to tank fill pump - embedded or seismically braced.
14. Roof tank controls - Seismically braced.

B. Intent

1. This work applies to but not limited to Electrical, HVAC, Plumbing and Sprinkler Contractors as applicable.
2. All mechanical equipment, piping and ductwork as noted on the equipment schedule or in the specification shall be mounted on vibration isolators to prevent the transmission of

vibration and mechanically transmitted sound to the building structure. Vibration isolators shall be selected in accordance with the weight distribution so as to produce reasonably uniform deflections. This applies only to life safety equipment and hazardous systems (gas systems)

3. All isolators and isolation materials shall be of the same manufacturer and shall be certified by the manufacturer.
 4. It is the intent of the seismic portion of this specification to keep all mechanical and electrical building system components in place during a seismic event.
 5. All such systems must be installed in strict accordance with seismic codes.
 6. Component manufacturer's and building construction standards. Whenever a conflict occurs between the manufacturers or construction standards, the most stringent shall apply.
 7. This specification is considered to be minimum requirements for seismic consideration and is not intended as a substitute for legislated, more stringent, national, state or local construction requirements.
 8. Any variance or non-compliance with these specification requirements shall be corrected by the contractor in an approved manner.
 9. Seismic restraints shall be designed in accordance with seismic force levels as detailed in this section.
- C. The work in this section applies only to "Life Safety Systems" and includes, but is not limited to the following:
1. Vibration isolation for piping, ductwork and equipment.
 2. Equipment isolation bases.
 3. Flexible piping connections.
 4. Seismic restraints for isolated equipment.
 5. Seismic restraints for non-isolated equipment.
 6. Certification of seismic restraint designs and installation supervision.
 7. Certification of seismic attachment of housekeeping pads.
- D. All mechanical and electrical systems defined as life safety systems Equipment buried underground is included but entry of services through the foundation wall is included. Equipment referred to below is typical. (Equipment not listed is still included in this specification action).
1. Boilers
 2. Conduit
 3. Electrical Panels Fans
 4. Emergency Light Fixtures
 5. Gas Piping (all)
 6. Pumps
 7. Piping
 8. Electric Power Switching
 9. Water Heaters, Fans, Tanks (all types),
 10. Low Voltage Control, Equipment and Panels.
 11. Gas Piping (all)
 12. Pumps related to Fire Standpipe, Sprinkler and Gas Systems
 13. Low Voltage Controls
 14. Fire Pump

15. Fans (all types)

E. Housekeeping Pads

1. Housekeeping pad reinforcement and monolithic pad attachment to the structure details and design shall be prepared by the restraint vendor if not already indicated on the drawings.
2. Housekeeping pads shall be coordinated with restraint vendor and sized to provide a minimum edge distance of ten (10) bolt diameters all around the outermost anchor bolt to allow development of full drill-in wedge anchor ratings. If cast-in anchors are to be used, the housekeeping pads shall be sized to accommodate the ACI requirements for bolt plate coverage and embedment. B. Supplementary Support Steel 1. Contractor shall supply supplementary support steel for all equipment, piping, ductwork, etc. including roof-mounted equipment, as required or specified. C. Attachments 1. Contractor shall supply restraint attachment plates cast into housekeeping pads, concrete inserts, double-sided beam clamps, etc. in accordance with the requirements of the vibration vendor's calculations.

1.5 PERFORMANCE REQUIREMENTS

A. Wind-Restraint Loading:

1. Basic Wind Speed: 105mph.
2. Wind exposure category: B.
3. Minimum 10 lb/sq. ft. multiplied by the maximum area of the HVAC component projected on a vertical plane that is normal to the wind direction, and 45 degrees either side of normal.
4. Occupancy Category: II

B. Seismic-Restraint Loading:

1. Site Class as Defined in the New York State Building Code: B.
2. Assigned Seismic Use Group or Building Category as Defined in the New York State Building Code: I.
 - a. Component Importance Factor: 1.0.

1.6 SUBMITTALS

A. Product Data: For the following:

1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.

- a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an agency acceptable to authorities having jurisdiction.
 - b. Annotate to indicate application of each product submitted and compliance with requirements.
 3. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.
- B. Delegated-Design Submittal: For vibration isolation and seismic-restraint details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
1. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, seismic and wind forces required to select vibration isolators, seismic and wind] restraints, and for designing vibration isolation bases.
 - a. Coordinate design calculations with wind load calculations required for equipment mounted outdoors. Comply with requirements in other Division 22 Sections for equipment mounted outdoors.
 2. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes, and seismic loads. Include certification that riser system has been examined for excessive stress and that none will exist.
 3. Vibration Isolation Base Details: Detail overall dimensions, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, base weights, equipment static loads, power transmission, component misalignment, and cantilever loads.
 4. Seismic and Wind-Restraint Details:
 - a. Design Analysis: To support selection and arrangement of seismic and wind restraints. Include calculations of combined tensile and shear loads.
 - b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
 - c. Coordinate seismic-restraint and vibration isolation details with wind-restraint details required for equipment mounted outdoors. Comply with requirements in other Division 22 Sections for equipment mounted outdoors.
 - d. Preapproval and Evaluation Documentation: By an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).
- C. Qualification Data: For professional engineer and testing agency.
- D. Air-Mounting System Performance Certification: Include natural frequency, load, and damping test data performed by an independent agency.

- E. Field quality-control test reports.
- F. Operation and Maintenance Data: For air-mounting systems to include in operation and maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
- B. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.
- C. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.
- D. Codes and Standards
 - 1. New York State LLI7/95 2.UBC Section 2312-1990
 - 2. New York State Building Code

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATORS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Ace Mountings Co., Inc.
 - 2. Amber/Booth Company, Inc.
 - 3. California Dynamics Corporation.
 - 4. Isolation Technology, Inc.
 - 5. Kinetics Noise Control.
 - 6. Mason Industries.
 - 7. Vibration Eliminator Co., Inc.
 - 8. Vibration Isolation.
 - 9. Vibration Mountings & Controls, Inc.
- B. Pads: Arranged in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment.

1. Resilient Material: Oil- and water-resistant neoprene.
- C. Mounts: Double-deflection type, with molded, oil-resistant rubber, hermetically sealed compressed fiberglass, or neoprene isolator elements with factory-drilled, encapsulated top plate for bolting to equipment and with baseplate for bolting to structure. Color-code or otherwise identify to indicate capacity range.
1. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
 2. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.
- D. Restrained Mounts: All-directional mountings with seismic restraint.
1. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
 2. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.
- E. Spring Isolators: Freestanding, laterally stable, open-spring isolators.
1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 5. Baseplates: Factory drilled for bolting to structure and bonded to 1/4-inch- thick, rubber isolator pad attached to baseplate underside. Baseplates shall limit floor load to 500 psig.
 6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.
 7. Mason type SLF, or as approved.
- F. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic or limit-stop restraint.
1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to weight being removed; factory-drilled baseplate bonded to 1/4-inch- thick, neoprene or rubber isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.
 2. Restraint: Seismic or limit stop as required for equipment and authorities having jurisdiction.
 3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

7. Mason type SLR, or as approved.
- G. Housed Spring Mounts: Housed spring isolator with integral seismic snubbers.
1. Housing: Ductile-iron or steel housing to provide all-directional seismic restraint.
 2. Base: Factory drilled for bolting to structure.
 3. Snubbers: Vertically adjustable to allow a maximum of 1/4-inch travel up or down before contacting a resilient collar.
- H. Elastomeric Hangers: Double-deflection type, fitted with molded, oil-resistant elastomeric isolator elements bonded to steel housings with threaded connections for hanger rods. Color-code or otherwise identify to indicate capacity range. Mason type HD, or as approved.
- I. Spring Hangers: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression.
1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
 2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 6. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
 7. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.
- J. Spring Hangers with Vertical-Limit Stop: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression and with a vertical-limit stop.
1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
 2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
 7. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
 8. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.
 9. Mason type 30N, or as approved.

- K. Pipe Riser Resilient Support: All-directional, acoustical pipe anchor consisting of 2 steel tubes separated by a minimum of 1/2-inch- thick neoprene. Include steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions. Design support for a maximum load on the isolation material of 500 psig and for equal resistance in all directions. Mason type ADA, or as approved.
- L. Resilient Pipe Guides: Telescopic arrangement of 2 steel tubes or post and sleeve arrangement separated by a minimum of 1/2-inch- thick neoprene. Where clearances are not readily visible, a factory-set guide height with a shear pin to allow vertical motion due to pipe expansion and contraction shall be fitted. Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

2.2 RESTRAINED VIBRATION ISOLATION ROOF-CURB RAILS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Amber/Booth Company, Inc.
 - 2. California Dynamics Corporation.
 - 3. Isolation Technology, Inc.
 - 4. Kinetics Noise Control.
 - 5. Mason Industries.
 - 6. Thybar Corporation.
 - 7. Vibration Eliminator Co., Inc.
 - 8. Vibration Isolation.
 - 9. Vibration Mountings & Controls, Inc.
- B. General Requirements for Restrained Vibration Isolation Roof-Curb Rails: Factory-assembled, fully enclosed, insulated, air- and watertight curb rail designed to resiliently support equipment and to withstand seismic and wind forces. There shall be Mason type RSC, or as approved.
- C. Lower Support Assembly: Formed sheet-metal section containing adjustable and removable steel springs that support upper frame. Upper frame shall provide continuous support for equipment and shall be captive to resiliently resist seismic and wind forces. Lower support assembly shall have a means for attaching to building structure and a wood nailer for attaching roof materials, and shall be insulated with a minimum of 2 inches of rigid, glass-fiber insulation on inside of assembly.
- D. Spring Isolators: Adjustable, restrained spring isolators shall be mounted on 1/4-inch- thick, elastomeric vibration isolation pads and shall have access ports, for level adjustment, with removable waterproof covers at all isolator locations. Isolators shall be located so they are accessible for adjustment at any time during the life of the installation without interfering with the integrity of the roof.
 - 1. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic restraint.
 - a. Housing: Steel with resilient vertical-limit stops and adjustable equipment mounting and leveling bolt.

- b. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 - c. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 - d. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 - e. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
- 2. Pads: Arranged in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment.
 - a. Resilient Material: Oil- and water-resistant standard neoprene.
- E. Snubber Bushings: All-directional, elastomeric snubber bushings at least 1/4 inch thick.
- F. Water Seal: Galvanized sheet metal with EPDM seals at corners, attached to upper support frame, extending down past wood nailer of lower support assembly, and counterflashed over roof materials.
- G. Curbs shall be mason RSC or as approved equal.

2.3 VIBRATION ISOLATION EQUIPMENT BASES

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Amber/Booth Company, Inc.
 - 2. California Dynamics Corporation.
 - 3. Isolation Technology, Inc.
 - 4. Kinetics Noise Control.
 - 5. Mason Industries.
 - 6. Vibration Eliminator Co., Inc.
 - 7. Vibration Isolation.
 - 8. Vibration Mountings & Controls, Inc.
- B. Steel Base : Factory-fabricated, welded, structural-steel bases and rails.
 - 1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.
 - a. Include supports for suction and discharge elbows for pumps.
 - 2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
 - 3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
 - 4. Mason type M,WF or as approved.

- C. Inertia Base: Factory-fabricated, welded, structural-steel bases and rails ready for placement of cast-in-place concrete.
1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.
 - a. Include supports for suction and discharge elbows for pumps.
 2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
 3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
 4. Fabrication: Fabricate steel templates to hold equipment anchor-bolt sleeves and anchors in place during placement of concrete. Obtain anchor-bolt templates from supported equipment manufacturer.
 5. Minimum thickness of concrete base shall be according to the following tabulation:

Motor Size (HP)	Min Thickness (in)
5 – 16	6
20 – 50	8
60 – 75	10
100 – 250	12

6. Mason type K, BMK or as approved.

2.4 SEISMIC-RESTRAINT DEVICES

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Amber/Booth Company, Inc.
 2. California Dynamics Corporation.
 3. Cooper B-Line, Inc.; a division of Cooper Industries.
 4. Hilti, Inc.
 5. Kinetics Noise Control.
 6. Loos & Co.; Cableware Division.
 7. Mason Industries.
 8. TOLCO Incorporated; a brand of NIBCO INC.
 9. Unistrut; Tyco International, Ltd.
- B. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an agency acceptable to authorities having jurisdiction.
1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.

- C. Snubbers: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.
 - 1. Anchor bolts for attaching to concrete shall be seismic-rated, drill-in, and stud-wedge or female-wedge type.
 - 2. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.
 - 3. Maximum 1/4-inch air gap, and minimum 1/4-inch- thick resilient cushion.
- D. Channel Support System: MFMA-3, shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; and rated in tension, compression, and torsion forces.
- E. Restraint Cables: ASTM A 603 galvanized-steel cables with end connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; and with a minimum of two clamping bolts for cable engagement.
- F. Hanger Rod Stiffener: Reinforcing steel angle clamped to hanger rod.
- G. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.
- H. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices used.
- I. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.
- J. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter.
- K. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

2.5 FACTORY FINISHES

- A. Finish: Manufacturer's standard prime-coat finish ready for field painting.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation and seismic and wind control devices for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 GENERAL

- A. All vibration isolators and seismic restraint systems must be installed in strict accordance with the manufacturers written instructions and all certified submittal data.
- B. Installation of vibration isolators and seismic restraints must not cause any change of position of equipment, piping or ductwork resulting in stresses or misalignment.
- C. No rigid connections between equipment and the building structure shall be made that degrades the noise and vibration control system herein specified.
- D. The contractor shall not install any equipment, piping, duct or conduit, which makes rigid connections with the building unless isolation is not specified. "Building" includes, but is not limited to slabs, beams, columns, studs and walls.
- E. Coordinate work with other trades to avoid rigid contact with the building.
- F. Any conflicts with other trades which will result in rigid contact with equipment or piping due to inadequate space or other unforeseen conditions should be brought to the architects/engineers attention prior to installation. Corrective work necessitated by conflicts after installation shall be at the responsible contractors expense.
- G. Bring to the architects/engineers attention any discrepancies between the specifications and the field conditions or changes required due to specific equipment selection, prior to installation. Corrective work necessitated by discrepancies after installation shall be at the responsible contractors expense.
- H. Correct, at no additional cost, all installations which are deemed defective in workmanship and materials at the contractors expense.
- I. Overstressing of the building structure must not occur because of overhead support of equipment. Contractor must submit loads to the structural engineer of record for approval. Generally bracing may occur from:
 - 1. Flanges of structural beams.

2. Upper truss cords in bar joist construction.
 3. Cast in place inserts or wedge type drill-in concrete anchors.
- J. Specification 12 cable restraints shall be installed slightly slack to avoid short circuiting the isolated suspended equipment, piping or conduit.
- K. Specification 12 cable assemblies are installed taut on non-isolated systems. Specification 13 seismic solid braces may be used in place of cables on rigidly attached systems only.
- L. At locations where specification 12 or I3 restraints are located, the support rods must be braced when necessary to accept compressive loads with specification 14 braces.
- M. At all locations where specification 12 or 13 restraints are attached to pipe clevises, the clevis cross bolt must be reinforced with specification type 15 braces.
- N. Drill-in concrete anchors for ceiling and wall installation shall be specification type 18, and specification type 19 female wedge type for floor mounted equipment.
- O. Vibration isolation manufacturer shall furnish integral structural steel bases as required. Independent steel rails are not permitted on this project.
- P. Hand built elastomeric expansion joints may be used when pipe sizes exceed 24" or specified movements exceed specification 23 capabilities.
- Q. Where piping passes through walls, floors or ceilings the vibration isolation manufacturer shall provide specification 27 wall seals.
- R. Air handling equipment and centrifugal fans shall be protected against excessive displacement which results from high air thrust in relation to the equipment weight. Horizontal thrust restraint shall be specification type 28 (see section guide).
- S. Locate isolation hangers as near to the overhead support structure as possible.

3.3 APPLICATIONS

- A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.
- B. Hanger Rod Stiffeners: Install hanger rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.
- C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.4 VIBRATION-CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

- A. Comply with requirements in Division 07 Section "Roof Accessories" for installation of roof curbs, equipment supports, and roof penetrations.
- B. Equipment Restraints:
 - 1. Install seismic snubbers on HVAC equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.
 - 2. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
 - 3. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.
- C. Piping Restraints:
 - 1. Comply with requirements in MSS SP-127.
 - 2. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
 - 3. Brace a change of direction longer than 12 feet.
- D. Install cables so they do not bend across edges of adjacent equipment or building structure.
- E. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.
- F. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.
- G. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.
- H. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.
- I. Drilled-in Anchors:
 - 1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
 - 2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
 - 3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
 - 4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole

and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.

5. Set anchors to manufacturer's recommended torque, using a torque wrench.
6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.5 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

- A. Install flexible connections in piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment. Comply with requirements in Division 22 Section "Hydronic Piping" for piping flexible connections.

3.6 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
 2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
 3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
 4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
 5. Test to 90 percent of rated proof load of device.
 6. Measure isolator restraint clearance.
 7. Measure isolator deflection.
 8. Verify snubber minimum clearances.
 9. If a device fails test, modify all installations of same type and retest until satisfactory results are achieved.
- C. Remove and replace malfunctioning units and retest as specified above.
- D. Prepare test and inspection reports.

3.7 ADJUSTING

- A. Adjust isolators after piping system is at operating weight.
- B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

- C. Adjust active height of spring isolators.
- D. Adjust restraints to permit free movement of equipment within normal mode of operation.

3.8 VIBRATION CONTROL OF PIPING

A. Installation

1. All piping 2" and over located in mechanical equipment rooms, and for a minimum of fifty (50) feet or 100 pipe diameters, whichever is greater, from connection to vibrating mechanical or electrical equipment, shall be isolated from the building structure by means of noise and vibration isolation hangers, Type 30 N as described in section 2.1J, with a minimum static deflection of 1 inch.
2. Horizontal suspended pipe 2' and smaller and all steam piping shall be suspended by Type HD isolators as described in section 2.1 H with a minimum 3/8" deflection. Water pipe larger than 2" (50 mm) shall be supported by Type 30N isolators (section 2.1 J) with a minimum 1.5", or the same static deflection as isolated equipment to which pipe connects, whichever is greater.
3. Horizontal pipe floor supported at slab shall be supported via Type SLR (section 2.1 F), with a minimum static deflection of 1", or the same static deflection as isolated equipment to which pipe connects, whichever is the greater.
4. Pipe anchors, where required, shall utilize resilient pipe anchors, Mason Industries Type ADA (section 2.1 K), or equivalent, to avoid direct contact of piping with the building.

B. Domestic Water

1. Support all domestic water piping in horizontal and vertical runs with a resilient wrapping or clamp system employing a resilient element of wool, felt, neoprene, or other suitable material; "Trisolators" by Semco or P.R. Isolators by Potter-Roemer, or as approved.
2. All domestic water piping, size 2" and larger within the building shall be isolated as follows:
 - a. Provide Type 30N hanger rod isolators (section 2.1 J) with a minimum static deflection of 1.5" or as scheduled.
 - b. Provide Type SLR isolators (section 2.1 F) with 1" static deflection, or as scheduled.
 - c. Support water piping in shafts and floor supports entering shaft with Type ADA isolators (section 2.1 K) to prevent direct contact of piping with building structure.

C. Seismic Restraint of Piping

1. Seismically restrain all piping listed as a. b or c below. Use specification 12 cables if isolated. Specification 12 or 13 restraints may be used on unisolated piping.
 - a. Gas piping that is 1" I.D. or larger.
 - b. Piping located in boiler rooms, mechanical equipment rooms, and refrigeration equipment rooms that is 1-1/4" I.D. and larger.
 - c. All other piping 2-1/2" diameter and larger.
2. Transverse piping restraints shall be at 40' maximum spacing for all pipe sizes, except where lesser spacing is required to limit anchorage loads.
3. Longitudinal restraints shall be at 80' maximum spacing for all pipe sizes, except where lesser spacing as required to limit anchorage loads.
4. Where thermal expansion is a consideration, guides and anchors may be used as transverse and longitudinal restraints provided they have a capacity equal to or greater than the restraint loads in addition to the loads induced by expansion or contraction.
5. For fuel oil and all gas piping transverse restraints must be at 20' maximum and longitudinal restraints at 40' maximum spacing.
6. Transverse restraint for one pipe section may also act as a longitudinal restraint for a pipe section of the same size connected perpendicular to it if the restraint is installed within 24" of the elbow or TEE or combined stresses are within allowable limits at longer distances.
7. Hold down clamps must be used to attach pipe to all trapeze members before applying restraints in a manner similar to clevis supports.
8. Branch lines may not be used to restrain main lines.
9. Cast iron pipe of all types, glass pipe and any other pipes joined with a four band shield and clamp assembly in Zones 2B, 3 and 4 shall be braced as in sections 3.02.C.2 and 3. For Zones 0, 1 and 2A, 2 band clamps may be used with reduced spacings of 1/2 of those listed in sections 3.7.C.2 and 3.

D. Vibration Isolation of Ductwork

10. All discharge runs for a distance of 50' from the connected equipment shall be isolated from the building structure by means of specification 10 hangers or specification 5 floor isolators. Spring deflection shall be a minimum of 0.75".
11. All duct runs having air velocity of 1000 fpm or more shall be isolated from the building structure by specification 11 hangers or 5 floor supports. Spring deflection shall be a minimum of 0.75".

E. Seismic Restraint of Ductwork

12. Seismically restrain all ductwork with specification 12 or 13 restraints as listed below:
 - a. Restrain rectangular ducts with cross sectional area of 6 sq.ft or larger.
 - b. Restrain round ducts with diameters of 28" or larger.
 - c. Restrain flat oval ducts the same as rectangular ducts of the same nominal size.
13. Transverse restraints shall occur at 30' intervals or at both ends of the duct run if less than the specified interval. Transverse restraints shall be installed at each duct turn and at each end of a duct run.
14. Longitudinal restraints shall occur at 60' intervals with at least one restraint per duct run. Transverse restraints for one duct section may also act as a longitudinal restraint for a duct section connected perpendicular to it if the restraints are installed within 4' of the intersection of the ducts and if the restraints are sized for the larger duct. Duct joints shall conform to SMACNA duct construction standards.

15. The ductwork must be reinforced at the restraint locations. Reinforcement shall consist of an additional angle on top of the ductwork that is attached to the support hanger rods. Ductwork is to be attached to both upper angle and lower trapeze.
16. A group of ducts may be combined in a larger frame so that the combined weights and dimensions of the ducts are less than or equal to the maximum weight and dimensions of the duct for which bracing details are selected.
17. Walls, including gypsum board non-bearing partitions, which have ducts running through them, may replace a typical transverse brace. Provide channel framing around ducts and solid blocking between the duct and frame.

F. Seismic Restraint of Electrical Services

18. All electrical conduit 2-1/2" in diameter and larger shall be restrained with specification type 12 seismic cable restraints or specification type 13 for seismic solid brace restraints.
19. All electrical bus ducts, cable trays and ladder trays shall be restrained with specification type 12, seismic cable restraints or specification 13 seismic solid brace restraints.
20. Transverse restraints shall occur at 30' intervals or both ends if the electrical run is less than the specified interval. Transverse restraints shall be installed at each electrical services turn and at each end of the electric run.
21. Longitudinal restraints shall occur at 60' intervals with at least one restraint per electric run. Transverse restraints for one electric section may also act as a longitudinal restraint for a duct for an electric section connected perpendicular to it if the restraints are installed within 4' of the intersection of the electric run and if the restraints are sized for the larger electric run.
22. All rigid floor mounted equipment must have a resilient media between the equipment mounting hole and the anchor bolt. Anchor bolts shall be designed in accordance with section 1.06 seismic forces. Neoprene bushings shall be specification type 4 and anchor bolts shall be specification type 18 or 19.
23. Wall mounted panels shall be mounted with specification type 3 bushings. Floor mounted panels shall be mounted on specification type 4 bushings. Anchor bolts shall be specification type 18 or 19.

G. All fire protection piping shall be braced in accordance with NFPA 13 and 1=1

H. All mechanical equipment shall be vibration isolated (Ted and seismically restrained as per the schedules in part 4 of this specification.

I. All fire protection equipment is considered life safety equipment and shall be seismically restrained using the seismic force levels for life safety equipment in table 1.06-1.if higher levels is shown.

3.9 SEISMIC RESTRAINT EXCLUSIONS

A. Piping

1. Gas piping less than 1 " inside diameter.
2. Piping in boiler and mechanical rooms less than 1 1/4" inside diameter.
3. All other piping less than 2 1/2" inside diameter.

4. All piping suspended by individual hangers 12" or less as measured from the top of the pipe to the bottom of the support where the hanger is attached. However, if the 12" limit is exceeded by any hanger in the run, seismic bracing is required for the run. The 12" exemption applies for trapeze-supported systems if the top of each item supported by the trapeze qualifies.

B. Duct work

1. Rectangular and square and ducts that are less than 6 square feet in cross sectional area.
2. Oval ducts that are less than 6 square feet in cross sectional area based on nominal size.
3. Round duct less than 28" in diameter.
4. All duct suspended by hangers 12" or less in length as measured from the top of the duct to the point of attachment to the structure. Hangers must be attached within 2" of the top of the duct with a minimum of two # 10 sheet metal screws. If the 12" limit is exceeded by any hanger in the run, seismic bracing is required for the run.

C. Electrical

1. All conduit less than 2-1/2" diameter suspended by individual hanger rods.
2. All conduits suspended by individual hangers 12" or less as measured from the top of the conduit to the bottom of the support where the hanger is attached. However, if the 12" limit is exceeded by any hanger in the run, seismic bracing is required for the run. The 12" exemption applies for trapeze-supported systems if the top of each item supported by the trapeze qualifies.

D. Suspended equipment

1. VAV boxes and fan powered equipment weighing less than 50 pounds and rigidly connected to the supply side of the duct system and supported with a minimum of 4 hanger rods.

3.10 VIBRATION CONTROL SCHEDULE

A. Installation

1. At each equipment location, provide the required deflection under the imposed load and produce uniform loading and deflection even when equipment weight is not evenly distributed. Jack bases into position and wedge in place before spring loading; leveling bolts shall not be used as jacking screws. After equipment is in place and springs are loaded through leveling bolts, remove wedges and jacks. Isolators shall be suitable for the lowest operating speed of the equipment.
2. Where the floor is waterproofed or finished with waterproof cement, install vibration isolation in such manner that the waterproofing is not damaged.
3. Isolation equipment shall be in accordance with the following table unless noted otherwise in these specifications:

Lowest RPM	Min. Deflection (in.)	Efficiency %	Type
1750 & Over	.25	95	Single Neoprene in-shear

1200-1749	.50	95	Double Neoprene in-shear
1100-1199	.75	95	Spring
570-999	1.25	90-95	Spring
330-519	1.5	80-90	Spring
Up to 329	3.5	80	Spring

4. Install combination spring and double deflection neoprene position hangers on the suction and discharge piping at each circulating pump in the hot and/or chilled water system. Each hanger shall be located on the pump side of the flexible hose connection.
5. Provide vibration isolation supports for HVAC equipment as indicated in this schedule:

Vibration Isolation			
Equipment Type	Base Type (Spec Section)	Isolator Type (Spec Section)	Static Deflection (Inches)
Rooftop mounted Fans	2.3 B	2.1 F	1.0
Ceiling Suspended Split System Evaporator Units/Condenser Units/Fans	--	2.1 J	1.0
Outdoor Split System Condensing Units	--	2.1 F	1.0
Inline Pumps	--	2.1 J	1.0
Pumps	2.3 C	2.1 E	1.0
Roof Mounted Air Handling Unit		2.2	1.0
Cogenerator	2.3 B	2.1 F	2.0
Heat Exchangers/PRV Stations	2.3 B	2.1 F	1.0
Piping, see spec section 3.8			
Generator/Cogen	2.3B	2.1F	2.0

6. Boilers Slab on Grade
 - a. The boiler shall be bolted directly to the building structure or can be installed with seismically installed neoprene pads or spring isolation systems.
 - b. Piping to be seismically braced to the building structure. Isolation hangers shall be installed in addition to the bracing to attenuate structure borne energy.
7. Slab above Grade
 - a. Seismically rated spring mounts equivalent to mason type SSLR with a minimum static deflection of 1" are required, no matter if the residence are located above or below the boilers.
 - b. Piping to be seismically braced to the building structure. Isolation hangers shall be installed in addition to the bracing to attenuate structure borne energy.

8. Pumps

- a. Inline pumps 15HP or less shall be hard mounted to piping per manufacturer's requirements. All associated piping will require vibration isolation mounts or hangers as described in section 3.8.
- b. Inline pumps larger than 15HP but less than 50HP shall be hard mounted to piping per manufacturer's requirements. All associated piping will require vibration isolation mounts or hangers with a nominal 1.5" deflection within 50 feet. Similar to Mason Industries type SLR mounts on 30N hangers.

END OF SECTION 230548

SECTION 230553 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes, but not limited to:

1. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.
4. Duct labels.
5. Stencils.
6. Valve tags.
7. Warning tags.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- D. Valve numbering scheme.
- E. Valve Schedules: For each piping system to include in maintenance manuals.

1.4 COORDINATION

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Material and Thickness: ,Brass, 0.032-inch, Stainless steel, 0.025-inch , Aluminum, 0.032-inch or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch
3. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
4. Fasteners: Stainless-steel rivets or self-tapping screws.
5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving , and having predrilled holes for attachment hardware.
2. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
3. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
4. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
5. Fasteners: Stainless-steel rivets or self-tapping screws.
6. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

C. Label Content: Include equipment's Drawing designation or unique equipment number, and drawing numbers where equipment is indicated (plans, details, and schedules).

D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules). Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, and having predrilled holes for attachment hardware.

B. Letter Color: White.

C. Background Color: Red.

- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- G. Fasteners: Stainless-steel rivets or self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
 - 2. Lettering Size: At least 1-1/2 inches high.

2.4 DUCT LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, and having predrilled holes for attachment hardware.
- B. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- C. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- D. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

- E. Fasteners: Stainless-steel rivets or self-tapping screws.
- F. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- G. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings, duct size, and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions, or as separate unit on each duct label to indicate flow direction.
 - 2. Lettering Size: At least 1-1/2 inches high.

2.5 STENCILS

- A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; minimum letter height of 1-1/4 inches for ducts; and minimum letter height of 3/4 inch for access panel and door labels, equipment labels, and similar operational instructions.
 - 1. Stencil Material: Aluminum.
 - 2. Stencil Paint: Exterior, gloss, acrylic enamel black unless otherwise indicated. Paint may be in pressurized spray-can form.
 - 3. Identification Paint: Exterior, acrylic enamel in colors according to ASME A13.1 unless otherwise indicated.

2.6 VALVE TAGS

- A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
 - 1. Tag Material: Brass, 19 gauge minimum thickness, and having predrilled or stamped holes for attachment hardware.
 - 2. Fasteners: Brass wire-link or beaded chain; or S-hook.
- B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
 - 1. Valve-tag schedule shall be included in operation and maintenance data.

2.7 WARNING TAGS

- A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
 - 1. Size: 3 by 5-1/4 inches minimum.
 - 2. Fasteners: Brass grommet and wire.

3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
4. Color: Yellow background with black lettering.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

- A. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
 1. Near each valve and control device.
 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
 4. At access doors, manholes, and similar access points that permit view of concealed piping.
 5. Near major equipment items and other points of origination and termination.
 6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
- B. Pipe Label Color Schedule:
 1. Heating Water Piping:
 - a. Background Color: Green.
 - b. Letter Color: White.
 2. Refrigerant Piping:
 - a. Background Color: Blue.
 - b. Letter Color: White.

3.4 DUCT LABEL INSTALLATION

- A. Install plastic-laminated duct labels with permanent adhesive on air ducts in the following color codes:
 - 1. Green: For cold-air supply ducts.
 - 2. Yellow: For hot-air supply ducts.
 - 3. Blue: For exhaust-, outside-, relief-, return-, and mixed-air ducts.
 - 4. ASME A13.1 Colors and Designs: For hazardous material exhaust.
- B. Locate labels near points where ducts enter into concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

3.5 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:
 - 1. Valve-Tag Size and Shape:
 - a. 2 inches, square.
 - 2. Valve-Tag Color:
 - a. Refrigerant: Blue.
 - b. Hot Water: Green.
 - 3. Letter Color:
 - a. Refrigerant: White.
 - b. Hot Water: White.
 - 4. Arrange the numbering of valves in the following manner:
 - a. In First Floor - No. 1000 to No. 1999.
 - b. In Second Floor - No. 2000 to No. 2999.
 - c. In Third Floor - No. 3000 to No. 3999.
 - d. In Fourth Floor - No. 4000 to No. 4999, etc., for all remaining floors.
 - e. On Roof No. R001 to No. R999, etc.
 - f. In no case shall a number applying to one floor, be assigned to a valve located in another floor.

3.6 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 230553

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SECTION 230593 - TESTING, ADJUSTING AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Balancing Air Systems:
 - a. Constant-volume air systems.
 - b. Variable-air-volume systems.
 - c. Multizone systems.
 - 2. Balancing Hydronic Piping Systems:
 - a. Constant-flow hydronic systems.
 - b. Variable-flow hydronic systems.
 - c. Primary-secondary hydronic systems.

1.3 DEFINITIONS

- A. AABC: Associated Air Balance Council.
- B. NEBB: National Environmental Balancing Bureau.
- C. TAB: Testing, adjusting, and balancing.
- D. TABB: Testing, Adjusting, and Balancing Bureau.
- E. TAB Specialist: An entity engaged to perform TAB Work.

1.4 SUBMITTALS

- A. Qualification Data: Within 45 days of Contractor's Notice to Proceed, submit documentation that the TAB contractor and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.
- B. Contract Documents Examination Report: Within 15 days of Contractor's Notice to Proceed, submit the Contract Documents review report as specified in Part 3.

- C. Strategies and Procedures Plan: Within 30 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.
- D. Certified TAB reports.
- E. Instrument calibration reports, to include the following:
 - 1. Instrument type and make.
 - 2. Serial number.
 - 3. Application.
 - 4. Dates of use.
 - 5. Dates of calibration.

1.5 QUALITY ASSURANCE

- A. TAB Meeting: Meet with Commissioning Authority on approval of the TAB strategies and procedures plan to develop a mutual understanding of the details. Require the participation of the TAB field supervisor and technicians. Provide seven days' advance notice of scheduled meeting time and location.
 - 1. Agenda Items:
 - a. The Contract Documents examination report.
 - b. The TAB plan.
 - c. Coordination and cooperation of trades and subcontractors.
 - d. Coordination of documentation and communication flow.
- B. Certify TAB field data reports and perform the following:
 - 1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
 - 2. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.
- C. TAB Report Forms: Use standard TAB contractor's forms approved by Commissioning Authority.
- D. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation."
- E. **Qualifications: All testing, adjusting and balancing shall be performed by an AABC or NEBB – certified professional.**

1.6 PROJECT CONDITIONS

- A. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

1.7 COORDINATION

- A. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.
- B. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.
- B. Examine systems for installed balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are accessible.
- C. Examine the approved submittals for HVAC systems and equipment.
- D. Examine ceiling plenums and underfloor air plenums used for supply, return, or relief air to verify that they meet the leakage class of connected ducts as specified in Division 23 Section "Metal Ducts" and are properly separated from adjacent areas. Verify that penetrations in plenum walls are sealed and fire-stopped if required.
- E. Examine equipment performance data including fan and pump curves.
 - 1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
- F. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
- G. Examine test reports specified in individual system and equipment Sections.
- H. Examine HVAC equipment and filters and verify that bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- I. Examine terminal units; such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.
- J. Examine strainers. Verify that startup screens are replaced by permanent screens with indicated perforations.

- K. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.
- L. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- M. Examine system pumps to ensure absence of entrained air in the suction piping.
- N. Examine operating safety interlocks and controls on HVAC equipment.
- O. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

- A. Prepare a TAB plan that includes strategies and step-by-step procedures.
- B. Complete system-readiness checks and prepare reports. Verify the following:
 - 1. Permanent electrical-power wiring is complete.
 - 2. Hydronic systems are filled, clean, and free of air.
 - 3. Automatic temperature-control systems are operational.
 - 4. Equipment and duct access doors are securely closed.
 - 5. Balance, smoke, and fire dampers are open.
 - 6. Isolating and balancing valves are open and control valves are operational.
 - 7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
 - 8. Windows and doors can be closed so indicated conditions for system operations can be met.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system according to the procedures contained in SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing" and in this Section.
- B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.
 - 1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
 - 2. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Division 23 Section "HVAC Insulation."
- C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.
- D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic diagrams of systems' "as-built" duct layouts.
- C. For variable-air-volume systems, develop a plan to simulate diversity.
- D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.
- E. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.
- F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- G. Verify that motor starters are equipped with properly sized thermal protection.
- H. Check dampers for proper position to achieve desired airflow path.
- I. Check for airflow blockages.
- J. Check condensate drains for proper connections and functioning.
- K. Check for proper sealing of air-handling-unit components.
- L. Verify that air duct system is sealed as specified in Division 23 Section "Metal Ducts."

3.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

- A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
 - 1. Measure total airflow.
 - a. Where sufficient space in ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow.
 - 2. Measure fan static pressures as follows to determine actual static pressure:
 - a. Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.
 - b. Measure static pressure directly at the fan outlet or through the flexible connection.
 - c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from the flexible connection, and downstream from duct restrictions.
 - d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.

3. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.
 - a. Report the cleanliness status of filters and the time static pressures are measured.
 4. Measure static pressures entering and leaving other devices, such as sound traps, heat-recovery equipment, and air washers, under final balanced conditions.
 5. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
 6. Obtain approval from Commissioning Authority or Engineer for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in Division 23 Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
 7. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.
- B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.
1. Measure airflow of submain and branch ducts.
 - a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.
 2. Measure static pressure at a point downstream from the balancing damper, and adjust volume dampers until the proper static pressure is achieved.
 3. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.
- C. Measure air outlets and inlets without making adjustments.
1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.
- D. Adjust air outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using branch volume dampers rather than extractors and the dampers at air terminals.
1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
 2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.6 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

- A. Prepare test reports with pertinent design data, and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against the approved pump flow rate. Correct variations that exceed plus or minus 5 percent.
- B. Prepare schematic diagrams of systems' "as-built" piping layouts.
- C. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:
 - 1. Open all manual valves for maximum flow.
 - 2. Check liquid level in expansion tank.
 - 3. Check makeup water-station pressure gage for adequate pressure for highest vent.
 - 4. Check flow-control valves for specified sequence of operation, and set at indicated flow.
 - 5. Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive-displacement type unless several terminal valves are kept open.
 - 6. Set system controls so automatic valves are wide open to heat exchangers.
 - 7. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.
 - 8. Check air vents for a forceful liquid flow exiting from vents when manually operated.

3.7 PROCEDURES FOR CONSTANT-FLOW HYDRONIC SYSTEMS

- A. Measure water flow at pumps. Use the following procedures except for positive-displacement pumps:
 - 1. Verify impeller size by operating the pump with the discharge valve closed. Read pressure differential across the pump. Convert pressure to head and correct for differences in gage heights. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
 - a. If impeller sizes must be adjusted to achieve pump performance, obtain approval from Commissioning Authority and comply with requirements in Division 23 Section "Hydronic Pumps."
 - 2. Check system resistance. With all valves open, read pressure differential across the pump and mark pump manufacturer's head-capacity curve. Adjust pump discharge valve until indicated water flow is achieved.
 - a. Monitor motor performance during procedures and do not operate motors in overload conditions.
 - 3. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on pump manufacturer's performance data. Compare calculated brake horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.
 - 4. Report flow rates that are not within plus or minus 10 percent of design.

- B. Measure flow at all automatic flow control valves to verify that valves are functioning as designed.
- C. Measure flow at all pressure-independent characterized control valves, with valves in fully open position, to verify that valves are functioning as designed.
- D. Set calibrated balancing valves, if installed, at calculated presettings.
- E. Measure flow at all stations and adjust, where necessary, to obtain first balance.
 - 1. System components that have Cv rating or an accurately cataloged flow-pressure-drop relationship may be used as a flow-indicating device.
- F. Measure flow at main balancing station and set main balancing device to achieve flow that is 5 percent greater than indicated flow.
- G. Adjust balancing stations to within specified tolerances of indicated flow rate as follows:
 - 1. Determine the balancing station with the highest percentage over indicated flow.
 - 2. Adjust each station in turn, beginning with the station with the highest percentage over indicated flow and proceeding to the station with the lowest percentage over indicated flow.
 - 3. Record settings and mark balancing devices.
- H. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems' pressures and temperatures including outdoor-air temperature.
- I. Measure the differential-pressure-control-valve settings existing at the conclusion of balancing.
- J. Check settings and operation of each safety valve. Record settings.

3.8 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS

- A. Balance systems with automatic two- and three-way control valves by setting systems at maximum flow through heat-exchange terminals and proceed as specified above for hydronic systems.

3.9 PROCEDURES FOR PRIMARY-SECONDARY HYDRONIC SYSTEMS

- A. Balance the primary circuit flow first and then balance the secondary circuits.

3.10 PROCEDURES FOR HEAT EXCHANGERS

- A. Measure water flow through all circuits.
- B. Adjust water flow to within specified tolerances.
- C. Measure inlet and outlet water temperatures.

- D. Measure inlet steam pressure.
- E. Check settings and operation of safety and relief valves. Record settings.

3.11 PROCEDURES FOR MOTORS

- A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:
 - 1. Manufacturer's name, model number, and serial number.
 - 2. Motor horsepower rating.
 - 3. Motor rpm.
 - 4. Efficiency rating.
 - 5. Nameplate and measured voltage, each phase.
 - 6. Nameplate and measured amperage, each phase.
 - 7. Starter thermal-protection-element rating.
- B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass of the controller to prove proper operation. Record observations including name of controller manufacturer, model number, serial number, and nameplate data.

3.12 PROCEDURES FOR CONDENSING UNITS

- A. Verify proper rotation of fans.
- B. Measure entering- and leaving-air temperatures.
- C. Record compressor data.

3.13 PROCEDURES FOR BOILERS

- A. Hydronic Boilers: Measure and record entering- and leaving-water temperatures and water flow.

3.14 PROCEDURES FOR HEAT-TRANSFER COILS

- A. Measure, adjust, and record the following data for each water coil:
 - 1. Entering- and leaving-water temperature.
 - 2. Water flow rate.
 - 3. Water pressure drop.
 - 4. Dry-bulb temperature of entering and leaving air.
 - 5. Wet-bulb temperature of entering and leaving air for cooling coils.
 - 6. Airflow.
 - 7. Air pressure drop.
- B. Measure, adjust, and record the following data for each electric heating coil:

1. Nameplate data.
2. Airflow.
3. Entering- and leaving-air temperature at full load.
4. Voltage and amperage input of each phase at full load and at each incremental stage.
5. Calculated kilowatt at full load.
6. Fuse or circuit-breaker rating for overload protection.

C. Measure, adjust, and record the following data for each steam coil:

1. Dry-bulb temperature of entering and leaving air.
2. Airflow.
3. Air pressure drop.
4. Inlet steam pressure.

D. Measure, adjust, and record the following data for each refrigerant coil:

1. Dry-bulb temperature of entering and leaving air.
2. Wet-bulb temperature of entering and leaving air.
3. Airflow.
4. Air pressure drop.
5. Refrigerant suction pressure and temperature.

3.15 TOLERANCES

A. Set HVAC system's air flow rates and water flow rates within the following tolerances:

1. Duct leakage, as tested by owner's representative, shall be no more than **3 CFM** per floor per shaft, inclusive of duct from roof curb to grille.
2. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent.
3. Air Outlets and Inlets: Plus or minus 10 percent.
4. Heating-Water Flow Rate: Plus or minus 10 percent.

3.16 REPORTING

- A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.
- B. Status Reports: Prepare progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.17 FINAL REPORT

- A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
 - 1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
 - 2. Include a list of instruments used for procedures, along with proof of calibration.
- B. Final Report Contents: In addition to certified field-report data, include the following:
 - 1. Pump curves.
 - 2. Fan curves.
 - 3. Manufacturers' test data.
 - 4. Field test reports prepared by system and equipment installers.
 - 5. Other information relative to equipment performance; do not include Shop Drawings and product data.
- C. General Report Data: In addition to form titles and entries, include the following data:
 - 1. Title page.
 - 2. Name and address of the TAB contractor.
 - 3. Project name.
 - 4. Project location.
 - 5. Architect's name and address.
 - 6. Engineer's name and address.
 - 7. Contractor's name and address.
 - 8. Report date.
 - 9. Signature of TAB supervisor who certifies the report.
 - 10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
 - 11. Summary of contents including the following:
 - a. Indicated versus final performance.
 - b. Notable characteristics of systems.
 - c. Description of system operation sequence if it varies from the Contract Documents.
 - 12. Nomenclature sheets for each item of equipment.
 - 13. Data for terminal units, including manufacturer's name, type, size, and fittings.
 - 14. Notes to explain why certain final data in the body of reports vary from indicated values.
 - 15. Test conditions for fans and pump performance forms including the following:
 - a. Settings for outdoor-, return-, and exhaust-air dampers.
 - b. Conditions of filters.
 - c. Cooling coil, wet- and dry-bulb conditions.
 - d. Face and bypass damper settings at coils.
 - e. Fan drive settings including settings and percentage of maximum pitch diameter.
 - f. Inlet vane settings for variable-air-volume systems.
 - g. Settings for supply-air, static-pressure controller.

- h. Other system operating conditions that affect performance.

D. Air-Handling-Unit Test Reports: For air-handling units with coils, include the following:

1. Unit Data:

- a. Unit identification.
- b. Location.
- c. Make and type.
- d. Model number and unit size.
- e. Manufacturer's serial number.
- f. Unit arrangement and class.
- g. Discharge arrangement.
- h. Sheave make, size in inches, and bore.
- i. Number, make, and size of belts.
- j. Number, type, and size of filters.

2. Motor Data:

- a. Motor make, and frame type and size.
- b. Horsepower and rpm.
- c. Volts, phase, and hertz.
- d. Full-load amperage and service factor.
- e. Sheave make, size in inches, and bore.
- f. Center-to-center dimensions of sheave, and amount of adjustments in inches.

3. Test Data (Indicated and Actual Values):

- a. Total air flow rate in cfm.
- b. Total system static pressure in inches wg.
- c. Fan rpm.
- d. Discharge static pressure in inches wg.
- e. Filter static-pressure differential in inches wg.
- f. Heating-coil static-pressure differential in inches wg.
- g. Outdoor airflow in cfm.
- h. Return airflow in cfm.
- i. Outdoor-air damper position.
- j. Return-air damper position.

E. Apparatus-Coil Test Reports:

1. Coil Data:

- a. System identification.
- b. Location.
- c. Coil type.
- d. Number of rows.
- e. Fin spacing in fins per inch o.c.
- f. Make and model number.
- g. Face area in sq. ft.

- h. Tube size in NPS.
- i. Tube and fin materials.
- j. Circuiting arrangement.

2. Test Data (Indicated and Actual Values):

- a. Air flow rate in cfm.
- b. Average face velocity in fpm.
- c. Air pressure drop in inches wg.
- d. Outdoor-air, wet- and dry-bulb temperatures in deg F.
- e. Return-air, wet- and dry-bulb temperatures in deg F.
- f. Entering-air, wet- and dry-bulb temperatures in deg F.
- g. Leaving-air, wet- and dry-bulb temperatures in deg F.
- h. Water flow rate in gpm.
- i. Water pressure differential in feet of head or psig.
- j. Entering-water temperature in deg F.
- k. Leaving-water temperature in deg F.

F. Fan Test Reports: For supply, return, and exhaust fans, include the following:

1. Fan Data:

- a. System identification.
- b. Location.
- c. Make and type.
- d. Model number and size.
- e. Manufacturer's serial number.
- f. Arrangement and class.
- g. Sheave make, size in inches, and bore.

2. Motor Data:

- a. Motor make, and frame type and size.
- b. Horsepower and rpm.
- c. Volts, phase, and hertz.
- d. Full-load amperage and service factor.
- e. Sheave make, size in inches, and bore.
- f. Number, make, and size of belts.

3. Test Data (Indicated and Actual Values):

- a. Total airflow rate in cfm.
- b. Total system static pressure in inches wg.
- c. Fan rpm.
- d. Discharge static pressure in inches wg.
- e. Suction static pressure in inches wg.

G. Air-Terminal-Device Reports:

1. Unit Data:

- a. System and air-handling unit identification.
 - b. Location and zone.
 - c. Apparatus used for test.
 - d. Area served.
 - e. Make.
 - f. Number from system diagram.
 - g. Type and model number.
 - h. Size.
 - i. Effective area in sq. ft..
 2. Test Data (Indicated and Actual Values):
 - a. Final air flow rate in cfm.
 - b. Final velocity in fpm.
 - c. Space temperature in deg F.
- H. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:
 1. Unit Data:
 - a. System and air-handling-unit identification.
 - b. Location and zone.
 - c. Room or riser served.
 - d. Coil make and size.
 2. Test Data (Indicated and Actual Values):
 - a. Air flow rate in cfm.
 - b. Entering-water temperature in deg F.
 - c. Leaving-water temperature in deg F.
 - d. Water pressure drop in feet of head or psig.
 - e. Entering-air temperature in deg F.
 - f. Leaving-air temperature in deg F.
- I. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves and include the following:
 1. Unit Data:
 - a. Unit identification.
 - b. Location.
 - c. Service.
 - d. Make and size.
 - e. Model number and serial number.
 - f. Water flow rate in gpm.
 - g. Water pressure differential in feet of head or psig.
 - h. Required net positive suction head in feet of head or psig.
 - i. Pump rpm.
 - j. Impeller diameter in inches.
 - k. Motor make and frame size.

- l. Motor horsepower and rpm.
 - m. Voltage at each connection.
 - n. Amperage for each phase.
 - o. Full-load amperage and service factor.
 - p. Seal type.
2. Test Data (Indicated and Actual Values):
 - a. Static head in feet of head or psig.
 - b. Pump shutoff pressure in feet of head or psig.
 - c. Full-open flow rate in gpm.
 - d. Full-open pressure in feet of head or psig.
 - e. Final discharge pressure in feet of head or psig.
 - f. Final suction pressure in feet of head or psig.
 - g. Final total pressure in feet of head or psig.
 - h. Final water flow rate in gpm.
 - i. Voltage at each connection.
 - j. Amperage for each phase.

J. Instrument Calibration Reports:

1. Report Data:
 - a. Instrument type and make.
 - b. Serial number.
 - c. Application.
 - d. Dates of use.
 - e. Dates of calibration.

3.18 INSPECTIONS

A. Initial Inspection:

1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the final report.
2. Check the following for each system:
 - a. Measure airflow of at least 10 percent of air outlets.
 - b. Measure water flow of at least 5 percent of terminals.
 - c. Measure room temperature at each thermostat/temperature sensor. Compare the reading to the set point.
 - d. Verify that balancing devices are marked with final balance position.
 - e. Note deviations from the Contract Documents in the final report.

B. Final Inspection:

1. After initial inspection is complete and documentation by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by Commissioning Authority.
 2. The TAB contractor's test and balance engineer shall conduct the inspection in the presence of Commissioning Authority.
 3. Commissioning Authority shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.
 4. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
 5. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.
- C. TAB Work will be considered defective if it does not pass final inspections. If TAB Work fails, proceed as follows:
1. Recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.
 2. If the second final inspection also fails, Owner may contract the services of another TAB contractor to complete TAB Work according to the Contract Documents and deduct the cost of the services from the original TAB contractor's final payment.
- D. Prepare test and inspection reports.

3.19 ADDITIONAL TESTS

- A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.
- B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION 230593

SECTION 230800 - COMMISSIONING OF HVAC

PART 1 - GENERAL

1.1 SUMMARY

- A. See Section 019113 - General Commissioning Requirements for overall objectives; comply with the requirements of Section 019113.
- B. Each subcontractor or installer responsible for the installation of a particular system or equipment item to be commissioned is responsible for the commissioning activities relating to that system or equipment item.
- C. The entire HVAC system is to be commissioned, including commissioning activities for the following specific items:
 - 1. Control system.
 - a. Submit control drawings which shall include complete detailed sequences of operation for each piece of equipment, regardless of the completeness and clarity of the sequences in the specifications. They shall include:
 - 1) An overview narrative of the system (1 or 2 paragraphs) generally describing its purpose, components, function and areas served.
 - 2) All interactions and interlocks with other systems.
 - 3) Written sequences of control for packaged controlled equipment.
 - 4) Start-up sequences.
 - 5) Warm-up mode sequences.
 - 6) Normal operating mode sequences.
 - 7) Unoccupied mode sequences.
 - 8) Shutdown sequences.
 - 9) Capacity control sequences and equipment staging.
 - 10) Temperature and pressure control: setbacks, setups, resets, etc.
 - 11) Detailed sequences for all control strategies, e.g., economizer control, optimum start/stop, staging, optimization, demand limiting, etc.
 - 12) Effects of power or equipment failure with all standby component functions.
 - 13) Sequences for all alarms and emergency shut downs.
 - 14) Initial and recommended values for all adjustable settings, setpoints and parameters that are typically set or adjusted by operating staff; and any other control settings or fixed values, delays, etc. that will be useful during testing and operating the equipment.
 - 15) Control drawings containing graphic schematic depictions of the systems and each component.
 - b. Assist and cooperate with the CX to execute the functional performance testing of the controls systems. Assist in the functional testing of all equipment specified.
 - 2. Major and minor equipment items.
 - 3. Piping systems and equipment.
 - 4. Ductwork and accessories.
 - 5. Terminal units.
 - 6. Variable frequency drives.

D. VRF Systems Commissioning

1. Detailed documentation of 600 psig 24+hr refrigerant pressure tests and 500 micron evacuation are required prior to weighing in charge.
2. Detailed as-built refrigerant piping drawings and line length calculations for additional charge required must be submitted for CxA review.
3. Manufacturer's representative must provide startup report for all VRF systems
4. Manufacturer's representative must be present for CxA led functional testing of the VRF systems. Representative shall be knowledgeable and experienced with the system including the service tool used for detailed commissioning and troubleshooting.
5. Trend reports and output reports from the VRF system to be provided to CxA upon request on up to 2 separate occasions.
6. See 019113 for additional detail, VRF rep to be a part of the project's commissioning team and participate in Cx meetings as needed.

1.2 REFERENCE STANDARDS

- A. ASHRAE Guideline 1.1 - The HVAC Commissioning Process; 2007

END OF SECTION 230800

SECTION 238239 - UNIT HEATERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. General: Provide all plant, labor, tools, appliances, equipment, materials and services required for the work indicated on the drawings and specified in this section.
- B. Section Includes but not limited to:
 - 1. Cabinet unit heaters with centrifugal fans and hot-water.

1.3 DEFINITIONS

- A. CWP: Cold working pressure.
- B. PTFE: Polytetrafluoroethylene plastic.
- C. TFE: Tetrafluoroethylene plastic.

1.4 SUBMITTALS

- A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for each product indicated.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 1. Plans, elevations, sections, and details.
 - 2. Location and size of each field connection.
 - 3. Equipment schedules to include rated capacities, operating characteristics, furnished specialties, and accessories.
 - 4. Location and arrangement of piping valves and specialties.
 - 5. Wiring Diagrams: Power, signal, and control wiring.
- C. Samples for Initial Selection: Finish colors for units with factory-applied color finishes.

- D. Samples for Verification: Finish colors for each type of cabinet unit heater and wall and ceiling heaters indicated with factory-applied color finishes.
- E. Field quality-control test reports.
- F. Operation and Maintenance Data: For cabinet unit heaters to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of cabinet heaters, of types and sizes required, whose products have been in satisfactory use in similar service for not less than five (5) years.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. ASHRAE/IESNA 90.1-2004 Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2004, Section 6 - "Heating, Ventilating, and Air-Conditioning."
- D. 2020 New York State Energy Conservation Construction Code
- E. 2020 New York State Mechanical Code

1.6 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Cabinet Unit Heater Filters: Furnish one spare filter(s) for each filter installed.

PART 2 - PRODUCTS

2.1 CABINET UNIT HEATERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Rittling, Hydro-Air Components Inc. or a comparable product by one of the following:
 - 1. Airtherm; a Mestek Company.
 - 2. Dunham-Bush, Inc.
 - 3. International Environmental Corporation.
 - 4. McQuay International.
 - 5. Trane.
- B. Description: A factory-assembled and -tested unit complying with ARI 440.

- C. Cabinet: Steel with baked-enamel finish with manufacturer's standard paint, in color selected by Architect
 - 1. Vertical Unit, Exposed Front Panels: Minimum 16 gauge thick, sheet steel, removable panels with channel-formed edges secured with tamperproof cam fasteners.
 - 2. Horizontal Unit, Exposed Bottom Panels: Minimum 16 gauge thick, sheet steel, removable panels secured with tamperproof cam fasteners and safety chain.
 - 3. Recessing Flanges: Steel, finished to match cabinet.
 - 4. Control Access Door: Key operated.
 - 5. Base: finished to match cabinet, 4 inches high with leveling bolts.
 - 6. Extended Piping Compartment: 8-inch-wide piping end pocket.
- D. Hot-Water Coil: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.083 inch and rated for a minimum working pressure of 300 psig and a maximum entering-water temperature of 220 deg F. Include manual air vent and drain.
- E. Fan and Motor Board: Removable.
 - 1. Fan: Forward curved, double width, centrifugal; directly connected to motor. Thermoplastic or painted-steel wheels, and aluminum, painted-steel, or galvanized-steel fan scrolls.
 - 2. Motor: Permanently lubricated, multispeed; resiliently mounted on motor board. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."
 - 3. Wiring Terminations: Connect motor to chassis wiring with plug connection.
- F. Factory, Hot-Water Piping Package: ASTM B 88, Type L copper tube with wrought-copper fittings and brazed joints. Label piping to indicate service, inlet and outlet.
 - 1. Two, modulating control valve.
 - 2. Two-Piece, Ball Valves: Bronze body with full-port, chrome-plated bronze ball; PTFE or TFE seats; and 600-psig minimum CWP rating and blowout-proof stem.
 - 3. Calibrated-Orifice Balancing Valves: Bronze body, ball type, 125-psig working pressure, 250 deg F maximum operating temperature; with calibrated orifice or venture, connection for portable differential pressure meter with integral seals, threaded ends, and equipped with a memory stop to retain set position.
 - 4. Automatic Flow-Control Valve: Brass or ferrous-metal body, 300-psig working pressure at 200 deg F, with removable, corrosion-resistant, tamperproof, self-cleaning, piston-spring; factory set to maintain constant indicated flow with plus or minus 10 percent over differential pressure range of 2 to 80 psig.
 - 5. Y-Pattern, Hot-Water Strainers: Cast-iron body (ASTM A 126, Class B); 125-psig minimum working pressure; with threaded connections, bolted cover, perforated stainless-steel basket, and bottom drain connection. Include minimum 1/2-inch- threaded pipe and full-port ball valve in strainer drain connection.
 - 6. Wrought-Copper Unions: ASME B16.22.
- G. Basic Unit Controls:
 - 1. Control voltage transformer.
 - 2. Unit-mounted thermostat with the following features.

- a. Heat-off switch.
 - b. Fan on-auto switch.
 - c. Manual fan speed switch.
 - d. Adjustable deadband.
 - e. Concealed set point.
 - f. Concealed indication.
- 3. Unit-mounted temperature sensor.
- H. Electrical Connection: Factory wire motors and controls for a single field connection.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive unit heaters for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in for piping and electrical connections to verify actual locations before unit heater installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install wall boxes in finished wall assembly; seal and weatherproof. Joint-sealant materials and applications are specified in Division 07 Section "Joint Sealants."
- B. Install cabinet unit heaters to comply with NFPA 90A.
- C. Install propeller unit heaters level and plumb.
- D. Suspend cabinet unit heaters from structure with elastomeric hangers and seismic restraints. Vibration isolators and seismic restraints are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."
- E. Suspend propeller unit heaters from structure with all-thread hanger rods and spring hangers. Hanger rods and attachments to structure are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment." Vibration hangers are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."
- F. Install wall-mounting thermostats and switch controls in electrical outlet boxes at heights to match lighting controls. Verify location of thermostats and other exposed control sensors with Drawings and room details before installation.
- G. Install new filters in each fan-coil unit within two weeks of Substantial Completion.

3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to machine to allow service and maintenance.
- C. Connect piping to cabinet unit heater's factory, hot-water piping package. Install the piping package if shipped loose.
- D. Comply with safety requirements in UL 1995.
- E. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- F. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 2. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.
- B. Remove and replace malfunctioning units and retest as specified above.

3.5 ADJUSTING

- A. Adjust initial temperature set points.
- B. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain cabinet unit heaters. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 238239

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SECTION 260500 - COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

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

1.3 DEFINITIONS

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

1.4 SUBMITTALS

- A. Product Data: For sleeve seals.

1.5 COORDINATION

- A. Coordinate arrangement, mounting, and support of electrical equipment:
 1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
 2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
 3. To allow right of way for piping and conduit installed at required slope.
 4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.
- B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

- C. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 08 Section "Access Doors and Frames."
- D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

PART 2 - PRODUCTS

2.1 SLEEVES FOR RACEWAYS AND CABLES

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

2.2 SLEEVE SEALS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
 - 1. Manufacturers: Subject to compliance with all requirements:
 - 2. Basis-of-Design Product: Subject to compliance with requirements, provide comparable product by one of the following:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Metraflex Co.
 - d. Pipeline Seal and Insulator, Inc.
 - 3. Sealing Elements: EPDM NBR interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
 - 4. Pressure Plates: Plastic or Carbon steel. Include two for each sealing element.
 - 5. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.3 GROUT

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

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

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

3.2 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Electrical penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- E. Cut sleeves to length for mounting flush with both surfaces of walls.
- F. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level.
- G. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and raceway or cable, unless indicated otherwise.
- H. Seal space outside of sleeves with grout for penetrations of concrete and masonry

1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.
- I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants."
- J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping."
- K. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- L. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between raceway or cable and sleeve for installing mechanical sleeve seals.

3.3 SLEEVE-SEAL INSTALLATION

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

3.4 FIRESTOPPING

- A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electrical installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

END OF SECTION 260500

SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

- 1. Overhead-lines grounding.
- 2. Underground distribution grounding.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Other Informational Submittals: Plans showing dimensioned as-built locations of grounding features specified in Part 3 "Field Quality Control" Article, including the following:
 - 1. Test wells.
 - 2. Ground rods.
 - 3. Ground rings.
 - 4. Grounding arrangements and connections for separately derived systems.
- C. Qualification Data: For testing agency and testing agency's field supervisor.
- D. Field quality-control test reports.
- E. Operation and Maintenance Data: For grounding to include the following in emergency, operation, and maintenance manuals:
 - 1. Instructions for periodic testing and inspection of grounding features at test wells ground rings grounding connections for separately derived systems based on NFPA 70B.
 - a. Tests shall be to determine if ground resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if they do not.
 - b. Include recommended testing intervals.

1.4 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
 - 1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association to supervise on-site testing specified in Part 3.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 CONDUCTORS

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

2.2 CONNECTORS

- A. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.
- B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, bolted pressure-type, with at least two bolts.

1. Pipe Connectors: Clamp type, sized for pipe.
- C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.3 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel, 3/4 inch by 10 feet (19 mm by 3 m) in diameter.
- B. Chemical-Enhanced Grounding Electrodes: Copper tube, straight or L-shaped, charged with nonhazardous electrolytic chemical salts.
 1. Termination: Factory-attached No. 4/0 AWG bare conductor at least 48 inches (1200 mm) long.
 2. Backfill Material: Electrode manufacturer's recommended material.

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger, unless otherwise indicated.
- B. Underground Grounding Conductors: Install bare tinned-copper conductor, No. 2/0 AWG minimum.
 1. Bury at least 24 inches (600 mm) below grade.
 2. Duct-Bank Grounding Conductor: Bury 12 inches (300 mm) above duct bank when indicated as part of duct-bank installation.
- C. Isolated Grounding Conductors: Green-colored insulation with continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.
- D. Grounding Bus: Install in electrical and telephone equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
 1. Install bus on insulated spacers 1 inch (25 mm), minimum, from wall 6 inches (150 mm) above finished floor, unless otherwise indicated.
 2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, down to specified height above floor, and connect to horizontal bus.
- E. Conductor Terminations and Connections:
 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.

2. Underground Connections: Welded connectors, except at test wells and as otherwise indicated.
3. Connections to Ground Rods at Test Wells: Bolted connectors.
4. Connections to Structural Steel: Welded connectors.

3.2 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

- A. Comply with IEEE C2 grounding requirements.
- B. Grounding: Install a driven ground rod close to wall, and set rod depth so 4 inches (100 mm) will extend above finished floor. If necessary, install ground rod before exterior well is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into the earth.

3.3 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.
- B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
 1. Feeders and branch circuits.
 2. Lighting circuits.
 3. Receptacle circuits.
 4. Single-phase motor and appliance branch circuits.
 5. Three-phase motor and appliance branch circuits.
 6. Flexible raceway runs.
 7. Armored and metal-clad cable runs.
 8. Busway Supply Circuits: Install insulated equipment grounding conductor from grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.
 9. Computer and Rack-Mounted Electronic Equipment Circuits: Install insulated equipment grounding conductor in branch-circuit runs from equipment-area power panels and power-distribution units.
- C. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.
- D. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.
- E. Signal and Communication Equipment: For telephone, alarm, voice and data, and other communication equipment, provide No. 4 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.

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

3.4 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Common Ground Bonding with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.
- C. Ground Rods: Drive rods until tops are 2 inches (50 mm) below finished floor or final grade, unless otherwise indicated.
 1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating, if any.
 2. For grounding electrode system, install at least [three] rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.
- D. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.
 1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install so vibration is not transmitted to rigidly mounted equipment.
 3. Use exothermic-welded connectors for outdoor locations, but if a disconnect-type connection is required, use a bolted clamp.
- E. Grounding and Bonding for Piping:
 1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes, using a bolted clamp connector or by bolting a lug-type connector to a pipe flange, using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
 2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
 3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

3.5 FIELD QUALITY CONTROL

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

END OF SECTION 260526

SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Hangers and supports for electrical equipment and systems.
 - 2. Construction requirements for concrete bases.
- B. Related Sections include the following:
 - 1. Division 26 Section "Vibration And Seismic Controls For Electrical Systems" for products and installation requirements necessary for compliance with seismic criteria.

1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. IMC: Intermediate metal conduit.
- C. RMC: Rigid metal conduit.

1.4 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design supports for multiple raceways, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.
- C. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- D. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

1.5 SUBMITTALS

- A. Product Data: For the following:
 - 1. Steel slotted support systems.
 - 2. Nonmetallic slotted support systems.
- B. Shop Drawings: Show fabrication and installation details and include calculations for the following:
 - 1. Trapeze hangers. Include Product Data for components.
 - 2. Steel slotted channel systems. Include Product Data for components.
 - 3. Nonmetallic slotted channel systems. Include Product Data for components.
 - 4. Equipment supports.

1.6 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Comply with NFPA 70.

1.7 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Allied Tube & Conduit.
 - b. Cooper B-Line, Inc.; a division of Cooper Industries.
 - c. GS Metals Corp.
 - d. Thomas & Betts Corporation.

- e. Unistrut; Tyco International, Ltd.
- 3. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
- 4. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
- 5. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
- 6. Channel Dimensions: Selected for applicable load criteria.
- B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.
- C. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.
- E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
 - 1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
 - a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - b. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Hilti Inc.
 - 2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
 - 3) MKT Fastening, LLC.
 - 2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
 - a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - b. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- 1) Cooper B-Line, Inc.; a division of Cooper Industries.
 - 2) Empire Tool and Manufacturing Co., Inc.
 - 3) Hilti Inc.
-
3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
 4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
 5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
 6. Toggle Bolts: All-steel springhead type.
 7. Hanger Rods: Threaded steel.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.
- B. Materials: Comply with requirements in Division 05 Section "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.
- B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as NFPA 70. Minimum rod size shall be 1/4 inch (6 mm) in diameter.
- C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
 1. Secure raceways and cables to these supports with single-bolt conduit clamps.
- D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch (38-mm) and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.

- B. Raceway Support Methods: In addition to methods described in NECA 1, EMT, IMC, and RMC may be supported by openings through structure members, as permitted in NFPA 70.
- C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb (90 kg).
- D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
 - 1. To Wood: Fasten with lag screws or through bolts.
 - 2. To New Concrete: Bolt to concrete inserts.
 - 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
 - 4. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches (100 mm) thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches (100 mm) thick.
 - 5. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.
 - 6. To Light Steel: Sheet metal screws.
 - 7. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.
- E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Comply with installation requirements in Division 05 Section "Metal Fabrications" for site-fabricated metal supports.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- C. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated but not less than 4 inches (100 mm) larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.
- B. Use 3000-psi (20.7-MPa), 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Division 03 Section "Cast-in-Place Concrete."

C. Anchor equipment to concrete base.

1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
2. Install anchor bolts to elevations required for proper attachment to supported equipment.
3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.5 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils (0.05 mm).
- B. Touchup: Comply with requirements in Division 09 painting Sections [for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 260529

SECTION 260533 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.
- B. Related Sections include the following:
 - 1. Division 26 Section "Underground Ducts and Raceways for Electrical Systems" for exterior ductbanks, manholes, and underground utility construction.

1.3 DEFINITIONS

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

1.4 SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
- B. Shop Drawings: For the following raceway components. Include plans, elevations, sections, details, and attachments to other work.

1. Custom enclosures and cabinets.
2. For handholes and boxes for underground wiring, including the following:
 - a. Duct entry provisions, including locations and duct sizes.
 - b. Frame and cover design.
 - c. Grounding details.
 - d. Dimensioned locations of cable rack inserts, and pulling-in and lifting irons.
 - e. Joint details.
- C. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
 1. Structural members in the paths of conduit groups with common supports.
 2. HVAC and plumbing items and architectural features in the paths of conduit groups with common supports.
- D. Qualification Data: For professional engineer and testing agency.
- E. Source quality-control test reports.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 METAL CONDUIT AND TUBING

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Allied Tube & Conduit; a Tyco International Ltd. Co.
 2. Anamet Electrical, Inc.; Anaconda Metal Hose.
 3. Maverick Tube Corporation.
 4. Wheatland Tube Company.
- C. Rigid Steel Conduit: ANSI C80.1.
- D. Aluminum Rigid Conduit: ANSI C80.5.

- E. IMC: ANSI C80.6.
- F. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit, IMC.
 - 1. Comply with NEMA RN 1.
 - 2. Coating Thickness: 0.040 inch (1 mm), minimum.
- G. EMT: ANSI C80.3.
- H. FMC: Zinc-coated steel or aluminum.
- I. LFMC: Flexible steel conduit with PVC jacket.
- J. Fittings for Conduit (Including all Types and Flexible and Liquidtight), EMT, and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.
 - 1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886.
 - 2. Fittings for EMT: Steel or die-cast, set-screw type.
 - 3. Coating for Fittings for PVC-Coated Conduit: Minimum thickness, 0.040 inch (1 mm), with overlapping sleeves protecting threaded joints.
- K. Joint Compound for Rigid Steel Conduit or IMC: Listed for use in cable connector assemblies, and compounded for use to lubricate and protect threaded raceway joints from corrosion and enhance their conductivity.

2.2 NONMETALLIC CONDUIT AND TUBING

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Arnco Corporation.
 - 2. CANTEX Inc.
 - 3. CertainTeed Corp.; Pipe & Plastics Group.
 - 4. Condux International, Inc.
 - 5. Electri-Flex Co.
 - 6. RACO; a Hubbell Company.
- C. ENT: NEMA TC 13.
- D. RNC: NEMA TC 2, Type EPC-40-PVC, unless otherwise indicated.
- E. LFNC: UL 1660.
- F. Fittings for ENT and RNC: NEMA TC 3; match to conduit or tubing type and material.
- G. Fittings for LFNC: UL 514B.

2.3 OPTICAL FIBER/COMMUNICATIONS CABLE RACEWAY AND FITTINGS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Arnco Corporation.
 - 2. Endot Industries Inc.
 - 3. IPEX Inc.
 - 4. Lamson & Sessions; Carlon Electrical Products.
- C. Description: Comply with UL 2024; flexible type, approved for general-use installation.

2.4 METAL WIREWAYS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cooper B-Line, Inc.
 - 2. Hoffman.
 - 3. Square D; Schneider Electric.
- C. Description: Sheet metal sized and shaped as indicated, NEMA 250, Type , unless otherwise indicated.
- D. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- E. Wireway Covers: Screw-cover type or Flanged-and-gasketed type.
- F. Finish: Manufacturer's standard enamel finish.

2.5 NONMETALLIC WIREWAYS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Hoffman.
 - 2. Lamson & Sessions; Carlon Electrical Products.

- C. Description: Fiberglass polyester, extruded and fabricated to size and shape indicated, with no holes or knockouts. Cover is gasketed with oil-resistant gasket material and fastened with captive screws treated for corrosion resistance. Connections are flanged, with stainless-steel screws and oil-resistant gaskets.
- D. Description: PVC plastic, extruded and fabricated to size and shape indicated, with snap-on cover and mechanically coupled connections with plastic fasteners.
- E. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

2.6 SURFACE RACEWAYS

- A. Surface Metal Raceways: Galvanized steel with snap-on covers. Manufacturer's standard enamel finish in color selected by Architect.
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Thomas & Betts Corporation.
 - b. Walker Systems, Inc.; Wiremold Company (The).
 - c. Wiremold Company (The); Electrical Sales Division.
- B. Surface Nonmetallic Raceways: Two-piece construction, manufactured of rigid PVC with texture and color selected by Architect from colors.
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Butler Manufacturing Company; Walker Division.
 - b. Enduro Systems, Inc.; Composite Products Division.
 - c. Hubbell Incorporated; Wiring Device-Kellems Division.
 - d. Lamson & Sessions; Carlon Electrical Products.
 - e. Panduit Corp.
 - f. Wiremold Company (The); Electrical Sales Division.

2.7 BOXES, ENCLOSURES, AND CABINETS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
 2. EGS/Appleton Electric.
 3. Erickson Electrical Equipment Company.
 4. Hoffman.
 5. Hubbell Incorporated; Killark Electric Manufacturing Co. Division.
 6. O-Z/Gedney; a unit of General Signal.
 7. RACO; a Hubbell Company.
 8. Spring City Electrical Manufacturing Company.
 9. Thomas & Betts Corporation.
- C. Sheet Metal Outlet and Device Boxes: NEMA OS 1.
- D. Cast-Metal Outlet and Device Boxes: NEMA FB 1, [ferrous alloy], Type FD, with gasketed cover.
- E. Nonmetallic Outlet and Device Boxes: NEMA OS 2.
- F. Metal Floor Boxes: Cast or sheet metal, fully adjustable, rectangular.
- G. Nonmetallic Floor Boxes: Nonadjustable, round.
- H. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- I. Cast-Metal Access, Pull, and Junction Boxes: NEMA FB 1, galvanized, cast iron with gasketed cover.
- J. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous-hinge cover with flush latch, unless otherwise indicated.
1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
 2. Nonmetallic Enclosures: Plastic.
- K. Cabinets:
1. NEMA 250, Type 1, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
 2. Hinged door in front cover with flush latch and concealed hinge.
 3. Key latch to match panelboards.
 4. Metal barriers to separate wiring of different systems and voltage.
 5. Accessory feet where required for freestanding equipment.

2.8 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

- A. Description: Comply with SCTE 77.

1. Color of Frame and Cover: Gray.

2. Configuration: Units shall be designed for flush burial and have closed bottom, unless otherwise indicated.
 3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
 4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
 5. Cover Legend: Molded lettering, "ELECTRIC." "TELEPHONE." as indicated for each service.
 6. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
 7. Handholes 12 inches wide by 24 inches long (300 mm wide by 600 mm long) and larger shall have inserts for cable racks and pulling-in irons installed before concrete is poured.
- B. Fiberglass Handholes and Boxes: Molded of fiberglass-reinforced polyester resin, with covers of hot-dip galvanized-steel diamond plate or fiberglass
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 3. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - a. Carson Industries LLC.
 - b. Christy Concrete Products.
 - c. Nordic Fiberglass, Inc.

2.9 SLEEVES FOR RACEWAYS

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- C. Sleeves for Rectangular Openings: Galvanized sheet steel with minimum 0.052- or 0.138-inch (1.3- or 3.5-mm) thickness as indicated and of length to suit application.
- D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

2.10 SLEEVE SEALS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- C. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
1. Advance Products & Systems, Inc.
 2. Calpico, Inc.
 3. Metraflex Co.
 4. Pipeline Seal and Insulator, Inc.
- D. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and cable.
1. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
 2. Pressure Plates: Plastic. Include two for each sealing element.
 3. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.11 SOURCE QUALITY CONTROL FOR UNDERGROUND ENCLOSURES

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

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

- A. Outdoors: Apply raceway products as specified below, unless otherwise indicated:
1. Exposed Conduit: Rigid steel conduit IMC RNC, Type EPC-80-PVC.
 2. Concealed Conduit, Aboveground: Rigid steel conduit IMC RNC, Type EPC-40-PVC.
 3. Underground Conduit: RNC, Type EPC-40 -PVC, direct buried.
 4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
 5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.
 6. Application of Handholes and Boxes for Underground Wiring:
 - a. Handholes and Pull Boxes in Driveway, Parking Lot, and Off-Roadway Locations, Subject to Occasional, Nondeliberate Loading by Heavy Vehicles: Polymer concrete SCTE 77, Tier 15 structural load rating.

- b. Handholes and Pull Boxes in Sidewalk and Similar Applications with a Safety Factor for Nondeliberate Loading by Vehicles: Polymer-concrete units, SCTE 77, Tier 8 structural load rating.
 - c. Handholes and Pull Boxes Subject to Light-Duty Pedestrian Traffic Only: Fiberglass-reinforced polyester resin, structurally tested according to SCTE 77 with 3000-lbf (13 345-N) vertical loading.
- B. Comply with the following indoor applications, unless otherwise indicated:
 - 1. Exposed, Not Subject to Physical Damage: EMT.
 - 2. Exposed, Not Subject to Severe Physical Damage: EMT.
 - 3. Exposed and Subject to Severe Physical Damage: Rigid steel conduit, IMC. Includes raceways in the following locations:
 - a. Loading dock.
 - b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
 - c. Mechanical rooms.
 - 4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
 - 5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
 - 6. Damp or Wet Locations: Rigid steel conduit IMC.
 - 7. Raceways for Optical Fiber or Communications Cable Risers in Vertical Shafts: Riser-type, optical fiber/communications cable raceway EMT.
 - 8. Raceways for Concealed General Purpose Distribution of Optical Fiber or Communications Cable: General-use, optical fiber/communications cable raceway or EMT.
 - 9. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4, nonmetallic in damp or wet locations.
- C. Minimum Raceway Size: 3/4-inch (21-mm) trade size.
- D. Raceway Fittings: Compatible with raceways and suitable for use and location.
 - 1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.
 - 2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with that material. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer.
- E. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.
- F. Do not install aluminum conduits in contact with concrete.

3.2 INSTALLATION

- A. Comply with NECA 1 for installation requirements applicable to products specified in Part 2 except where requirements on Drawings or in this Article are stricter.
- B. Keep raceways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- C. Complete raceway installation before starting conductor installation.
- D. Support raceways as specified in Division 26 Section "Hangers and Supports for Electrical Systems."
- E. Arrange stub-ups so curved portions of bends are not visible above the finished slab.
- F. Install no more than the equivalent of three 90-degree bends in any conduit run except for communications conduits, for which fewer bends are allowed.
- G. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.
- H. Raceways Embedded in Slabs:
 - 1. Run conduit larger than 1-inch (27-mm) trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.
 - 2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
 - 3. Change from ENT to RNC, Type EPC-40-PVC, rigid steel conduit, or IMC before rising above the floor.
- I. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- J. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.
- K. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire.
- L. Raceways for Optical Fiber and Communications Cable: Install raceways, metallic and nonmetallic, rigid and flexible, as follows:
 - 1. 3/4-Inch (19-mm) Trade Size and Smaller: Install raceways in maximum lengths of 50 feet (15 m).
 - 2. 1-Inch (25-mm) Trade Size and Larger: Install raceways in maximum lengths of 75 feet (23 m).

3. Install with a maximum of two 90-degree bends or equivalent for each length of raceway unless Drawings show stricter requirements. Separate lengths with pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.
- M. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:
 1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 2. Where otherwise required by NFPA 70.
- N. Flexible Conduit Connections: Use maximum of 72 inches (1830 mm) of flexible conduit for recessed and semirecessed lighting fixtures, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
 1. Use LFMC in damp or wet locations.
- O. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall.
- P. Set metal floor boxes level and flush with finished floor surface.
- Q. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

- A. Direct-Buried Conduit:
 1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Division 31 Section "Earth Moving" for pipe less than 6 inches (150 mm) in nominal diameter.
 2. Install backfill as specified in Division 31 Section "Earth Moving."
 3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches (300 mm) of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Division 31 Section "Earth Moving."
 4. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through the floor, unless otherwise indicated. Encase elbows for stub-up ducts throughout the length of the elbow.
 5. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.

- a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches (75 mm) of concrete.
 - b. For stub-ups at equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches (1500 mm) from edge of equipment pad or foundation. Install insulated grounding bushings on terminations at equipment.
6. Warning Planks: Bury warning planks approximately 12 inches (300 mm) above direct-buried conduits, placing them 24 inches (600 mm) o.c. Align planks along the width and along the centerline of conduit.

3.4 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Rectangular Sleeve Minimum Metal Thickness:
 1. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and no side greater than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
 2. For sleeve cross-section rectangle perimeter equal to, or greater than, 50 inches (1270 mm) and 1 or more sides equal to, or greater than, 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).
- E. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- F. Cut sleeves to length for mounting flush with both surfaces of walls.
- G. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level.
- H. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and raceway unless sleeve seal is to be installed.
- I. Seal space outside of sleeves with grout for penetrations of concrete and masonry.
- J. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway, using joint sealant appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.
- K. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway penetrations. Install sleeves and seal with firestop materials. Comply with Division 07 Section "Penetration Firestopping."

- L. Roof-Penetration Sleeves: Seal penetration of individual raceways with flexible, boot-type flashing units applied in coordination with roofing work.
- M. Aboveground, Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- N. Underground, Exterior-Wall Penetrations: Install cast-iron "wall pipes" for sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between raceway and sleeve for installing mechanical sleeve seals.

3.5 SLEEVE-SEAL INSTALLATION

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

3.6 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

3.7 PROTECTION

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

END OF SECTION 260533

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SECTION 260543 - UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- B. This Section includes the following:
 - 1. Conduit, ducts, and duct accessories for direct-buried and concrete-encased duct banks, and in single duct runs.

1.3 DEFINITION

- A. RNC: Rigid nonmetallic conduit.

1.4 SUBMITTALS

- A. Product Data: For the following:
 - 1. Duct-bank materials, including separators and miscellaneous components.
 - 2. Ducts and conduits and their accessories, including elbows, end bells, bends, fittings, and solvent cement.
 - 3. Accessories for manholes, handholes, boxes.
 - 4. Warning tape.
 - 5. Warning planks.
- B. Shop Drawings for Precast or Factory-Fabricated Underground Utility Structures: Include plans, elevations, sections, details, attachments to other work, and accessories, including the following:
 - 1. Duct entry provisions, including locations and duct sizes.
 - 2. Reinforcement details.
 - 3. Frame and cover design and manhole frame support rings.
 - 4. Ladder/ Step details.
 - 5. Grounding details.
 - 6. Dimensioned locations of cable rack inserts, pulling-in and lifting irons, and sumps.
 - 7. Joint details.

- C. Shop Drawings for Factory-Fabricated Handholes and Boxes Other Than Precast Concrete: Include dimensioned plans, sections, and elevations, and fabrication and installation details, including the following:
 - 1. Duct entry provisions, including locations and duct sizes.
 - 2. Cover design.
 - 3. Grounding details.
 - 4. Dimensioned locations of cable rack inserts, and pulling-in and lifting irons.
- D. Duct-Bank Coordination Drawings: Show duct profiles and coordination with other utilities and underground structures.
 - 1. Include plans and sections, drawn to scale, and show bends and locations of expansion fittings.
 - 2. Drawings shall be signed and sealed by a qualified professional engineer.
- E. Qualification Data: For professional engineer and testing agency.
- F. Source quality-control test reports.
- G. Field quality-control test reports.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.
- B. Comply with ANSI C2.
- C. Comply with NFPA 70.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver ducts to Project site with ends capped. Store nonmetallic ducts with supports to prevent bending, warping, and deforming.
- B. Store underground utility structures at Project site as recommended by manufacturer to prevent physical damage. Arrange so identification markings are visible.
- C. Lift and support precast concrete units only at designated lifting or supporting points.

1.7 COORDINATION

- A. Coordinate layout and installation of ducts and boxes with final arrangement of other utilities, site grading, and surface features as determined in the field.
- B. Coordinate elevations of ducts and duct-bank entrances and boxes with final locations and profiles of ducts and duct banks as determined by coordination with other utilities, underground

obstructions, and surface features. Revise locations and elevations from those indicated as required to suit field conditions and to ensure that duct runs drain to manholes and handholes, and as approved by Architect.

PART 2 - PRODUCTS

2.1 CONDUIT

- A. Rigid Steel Conduit: Galvanized. Comply with ANSI C80.1.
- B. RNC: NEMA TC 2, Type EPC-80-PVC, UL 651, with matching fittings by same manufacturer as the conduit, complying with NEMA TC 3 and UL 514B.

2.2 NONMETALLIC DUCTS AND DUCT ACCESSORIES

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- C. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - 1. ARNCO Corp.
 - 2. Beck Manufacturing.
 - 3. Cantex, Inc.
 - 4. CertainTeed Corp.; Pipe & Plastics Group.
 - 5. Condux International, Inc.
 - 6. ElecSys, Inc.
 - 7. Electri-Flex Company.
 - 8. IPEX Inc.
 - 9. Lamson & Sessions; Carlon Electrical Products.
 - 10. Manhattan/CDT; a division of Cable Design Technologies.
 - 11. Spiraduct/AFC Cable Systems, Inc.
- D. Underground Plastic Utilities Duct: NEMA TC 6 & 8, Type DB-120-PVC, ASTM F 512, with matching fittings by the same manufacturer as the duct, complying with NEMA TC 9.
- E. Duct Accessories:
 - 1. Duct Separators: Factory-fabricated rigid PVC interlocking spacers, sized for type and sizes of ducts with which used, and selected to provide minimum duct spacings indicated while supporting ducts during concreting or backfilling.
 - 2. Warning Tape: Underground-line warning tape specified in Division 26 Section "Identification for Electrical Systems."

3. Concrete Warning Planks: Nominal 12 by 24 by 3 inches (300 by 600 by 76 mm) in size, manufactured from 6000-psi (41-MPa) concrete.
 - a. Color: Red dye added to concrete during batching.
 - b. Mark each plank with "ELECTRIC" in 2-inch- (50-mm-) high, 3/8-inch- (10-mm-) deep letters.

2.3 SOURCE QUALITY CONTROL

- A. Test and inspect precast concrete utility structures according to ASTM C 1037.
- B. Pull-Box Prototype Test: Test prototypes of boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.
 1. Tests of materials shall be performed by a independent testing agency.
 2. Strength tests of complete boxes and covers shall be by either an independent testing agency or the manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
 3. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012, and traceable to NIST standards.

PART 3 - EXECUTION

3.1 UNDERGROUND DUCT APPLICATION

- A. Ducts for Electrical Feeders 600 V and Less: RNC, NEMA Type EPC-80-PVC, in concrete-encased duct bank, unless otherwise indicated.
- B. Underground Ducts Crossing Paved Paths, Walks and Driveways, Roadways: RNC, NEMA Type EPC-40-PVC, encased in reinforced concrete.

3.2 EARTHWORK

- A. Excavation and Backfill: Comply with Division 31 Section "Earth Moving," but do not use heavy-duty, hydraulic-operated, compaction equipment.
- B. Restore surface features at areas disturbed by excavation and reestablish original grades, unless otherwise indicated. Replace removed sod immediately after backfilling is completed.
- C. Restore areas disturbed by trenching, storing of dirt, cable laying, and other work. Restore vegetation and include necessary topsoiling, fertilizing, liming, seeding, sodding, sprigging, and mulching. Comply with Division 32 Sections "Turf and Grasses" and "Plants."
- D. Cut and patch existing pavement in the path of underground ducts and utility structures according to Division 01 Section "Cutting and Patching."

3.3 DUCT INSTALLATION

- A. Slope: Pitch ducts a minimum slope of 1:300 down toward manholes and handholes and away from buildings and equipment. Slope ducts from a high point in runs between two manholes to drain in both directions.
- B. Curves and Bends: Use 5-degree angle couplings for small changes in direction. Use manufactured long sweep bends with a minimum radius of 48 inches (1220 mm) 12.5 feet (4 m) 25 feet (7.5 m), both horizontally and vertically, at other locations, unless otherwise indicated.
- C. Joints: Use solvent-cemented joints in ducts and fittings and make watertight according to manufacturer's written instructions. Stagger couplings so those of adjacent ducts do not lie in same plane.
- D. Building Wall Penetrations: Make a transition from underground duct to rigid steel conduit at least 10 feet (3 m) outside the building wall without reducing duct line slope away from the building, and without forming a trap in the line. Use fittings manufactured for duct-to-conduit transition. Install conduit penetrations of building walls as specified in Division 26 Section "Common Work Results for Electrical."
- E. Sealing: Provide temporary closure at terminations of ducts that have cables pulled. Seal spare ducts at terminations. Use sealing compound and plugs to withstand at least 15-psig (1.03-MPa) hydrostatic pressure.
- F. Pulling Cord: Install 100-lbf- (445-N-) test nylon cord in ducts, including spares.
- G. Concrete-Encased Ducts: Support ducts on duct separators.
 - 1. Separator Installation: Space separators close enough to prevent sagging and deforming of ducts, with not less than 5 spacers per 20 feet (6 m) of duct. Secure separators to earth and to ducts to prevent floating during concreting. Stagger separators approximately 6 inches (150 mm) between tiers. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.
 - 2. Concreting Sequence: Pour each run of envelope between manholes or other terminations in one continuous operation.
 - a. Start at one end and finish at the other, allowing for expansion and contraction of ducts as their temperature changes during and after the pour. Use expansion fittings installed according to manufacturer's written recommendations, or use other specific measures to prevent expansion-contraction damage.
 - b. If more than one pour is necessary, terminate each pour in a vertical plane and install 3/4-inch (19-mm) reinforcing rod dowels extending 18 inches (450 mm) into concrete on both sides of joint near corners of envelope.
 - 3. Pouring Concrete: Spade concrete carefully during pours to prevent voids under and between conduits and at exterior surface of envelope. Do not allow a heavy mass of concrete to fall directly onto ducts. Use a plank to direct concrete down sides of bank assembly to trench bottom. Allow concrete to flow to center of bank and rise up in

- middle, uniformly filling all open spaces. Do not use power-driven agitating equipment unless specifically designed for duct-bank application.
4. Reinforcement: Reinforce concrete-encased duct banks where they cross disturbed earth and where indicated. Arrange reinforcing rods and ties without forming conductive or magnetic loops around ducts or duct groups.
 5. Forms: Use walls of trench to form side walls of duct bank where soil is self-supporting and concrete envelope can be poured without soil inclusions; otherwise, use forms.
 6. Minimum Space between Ducts: 3 inches (75 mm) between ducts and exterior envelope wall, 2 inches (50 mm) between ducts for like services, and 4 inches (100 mm) between power and signal ducts.
 7. Depth: Install top of duct bank at least 24 inches (600 mm) below finished grade in areas not subject to deliberate traffic, and at least 30 inches (750 mm) below finished grade in deliberate traffic paths for vehicles, unless otherwise indicated.
 8. Stub-Ups: Use manufactured duct elbows for stub-ups at poles and equipment and at building entrances through the floor, unless otherwise indicated. Extend concrete encasement throughout the length of the elbow.
 9. Stub-Ups: Use manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.
 - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches (75 mm) of concrete.
 - b. Stub-Ups to Equipment: For equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches (1500 mm) from edge of base. Install insulated grounding bushings on terminations at equipment.
 10. Warning Tape: Bury warning tape approximately 12 inches (300 mm) above all concrete-encased ducts and duct banks. Align tape parallel to and within 3 inches (75 mm) of the centerline of duct bank. Provide an additional warning tape for each 12-inch (300-mm) increment of duct-bank width over a nominal 18 inches (450 mm). Space additional tapes 12 inches (300 mm) apart, horizontally.

3.4 INSTALLATION OF BOXES OTHER THAN PRECAST CONCRETE

- A. Install boxes level and plumb and with orientation and depth coordinated with connecting ducts to minimize bends and deflections required for proper entrances. Use box extension if required to match depths of ducts, and seal joint between box and extension as recommended by the manufacturer.
- B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch (12.7-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.
- C. Elevation: In paved areas and trafficways, set so cover surface will be flush with finished grade. Set covers of other handholes 1 inch (25 mm) above finished grade.
- D. Install handholes and boxes with bottom below the frost line at 30" below grade.
- E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm

lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in the enclosure.

- F. Field-cut openings for ducts and conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.
- G. For enclosures installed in asphalt paving and subject to occasional, nondeliberate, heavy-vehicle loading, form and pour a concrete ring encircling, and in contact with, enclosure and with top surface screeded to top of box cover frame. Bottom of ring shall rest on compacted earth .
 - 1. Concrete: 3000 psi (20 kPa), 28-day strength, complying with Division 03 Section "Cast-in-Place Concrete," with a troweled finish.
 - 2. Dimensions: 10 inches wide by 12 inches deep (250 mm wide by 300 mm deep).

3.5 GROUNDING

- A. Ground underground ducts and utility structures according to Division 26 Section "Grounding and Bonding for Electrical Systems."

3.6 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections and prepare test reports:
 - 1. Demonstrate capability and compliance with requirements on completion of installation of underground ducts and utility structures.
 - 2. Pull aluminum or wood test mandrel through duct to prove joint integrity and test for out-of-round duct. Provide mandrel equal to 80 percent fill of duct. If obstructions are indicated, remove obstructions and retest.
 - 3. Test manhole and handhole grounding to ensure electrical continuity of grounding and bonding connections. Measure and report ground resistance as specified in Division 26 Section "Grounding and Bonding for Electrical Systems."
- B. Correct deficiencies and retest as specified above to demonstrate compliance.

3.7 CLEANING

- A. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of ducts. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.
- B. Clean internal surfaces of manholes, including sump. Remove foreign material.

END OF SECTION 260543

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SECTION 260548 - VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Electrical substation, transformer and UPS systems shall be vibration isolated with steel spring isolation mounting assemblies utilizing bare springs with the spring diameter not less than 0.8 of the loaded operating height of the spring. Each isolator shall be designed and installed so that the ends of the spring remain parallel. The spring specified minimum deflection from loaded operating height shall be 50% of the rated deflection.
- B. Neoprene-in-shear isolation mounting assemblies shall utilize bare neoprene elements with unit type design molded in oil resistant neoprene. The neoprene shall be compounded to meet the following:
 - 1. Not greater than 70 durometer.
 - 2. Minimum tensile strength of 2000 PSI.
 - 3. Minimum elongation of 300%.
 - 4. Maximum compression at 25% of original deflection.
- C. Vibration isolation equipment submittal drawings shall include the following information:
 - 1. Isolation mounting deflections.
 - 2. Spring diameters, compressed spring heights at rated load; solid spring heights, where steel spring isolation mountings are used.
 - 3. Equipment operating frequencies.
 - 4. Calculations showing that the spring surge frequency is not coincided with any forcing frequencies/harmonics of the equipment to be mounted.
- D. Mounting Transformers Less than 150Kva
 - 1. Each transformer shall be either floor mounted or hung from structural members on an integral one-piece base or frame, reinforced as necessary, to prevent flexure.
 - 2. The structural base/frame shall be supported by neoprene mountings with a minimum static deflection of 3/8 inch. Isolator types shall be one of the following:
 - a. Floor mounts:
 - 1) Type ND – Mason Industries
 - 2) Type 368SD – Vibration Eliminator Company
 - 3) Type RD – Vibration Mountings and Controls
 - b. Hung Mounts:
 - 1) Type HD – Mason Industries
 - 2) Type CD – Vibration Eliminator Company
 - 3) Type RHD – Vibration Mountings and Controls

- E. Floor Mounting of Electrical Substations, Transformers Greater than 150 KVA, and UPS Systems.
1. Each substation, transformer, or UPS system shall be mounted on an integral one-piece structural base that is reinforced as necessary to prevent flexure of the base. The structural frame shall be drilled and tapped as necessary, to receive the transformer or UPS equipment so that the frame shall act as a template.
 2. The structural steel integral base shall be supported on steel spring mountings with a minimum static deflection of 1.5" (+/- 10%). These mountings shall be positioned in accordance with the weight distribution to ensure adequate deflection and vibration isolation. Housing or snubbing devices shall not be used to contain the isolator springs. Isolator types shall be one of the following, or as approved:
 - a. Type SLF – Mason Industries Inc. Hauppauge, NY
 - b. Type OST – Vibration Eliminator Company Long Island City, NY
 - c. Type AN – Vibration Mountings and Controls, Inc.
 3. A minimum 0.75" thick neoprene-in-shear pad at a maximum loading of 50 psi shall be provided between the spring isolator and the floor.

END OF SECTION 260548

SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Identification for conductors.
 - 2. Underground-line warning tape.
 - 3. Warning labels and signs.
 - 4. Instruction signs.
 - 5. Equipment identification labels.
 - 6. Miscellaneous identification products.

1.3 SUBMITTALS

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

1.4 QUALITY ASSURANCE

- A. Comply with ANSI A13.1 and IEEE C2.
- B. Comply with NFPA 70.
- C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.
- D. Comply with ANSI Z535.4 for safety signs and labels.
- E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

1.5 COORDINATION

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

PART 2 - PRODUCTS

2.1 CONDUCTOR IDENTIFICATION MATERIALS

- A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils (0.08 mm) thick by 1 to 2 inches (25 to 50 mm) wide.
- B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.
- C. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- D. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches (50 mm) long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- E. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.
- F. Write-On Tags: Polyester tag, 0.010 inch (0.25 mm) 0.015 inch (0.38 mm) thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.
 - 1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.
 - 2. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

2.2 FLOOR MARKING TAPE

- A. 2-inch- (50-mm-) wide, 5-mil (0.125-mm) pressure-sensitive vinyl tape, with black and white stripes and clear vinyl overlay.

2.3 UNDERGROUND-LINE WARNING TAPE

A. Tape:

1. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
2. Printing on tape shall be permanent and shall not be damaged by burial operations.
3. Tape material and ink shall be chemically inert, and not subject to degrading when exposed to acids, alkalis, and other destructive substances commonly found in soils.

B. Color and Printing:

1. Comply with ANSI Z535.1 through ANSI Z535.5.
2. Inscriptions for Red-Colored Tapes: ELECTRIC LINE, HIGH VOLTAGE.
3. Inscriptions for Orange-Colored Tapes: TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE.

C. Tag: Type II:

1. Multilayer laminate consisting of high-density polyethylene scrim coated with pigmented polyolefin, bright-colored, compounded for direct-burial service.
2. Thickness: 12 mils (0.3 mm).
3. Weight: 36.1 lb/1000 sq. ft. (17.6 kg/100 sq. m).
4. 3-Inch (75-mm) Tensile According to ASTM D 882: 400 lbf (1780 N), and 11,500 psi (79.2 MPa).

2.4 WARNING LABELS AND SIGNS

A. Comply with NFPA 70 and 29 CFR 1910.145.

B. Self-Adhesive Warning Labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.

C. Baked-Enamel Warning Signs:

1. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.
2. 1/4-inch (6.4-mm) grommets in corners for mounting.
3. Nominal size, 7 by 10 inches (180 by 250 mm).

D. Metal-Backed, Butyrate Warning Signs:

4. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch (1-mm) galvanized-steel backing; and with colors, legend, and size required for application.
5. 1/4-inch (6.4-mm) grommets in corners for mounting.
6. Nominal size, 10 by 14 inches (250 by 360 mm).

- E. Warning label and sign shall include, but are not limited to, the following legends:
1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
 2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES (915 MM)."

2.5 INSTRUCTION SIGNS

- A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch (1.6 mm) thick for signs up to 20 sq. inches (129 sq. cm) and 1/8 inch (3.2 mm) thick for larger sizes.
1. Engraved legend with black letters on white face .
 2. Punched or drilled for mechanical fasteners.
 3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.
- B. Adhesive Film Label: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch (10 mm).
- C. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch (10 mm). Overlay shall provide a weatherproof and UV-resistant seal for label.

2.6 EQUIPMENT IDENTIFICATION LABELS

- A. Adhesive Film Label: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch (10 mm).
- B. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch (10 mm). Overlay shall provide a weatherproof and UV-resistant seal for label.
- C. Self-Adhesive, Engraved, Laminated Acrylic or Melamine Label: Adhesive backed, with white letters on a dark-gray background. Minimum letter height shall be 3/8 inch (10 mm).
- D. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a dark-gray background. Minimum letter height shall be 3/8 inch (10 mm).
- E. Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height shall be 1 inch (25 mm).

2.7 CABLE TIES

- A. General-Purpose Cable Ties: Fungus inert, self extinguishing, one piece, self locking, Type 6/6 nylon.

1. Minimum Width: 3/16 inch (5 mm).
2. Tensile Strength at 73 deg F (23 deg C), According to ASTM D 638: 12,000 psi (82.7 MPa).
3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
4. Color: Black except where used for color-coding.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Verify identity of each item before installing identification products.
- B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
- C. Apply identification devices to surfaces that require finish after completing finish work.
- D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.
- E. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
- F. System Identification Color-Coding Bands for Raceways and Cables: Each color-coding band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot (15-m) maximum intervals in straight runs, and at 25-foot (7.6-m) maximum intervals in congested areas.
- G. Aluminum Wraparound Marker Labels and Metal Tags: Secure tight to surface of conductor or cable at a location with high visibility and accessibility.
- H. Cable Ties: For attaching tags. Use general-purpose type, except as listed below:
 1. Outdoors: UV-stabilized nylon.
 2. In Spaces Handling Environmental Air: Plenum rated.
- I. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches (150 to 200 mm) below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches (400 mm) overall.
- J. Painted Identification: Comply with requirements in Division 09 painting Sections for surface preparation and paint application.

3.2 IDENTIFICATION SCHEDULE

- A. Concealed Raceways, Duct Banks, More Than 600 V, within Buildings: Tape and stencil 4-inch- (100-mm-) wide black stripes on 10-inch (250-mm) centers over orange background that extends full length of raceway or duct and is 12 inches (300 mm) wide. Stencil legend "DANGER CONCEALED HIGH VOLTAGE WIRING" with 3-inch- (75-mm-) high black letters on 20-inch (500-mm) centers. Stop stripes at legends. Apply to the following finished surfaces:
1. Floor surface directly above conduits running beneath and within 12 inches (300 mm) of a floor that is in contact with earth or is framed above unexcavated space.
 2. Wall surfaces directly external to raceways concealed within wall.
 3. Accessible surfaces of concrete envelope around raceways in vertical shafts, exposed in the building, or concealed above suspended ceilings.
- B. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits More Than 30 A, and 120 V to ground: Identify with self-adhesive vinyl label. Install labels at 30-foot (10-m) maximum intervals.
- C. Accessible Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive vinyl labels with the wiring system legend and system voltage. System legends shall be as follows:
1. Emergency Power.
 2. Power.
 3. UPS.
- D. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.
1. Color-Coding for Phase Identification, 600 V or Less: Use colors listed below for ungrounded service feeder and branch-circuit conductors.
 - a. Color shall be factory applied or field applied for sizes larger than No. 8 AWG.
 - b. Colors for 208/120-V Circuits:
 - 1) Phase A: Black.
 - 2) Phase B: Red.
 - 3) Phase C: Blue.
 - c. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches (150 mm) from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.
- E. Install instructional sign including the color-code for grounded and ungrounded conductors using adhesive-film-type labels.
- F. Conductors to Be Extended in the Future: Attach write-on tags/ marker tape to conductors and list source.

- G. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.
1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
 2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
 3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.
- H. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.
1. Limit use of underground-line warning tape to direct-buried cables.
 2. Install underground-line warning tape for both direct-buried cables and cables in raceway.
- I. Workspace Indication: Install floor marking tape to show working clearances in the direction of access to live parts. Workspace shall be as required by NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.
- J. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive warning labels.
1. Comply with 29 CFR 1910.145.
 2. Identify system voltage with black letters on an orange background.
 3. Apply to exterior of door, cover, or other access.
 4. For equipment with multiple power or control sources, apply to door or cover of equipment including, but not limited to, the following:
 - a. Power transfer switches.
 - b. Controls with external control power connections.
- K. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.
- L. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch- (10-mm-) high letters for emergency instructions at equipment used for power transfer.
- M. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.
1. Labeling Instructions:

- a. Indoor Equipment: Self-adhesive, engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on 1-1/2-inch- (38-mm-) high label; where two lines of text are required, use labels 2 inches (50 mm) high.
 - b. Outdoor Equipment: Engraved, laminated acrylic or melamine label - Stenciled legend 4 inches (100 mm) high.
 - c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
 - d. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.
2. Equipment to Be Labeled:
- a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be self-adhesive, engraved, laminated acrylic or melamine label.
 - b. Enclosures and electrical cabinets.
 - c. Access doors and panels for concealed electrical items.
 - d. Switchgear.
 - e. Switchboards.
 - f. Emergency system boxes and enclosures.
 - g. Enclosed switches.
 - h. Enclosed circuit breakers.
 - i. Enclosed controllers.
 - j. Push-button stations.
 - k. Power transfer equipment.
 - l. Contactors.
 - m. Remote-controlled switches, dimmer modules, and control devices.
 - n. Power-generating units.
 - o. Monitoring and control equipment.

END OF SECTION 260553

SECTION 260800 - COMMISSIONING OF ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

- A. See Section 019113 - General Commissioning Requirements for overall objectives; comply with the requirements of Section 019113. The Energy Code referenced in this section is the code outlined in 019113.
- B. Each subcontractor or installer responsible for the installation of a particular system or equipment item to be commissioned is responsible for the commissioning activities relating to that system or equipment item.
- C. The following systems will be commissioned:
 - 1. All automatic lighting control systems (including, but not limited to timers, occupancy sensors, photocells)
 - 2. Bi-level switching, daylight switching controls and other manual controls as required by Energy Code.
 - 3. Photovoltaic system (including thorough startup and checkout documentation from the installing contractor.)
 - 4. Heat Trace Controllers (pipe temperature control and BMS alarm integration)
- D. Subcontractor or installer is responsible for providing detailed sequence of operations and controls layout for all lighting controls and combination of lighting controls to be commissioned, prior to functional testing. The following information must be provided:
 - 1. Layouts indicating location of all lighting controls and calibration systems
 - 2. Time-out delay setpoints for occupant sensor controls
 - 3. Schedule for time-switch controls
 - 4. Detailed sequences for combination lighting controls
 - 5. As-built markup of heat trace locations, lengths, termination points, and circuit numbers
- D. As referenced in 019113, prior to passing final inspection, the installing contractor or manufactures representative shall test the lighting system to ensure that control hardware and software are calibrated, adjusted, programmed and in proper working condition in accordance with the construction documents and manufacturer's instructions. Final Testing must be witnessed by the Commissioning Provider
 - 1. Where occupant sensor controls are provided, the following procedures shall be performed:
 - a. Certify that the occupant sensor has been located and aimed in accordance with manufacturer recommendations.
 - b. For projects with seven or fewer occupant sensors, each sensor shall be tested.
 - c. For projects with more than seven occupant sensors, testing shall be done for each unique combination of sensor type and space geometry. Where multiples of each unique combination of sensor type and space geometry are provided, not less than 10 percent, but in no case less than one, of each combination shall be tested unless the code official or design professional requires a higher percentage to be tested. Where 30 percent or more of the tested controls fail, all remaining identical combinations shall be tested.
 - d. Where occupant sensor controls include status indicators, verify correct operation.
 - e. The controlled lights turn off or down to the permitted level within the required time.

- f. For auto-on occupant sensor controls, the lights turn on to the permitted level when an occupant enters the space.
 - g. For manual-on occupant sensor controls, the lights turn on only when manually activated.
 - h. The lights are not incorrectly turned on by movement in adjacent areas or by HVAC operation.
 - 2. Where time-switch controls are provided, the following procedures shall be performed:
 - a. Confirm that the time-switch control is programmed with accurate weekday, weekend and holiday schedules.
 - b. Provide documentation to the owner of time-switch controls programming including weekday, weekend, holiday schedules, and set-up and preference program settings.
 - c. Verify the correct time and date in the time switch.
 - d. Verify that any battery back-up is installed and energized.
 - e. Verify that the override time limit is set to not more than 2 hours.
 - f. In a simulated occupied condition, all lights can be turned on and off by their respective area control switch.
 - g. In a simulated occupied condition, the switch only operates lighting in the enclosed space in which the switch is located.
 - h. In a simulated unoccupied condition, nonexempt lighting turns off.
 - i. In a simulated occupied condition, manual override switch allows only the lights in the enclosed space where the over-ride switch is located to turn on or remain on until the next scheduled shutoff occurs.
 - j. Additional testing as specified by the registered design professional.
 - 3. Where daylight responsive controls are provided, the following shall be verified:
 - a. Control devices have been properly located, field calibrated and set for accurate setpoints and threshold light levels.
 - b. Daylight controlled lighting loads adjust to light level set points in response to available daylight.
 - c. The locations of calibration adjustment equipment are readily accessible only to authorized personnel.
- E. As referenced in 019113, provide the following O&M information as required by the Energy Code.
 - 1. Operation and maintenance manuals for each piece of lighting equipment. Required routine maintenance actions, cleaning and recommended relamping shall be clearly identified.
 - 2. Submittal data indicating all selected options for each piece of lighting equipment and lighting controls.
 - 3. A schedule for inspecting and recalibrating all lighting controls.
 - 4. A narrative of how each system is intended to operate, including recommended set points.
- F. The commissioning authority shall provide documentation to the building owner within 90 days of receipt of the first certificate of occupancy certifying that the installed lighting controls meet documented performance criteria.

END OF SECTION 260800

SECTION 260923 - LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following lighting control devices:
 - 1. Time switches.
 - 2. Outdoor and indoor photoelectric switches.
 - 3. Indoor occupancy sensors.
 - 4. Outdoor motion sensors.
 - 5. Lighting contactors.
 - 6. Emergency shunt relays.
- B. Related Sections include the following:
 - 1. Division 26 Section "Wiring Devices" for wall-box dimmers, wall-switch occupancy sensors, and manual light switches.

1.3 DEFINITIONS

- A. LED: Light-emitting diode.
- B. PIR: Passive infrared.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show installation details for occupancy and light-level sensors.
 - 1. Interconnection diagrams showing field-installed wiring.
- C. Field quality-control test reports.
- D. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.6 COORDINATION

- A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression system, and partition assemblies.

PART 2 - PRODUCTS

2.1 TIME SWITCHES

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- C. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - 1. Area Lighting Research, Inc.; Tyco Electronics.
 - 2. Grasslin Controls Corporation; a GE Industrial Systems Company.
 - 3. Intermatic, Inc.
 - 4. Leviton Mfg. Company Inc.
 - 5. Lightolier Controls; a Genlyte Company.
 - 6. Lithonia Lighting; Acuity Lighting Group, Inc.
 - 7. Paragon Electric Co.; Invensys Climate Controls.
 - 8. Square D; Schneider Electric.
 - 9. TORK.
 - 10. Touch-Plate, Inc.
 - 11. Philips Lighting Controls.
- D. Electronic Time Switches: Electronic, solid-state programmable units with alphanumeric display; complying with UL 917.
 - 1. Contact Configuration: DPST.
 - 2. Contact Rating: 20-A ballast load, 120/240-V ac.
 - 3. Programs: 20 channels; each channel shall be individually programmable with 8 on-off set points on a 24-hour schedule.
 - 4. Circuitry: Allow connection of a photoelectric relay as substitute for on-off function of a program on selected channels.
 - 5. Astronomic Time: Selected channels.

6. Battery Backup: For schedules and time clock.

2.2 OUTDOOR PHOTOELECTRIC SWITCHES

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- C. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 1. Area Lighting Research, Inc.; Tyco Electronics.
 2. Grasslin Controls Corporation; a GE Industrial Systems Company.
 3. Intermatic, Inc.
 4. Lithonia Lighting; Acuity Lighting Group, Inc.
 5. Novitas, Inc.
 6. Paragon Electric Co.; Invensys Climate Controls.
 7. Square D; Schneider Electric.
 8. TORK.
 9. Touch-Plate, Inc.
 10. Watt Stopper (The).
- D. Description: Solid state, with SPST, DPST dry contacts rated for 1800-VA tungsten or 1000-VA inductive, to operate connected relay, contactor coils, or microprocessor input; complying with UL 773A.
 1. Light-Level Monitoring Range: 1.5 to 10 fc (16.14 to 108 lx), with an adjustment for turn-on and turn-off levels within that range, and a directional lens in front of photocell to prevent fixed light sources from causing turn-off.
 2. Time Delay: 15-second minimum, to prevent false operation.
 3. Surge Protection: Metal-oxide varistor, complying with IEEE C62.41.1, IEEE C62.41.2, and IEEE 62.45 for Category A1 locations.
 4. Mounting: Twist lock complying with IEEE C136.10, with base-and-stem mounting or stem-and-swivel mounting accessories as required to direct sensor to the north sky exposure.
- E. Description: Solid state, with SPST, DPST dry contacts rated for 1800 VA to operate connected load, relay, or contactor coils; complying with UL 773.
 1. Light-Level Monitoring Range: 1.5 to 10 fc (16.14 to 108 lx), with an adjustment for turn-on and turn-off levels within that range.
 2. Time Delay: 30-second minimum, to prevent false operation.
 3. Lightning Arrester: Air-gap type.
 4. Mounting: Twist lock complying with IEEE C136.10, with base.

2.3 INDOOR OCCUPANCY SENSORS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- C. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - 1. Hubbell Lighting.
 - 2. Leviton Mfg. Company Inc.
 - 3. Lithonia Lighting; Acuity Lighting Group, Inc.
 - 4. Novitas, Inc.
 - 5. RAB Lighting, Inc.
 - 6. Sensor Switch, Inc.
 - 7. TORK.
 - 8. Philips Lighting Controls.
- D. General Description: Wall- or ceiling-mounting, solid-state units with a separate relay unit.
 - 1. Operation: Unless otherwise indicated, turn lights on when covered area is occupied and off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
 - 2. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor shall be powered from the relay unit.
 - 3. Relay Unit: Dry contacts rated for 20-A ballast load at 120- V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Power supply to sensor shall be 24-V dc, 150-mA, Class 2 power source as defined by NFPA 70.
 - 4. Mounting:
 - a. Sensor: Suitable for mounting in any position on a standard outlet box.
 - b. Relay: Externally mounted through a 1/2-inch (13-mm) knockout in a standard electrical enclosure.
 - c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
 - 5. Indicator: LED, to show when motion is being detected during testing and normal operation of the sensor.
 - 6. Bypass Switch: Override the on function in case of sensor failure.
 - 7. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc (21.5 to 2152 lx); keep lighting off when selected lighting level is present.
- E. Dual-Technology Type: Ceiling mounting; detect occupancy by using a combination of PIR and ultrasonic detection methods in area of coverage. Particular technology or combination of technologies that controls on-off functions shall be selectable in the field by operating controls on unit.
 - 1. Sensitivity Adjustment: Separate for each sensing technology.

2. Detector Sensitivity: Detect occurrences of 6-inch- (150-mm-) minimum movement of any portion of a human body that presents a target of not less than 36 sq. in. (232 sq. cm), and detect a person of average size and weight moving not less than 12 inches (305 mm) in either a horizontal or a vertical manner at an approximate speed of 12 inches/s (305 mm/s).
3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. (93 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.

2.4 LIGHTING CONTACTORS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- C. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 1. Allen-Bradley/Rockwell Automation.
 2. ASCO Power Technologies, LP; a division of Emerson Electric Co.
 3. Eaton Electrical Inc.; Cutler-Hammer Products.
 4. GE Industrial Systems; Total Lighting Control.
 5. Grasslin Controls Corporation; a GE Industrial Systems Company.
 6. Hubbell Lighting.
 7. Lithonia Lighting; Acuity Lighting Group, Inc.
 8. MicroLite Lighting Control Systems.
 9. Square D; Schneider Electric.
 10. TORK.
 11. Touch-Plate, Inc.
 12. Watt Stopper (The).
- D. Description: Electrically operated and mechanically held, combination type with fusible switch and nonfused disconnect, complying with NEMA ICS 2 and UL 508.
 1. Current Rating for Switching: Listing or rating consistent with type of load served, including tungsten filament, inductive, and high-inrush ballast (ballast with 15 percent or less total harmonic distortion of normal load current).
 2. Fault Current Withstand Rating: Equal to or exceeding the available fault current at the point of installation.
 3. Enclosure: Comply with NEMA 250.
 4. Provide with control and pilot devices as scheduled, matching the NEMA type specified for the enclosure.

2.5 CONDUCTORS AND CABLES

- A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

- B. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 14 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 SENSOR INSTALLATION

- A. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

3.2 CONTACTOR INSTALLATION

- A. Mount electrically held lighting contactors with elastomeric isolator pads, to eliminate structure-borne vibration, unless contactors are installed in an enclosure with factory-installed vibration isolators.

3.3 WIRING INSTALLATION

- A. Wiring Method: Comply with Division 26 Section "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size shall be $\frac{3}{4}$ " C
- B. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.
- C. Size conductors according to lighting control device manufacturer's written instructions, unless otherwise indicated.
- D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.4 IDENTIFICATION

- A. Identify components and power and control wiring according to Division 26 Section "Identification for Electrical Systems."
 - 1. Identify controlled circuits in lighting contactors.
 - 2. Identify circuits or luminaries controlled by photoelectric and occupancy sensors at each sensor.
- B. Label time switches and contactors with a unique designation.

3.5 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:

1. After installing time switches and sensors, and after electrical circuitry has been energized, adjust and test for compliance with requirements.
2. Operational Test: Verify operation of each lighting control device, and adjust time delays.

B. Lighting control devices that fail tests and inspections are defective work.

3.6 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting sensors to suit occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.7 DEMONSTRATION

- A. Coordinate demonstration of products specified in this Section.
- B. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 260923

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SECTION 262413 - SWITCHBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

1. Service and distribution switchboards rated 600 V and less.
2. Transient voltage suppression devices.
3. Disconnecting and overcurrent protective devices.
4. Instrumentation.
5. Control power.
6. Accessory components and features.
7. Identification.
8. Mimic bus.

1.3 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Switchboards shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.
 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified .

1.4 SUBMITTALS

- A. Product Data: For each type of switchboard, overcurrent protective device, transient voltage suppression device, ground-fault protector, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
- B. Shop Drawings: For each switchboard and related equipment.
 1. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings.
 2. Detail enclosure types for types other than NEMA 250, Type 1.
 3. Detail bus configuration, current, and voltage ratings.

4. Detail short-circuit current rating of switchboards and overcurrent protective devices.
 5. Include descriptive documentation of optional barriers specified for electrical insulation and isolation.
 6. Detail utility company's metering provisions with indication of approval by utility company.
 7. Include evidence of NRTL listing for series rating of installed devices.
 8. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 9. Include time-current coordination curves for each type and rating of overcurrent protective device included in switchboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.
 10. Include diagram and details of proposed mimic bus.
 11. Include schematic and wiring diagrams for power, signal, and control wiring.
- C. Samples: Representative portion of mimic bus with specified material and finish, for color selection.
- D. Qualification Data: For qualified Installer.
- E. Seismic Qualification Certificates: Submit certification that switchboards, overcurrent protective devices, accessories, and components will withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems." Include the following:
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- F. Field Quality-Control Reports:
1. Test procedures used.
 2. Test results that comply with requirements.
 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
- G. Operation and Maintenance Data: For switchboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
1. Routine maintenance requirements for switchboards and all installed components.
 2. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
 3. Time-current coordination curves for each type and rating of overcurrent protective device included in switchboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers qualified as defined in NEMA PB 2.1 and trained in electrical safety as required by NFPA 70E.
- B. Testing Agency Qualifications: Member company of NETA or an NRTL.
 - 1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.
- C. Source Limitations: Obtain switchboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.
- D. Product Selection for Restricted Space: Drawings indicate maximum dimensions for switchboards including clearances between switchboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- F. Comply with NEMA PB 2.
- G. Comply with NFPA 70.
- H. Comply with UL 891.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver switchboards in sections or lengths that can be moved past obstructions in delivery path.
- B. Remove loose packing and flammable materials from inside switchboards and install temporary electric heating (250 W per section) to prevent condensation.
- C. Handle and prepare switchboards for installation according to NECA 400, NEMA PB 2.

1.7 PROJECT CONDITIONS

- A. Installation Pathway: Remove and replace access fencing, doors, lift-out panels, and structures to provide pathway for moving switchboards into place.
- B. Environmental Limitations:
 - 1. Do not deliver or install switchboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above switchboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - a. Ambient Temperature: Not exceeding 104 deg F (40 deg C).
 - b. Altitude: Not exceeding 6600 feet (2000 m).

M. Service Conditions: NEMA PB 2, usual service conditions, as follows:

1. Ambient temperatures within limits specified.
2. Altitude not exceeding 6600 feet (2000 m).

1.8 COORDINATION

- A. Coordinate layout and installation of switchboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.9 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.
 1. Warranty Period: Five years from date of Substantial Completion.

1.10 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Potential Transformer Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.
 2. Control-Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.
 3. Fuses and Fusible Devices for Fused Circuit Breakers: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
 4. Fuses for Fused Switches: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
 5. Fuses for Fused Power-Circuit Devices: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
 6. Indicating Lights: Equal to 10 percent of quantity installed for each size and type, but no fewer than one of each size and type.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - 3. Siemens Energy & Automation, Inc.
 - 4. Square D; a brand of Schneider Electric.
- C. Front-Connected, Front-Accessible Switchboards:
 - 1. Main Devices: Fixed, individually mounted.
 - 2. Branch Devices: Panel mounted.
 - 3. Sections front and rear aligned.
- D. Nominal System Voltage: 208Y/120 V.
- E. Main-Bus Continuous: 800 A.
- F. Seismic Requirements: Fabricate and test switchboards according to IEEE 344 to withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
- G. Indoor Enclosures: Steel, NEMA 250, Type 1.
- H. Enclosure Finish for Indoor Units: Factory-applied finish in manufacturer's standard gray finish over a rust-inhibiting primer on treated metal surface.
- I. Insulation and isolation for main and vertical buses of feeder sections.
- J. Cubical Space Heaters: Factory-installed electric space heaters of sufficient wattage in each vertical section to maintain enclosure temperature above expected dew point.
- K. Utility Metering Compartment: Fabricated, barrier compartment and section complying with utility company's requirements; hinged sealed door; buses provisioned for mounting utility company's current transformers and potential transformers or potential taps as required by utility company. If separate vertical section is required for utility metering, match and align with basic switchboard. Provide service entrance label and necessary applicable service entrance features.
- L. Customer Metering Compartment: A separate customer metering compartment and section with front hinged door, for indicated metering, and current transformers for each meter.

Current transformer secondary wiring shall be terminated on shorting-type terminal blocks. Include potential transformers having primary and secondary fuses with disconnecting means and secondary wiring terminated on terminal blocks.

- M. Bus Transition and Incoming Pull Sections: Matched and aligned with basic switchboard.
- N. Removable, Hinged Rear Doors and Compartment Covers: Secured by standard bolts, for access to rear interior of switchboard.
- O. Hinged Front Panels: Allow access to circuit breaker, metering, accessory, and blank compartments.
- P. Pull Box on Top of Switchboard:
 - 1. Adequate ventilation to maintain temperature in pull box within same limits as switchboard.
 - 2. Set back from front to clear circuit-breaker removal mechanism.
 - 3. Removable covers shall form top, front, and sides. Top covers at rear shall be easily removable for drilling and cutting.
 - 4. Bottom shall be insulating, fire-resistive material with separate holes for cable drops into switchboard.
 - 5. Cable supports shall be arranged to facilitate cabling and adequate to support cables indicated, including those for future installation.
- Q. Buses and Connections: Three phase, four wire unless otherwise indicated.
 - 1. Phase- and Neutral-Bus Material: Hard-drawn copper of 98 percent conductivity, silver-plated, with copper tin-plated copper feeder circuit-breaker line connections.
 - 2. Load Terminals: Insulated, rigidly braced, runback bus extensions, of same material as through buses, equipped with mechanical connectors for outgoing circuit conductors. Provide load terminals for future circuit-breaker positions at full-ampere rating of switches position.
 - 3. Ground Bus: Minimum-size required by UL 891, hard-drawn copper of 98 percent conductivity, equipped with mechanical connectors for feeder and branch-circuit ground conductors.
 - 4. Main Phase Buses and Equipment Ground Buses: Uniform capacity for entire length of switchboard's main and distribution sections. Provide for future extensions from both ends.
 - 5. Neutral Buses: 100 percent of the ampacity of phase buses unless otherwise indicated, equipped with mechanical connectors for outgoing circuit neutral cables.
 - 6. Isolation Barrier Access Provisions: Permit checking of bus-bolt tightness.
- R. Future Devices: Equip compartments with mounting brackets, supports, bus connections, and appurtenances at full rating of switch compartment.
- S. Bus-Bar Insulation: Factory-applied, flame-retardant, tape wrapping of individual bus bars or flame-retardant, spray-applied insulation. Minimum insulation temperature rating of 105 deg C.

2.2 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Bolted-Pressure Contact Switch: Operating mechanism uses rotary-mechanical-bolting action to produce and maintain high clamping pressure on the switch blade after it engages the stationary contacts.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Boltswitch, Inc.
 - b. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - c. Pringle Electrical Manufacturing Company, Inc.
 - d. Siemens Energy & Automation, Inc.
 - e. Square D; a brand of Schneider Electric.
 - 2. Main-Contact Interrupting Capability: Minimum of 12 times the switch current rating.
 - 3. Operating Mechanism: Manual handle operation to close switch; stores energy in mechanism for opening and closing.
 - a. Electrical Trip: Operation of lever or push-button trip switch, or trip signal from ground-fault relay or remote-control device, causes switch to open.
 - b. Mechanical Trip: Operation of mechanical lever, push button, or other device causes switch to open.
 - 4. Auxiliary Switches: Factory installed, single pole, double throw, with leads connected to terminal block, and including one set more than quantity required for functional performance indicated.
 - 5. Service-Rated Switches: Labeled for use as service equipment.
- B. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.
- C. Fuses are specified in Division 26 Section "Fuses."

2.3 INSTRUMENTATION

- A. Instrument Transformers: IEEE C57.13, NEMA EI 21.1, and the following:
 - 1. Current Transformers: IEEE C57.13; 5 A, 60 Hz, secondary; bar or window type; single secondary winding and secondary shorting device. Burden and accuracy shall be consistent with connected metering and relay devices.
- B. Multifunction Digital-Metering Monitor: Microprocessor-based unit suitable for three- or four-wire systems and with the following features:
 - 1. Switch-selectable digital display of the following values with maximum accuracy tolerances as indicated:
 - a. Phase Currents, Each Phase: Plus or minus 1 percent.
 - b. Phase-to-Phase Voltages, Three Phase: Plus or minus 1 percent.

- c. Phase-to-Neutral Voltages, Three Phase: Plus or minus 1 percent.
- 2. Mounting: Display and control unit flush or semiflush mounted in instrument compartment door.
- C. Ammeters, Voltmeters: ANSI C39.1.
 - 1. Meters: 4-inch (100-mm) diameter or 6 inches (150 mm) square, flush or semiflush, with antiparallax 250-degree scales and external zero adjustment.
 - 2. Voltmeters: Cover an expanded-scale range of nominal voltage plus 10 percent.
- D. Instrument Switches: Rotary type with off position.
 - 1. Voltmeter Switches: Permit reading of all phase-to-phase voltages and, where a neutral is indicated, phase-to-neutral voltages.
 - 2. Ammeter Switches: Permit reading of current in each phase and maintain current-transformer secondaries in a closed-circuit condition at all times.
- E. Watt-Hour Meters and Wattmeters:
 - 1. Comply with ANSI C12.1.
 - 2. Three-phase induction type with two stators, each with current and potential coil, rated 5 A, 120 V, 60 Hz.
 - 3. Suitable for connection to three- and four-wire circuits.
 - 4. Potential indicating lamps.
 - 5. Adjustments for light and full load, phase balance, and power factor.
 - 6. Four-dial clock register.
 - 7. Integral demand indicator.
 - 8. Contact devices to operate remote impulse-totalizing demand meter.
 - 9. Ratchets to prevent reverse rotation.
 - 10. Removable meter with drawout test plug.
 - 11. Semiflush mounted case with matching cover.
 - 12. Appropriate multiplier tag.
- F. Impulse-Totalizing Demand Meter:
 - 1. Comply with ANSI C12.1.
 - 2. Suitable for use with switchboard watt-hour meter, including two-circuit totalizing relay.
 - 3. Cyclometer.
 - 4. Four-dial, totalizing kilowatt-hour register.
 - 5. Positive chart drive mechanism.
 - 6. Capillary pen holding a minimum of one month's ink supply.
 - 7. Roll chart with minimum 31-day capacity; appropriate multiplier tag.
 - 8. Capable of indicating and recording [five] -minute integrated demand of totalized system.

2.4 IDENTIFICATION

- A. Mimic Bus: Entire single-line switchboard bus work, as depicted on factory record drawing, on a photoengraved nameplate.

1. Nameplate: At least 0.032-inch- (0.813-mm-) thick anodized aluminum, located at eye level on front cover of the switchboard incoming service section.
- B. Mimic Bus: Entire single-line switchboard bus work, as depicted on factory record drawing, on an engraved laminated-plastic (Gravoply) nameplate.
 1. Nameplate: At least 0.0625-inch- (1.588 mm-) thick laminated plastic (Gravoply), located at eye level on front cover of the switchboard incoming service section.
- C. Mimic Bus: Continuously integrated mimic bus factory applied to front of switchboard. Arrange in single-line diagram format, using symbols and letter designations consistent with final mimic-bus diagram.
- D. Coordinate mimic-bus segments with devices in switchboard sections to which they are applied. Produce a concise visual presentation of principal switchboard components and connections.
- E. Presentation Media: Painted graphics in color contrasting with background color to represent bus and components, complete with lettered designations.
- F. Service Equipment Label: NRTL labeled for use as service equipment for switchboards with one or more service disconnecting and overcurrent protective devices.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Receive, inspect, handle, and store switchboards according to NECA 400, NEMA PB 2.1.
- B. Examine switchboards before installation. Reject switchboards that are moisture damaged or physically damaged.
- C. Examine elements and surfaces to receive switchboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install switchboards and accessories according to NECA 400, NEMA PB 2.1.
- B. Equipment Mounting: Install switchboards on concrete base, 4-inch (100-mm) nominal thickness. Comply with requirements for concrete base specified in Division 03 Section "Cast-in-Place Concrete."

1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.
 2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 4. Install anchor bolts to elevations required for proper attachment to switchboards.
- C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from switchboard units and components.
- D. Comply with mounting and anchoring requirements specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
- E. Operating Instructions: Frame and mount the printed basic operating instructions for switchboards, including control and key interlocking sequences and emergency procedures. Fabricate frame of finished wood or metal and cover instructions with clear acrylic plastic. Mount on front of switchboards.
- F. Install filler plates in unused spaces of panel-mounted sections.
- G. Install overcurrent protective devices, transient voltage suppression devices, and instrumentation.
1. Set field-adjustable switches/fuse ranges.
- H. Install spare-fuse cabinet.
- I. Comply with NECA 1.

3.3 CONNECTIONS

- A. Comply with requirements for terminating feeder bus specified in Division 26 Section "Enclosed Bus Assemblies." Drawings indicate general arrangement of bus, fittings, and specialties.

3.4 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
- B. Switchboard Nameplates: Label each switchboard compartment with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
- C. Device Nameplates: Label each disconnecting and overcurrent protective device and each meter and control device mounted in compartment doors with a nameplate complying with

requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- C. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- D. Acceptance Testing Preparation:
 - 1. Test insulation resistance for each switchboard bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- E. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
 - 3. Perform the following infrared scan tests and inspections and prepare reports:
 - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switchboard. Remove front and rear panels so joints and connections are accessible to portable scanner.
 - b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switchboard 11 months after date of Substantial Completion.
 - c. Instruments and Equipment:
 - 1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 - 4. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- F. Switchboard will be considered defective if it does not pass tests and inspections.
- G. Prepare test and inspection reports, including a certified report that identifies switchboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.6 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges as indicated.

3.7 PROTECTION

- A. Temporary Heating: Apply temporary heat, to maintain temperature according to manufacturer's written instructions, until switchboard is ready to be energized and placed into service.

3.8 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain switchboards, overcurrent protective devices, instrumentation, and accessories.

END OF SECTION 262413

SECTION 262416 - PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Distribution panelboards.
 - 2. Lighting and appliance branch-circuit panelboards.
 - 3. Load centers.
 - 4. Electronic-grade panelboards.

1.3 DEFINITIONS

- A. SVR: Suppressed voltage rating.
- B. TVSS: Transient voltage surge suppressor.

1.4 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Panelboards shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.
 - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

1.5 SUBMITTALS

- A. Product Data: For each type of panelboard, switching and overcurrent protective device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each panelboard and related equipment.
 - 1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
 - 2. Detail enclosure types and details for types other than NEMA 250, Type 1.
 - 3. Detail bus configuration, current, and voltage ratings.

4. Short-circuit current rating of panelboards and overcurrent protective devices.
 5. Include evidence of NRTL listing for series rating of installed devices.
 6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 7. Include wiring diagrams for power, signal, and control wiring.
 8. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graph paper; include selectable ranges for each type of overcurrent protective device.
- C. Qualification Data: For qualified testing agency.
- D. Seismic Qualification Certificates: Submit certification that panelboards, overcurrent protective devices, accessories, and components will withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems." Include the following:
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- E. Field Quality-Control Reports:
1. Test procedures used.
 2. Test results that comply with requirements.
 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
- F. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.
- G. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
 2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Member company of NETA or an NRTL.
1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

- B. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.
- C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- E. Comply with NEMA PB 1.
- F. Comply with NFPA 70.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.
- B. Handle and prepare panelboards for installation according to NECA 407 NEMA PB 1.

1.8 PROJECT CONDITIONS

- A. Environmental Limitations:
 - 1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
 - 2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - a. Ambient Temperature: Not exceeding minus 22 deg F (minus 30 deg C) [23 deg F (minus 5 deg C) to plus 104 deg F (plus 40 deg C).
 - b. Altitude: Not exceeding 6600 feet (2000 m).
- B. Service Conditions: NEMA PB 1, usual service conditions, as follows:
 - 1. Ambient temperatures within limits specified.
 - 2. Altitude not exceeding 6600 feet (2000 m).

1.9 COORDINATION

- A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

- B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.10 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Five years from date of Substantial Completion.

1.11 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Keys: Two spares for each type of panelboard cabinet lock.
 - 2. Circuit Breakers Including GFCI and Ground Fault Equipment Protection (GFEP) Types: Two spares for each panelboard.
 - 3. Fuses for Fused Switches: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

PART 2 - PRODUCTS

2.01 GENERAL REQUIREMENTS FOR PANELBOARDS

- A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
- B. Enclosures: Flush- and surface-mounted cabinets.
 - 1. Rated for environmental conditions at installed location.
 - a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
 - b. Outdoor Locations: NEMA 250, Type 3R.
 - c. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.
 - 2. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
 - 3. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
 - 4. Skirt for Surface-Mounted Panelboards: Same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and ceiling or floor.

5. Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.
 6. Finishes:
 - a. Panels and Trim: galvanized steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
 - b. Back Boxes: Same finish as panels and trim.
 - c. Fungus Proofing: Permanent fungicidal treatment for overcurrent protective devices and other components.
 7. Directory Card: Inside panelboard door, mounted in metal frame with transparent protective cover.
- C. Incoming Mains Location: Top and bottom.
- D. Phase, Neutral, and Ground Buses:
1. Material: Hard-drawn copper, 98 percent conductivity.
 2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
 3. Extra-Capacity Neutral Bus: Neutral bus rated 200 percent of phase bus and UL listed as suitable for nonlinear loads.
 4. Split Bus: Vertical buses divided into individual vertical sections.
- E. Conductor Connectors: Suitable for use with conductor material and sizes.
1. Material: Hard-drawn copper, 98 percent conductivity.
 2. Main and Neutral Lugs: Mechanical type.
 3. Ground Lugs and Bus-Configured Terminators: Mechanical type.
 4. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
 5. Subfeed (Double) Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
 6. Gutter-Tap Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
- F. Service Equipment Label: NRTL labeled for use as service equipment for panelboards or load centers with one or more main service disconnecting and overcurrent protective devices.
- G. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
- H. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals.

2.2 DISTRIBUTION PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - 3. Siemens Energy & Automation, Inc.
 - 4. Square D; a brand of Schneider Electric.
- C. Panelboards: NEMA PB 1, power and feeder distribution type.
- D. Doors: Secured with vault-type latch with tumbler lock; keyed alike.
 - 1. For doors more than 36 inches (914 mm) high, provide two latches, keyed alike.
- E. Mains: Fused switch.
- F. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.
- G. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers.
- H. Branch Overcurrent Protective Devices: Fused switches.

2.3 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - 3. Siemens Energy & Automation, Inc.
 - 4. Square D; a brand of Schneider Electric.
- C. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- D. Mains: Circuit breaker or lugs only.
- E. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

- F. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.
- G. Column-Type Panelboards: Narrow gutter extension, with cover, to overhead junction box equipped with ground and neutral terminal buses.

2.4 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - 3. Siemens Energy & Automation, Inc.
 - 4. Square D; a brand of Schneider Electric.
- C. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.
 - 1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 - 2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
 - 3. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings:
 - a. Instantaneous trip.
 - b. Long- and short-time pickup levels.
 - c. Long- and short-time time adjustments.
 - d. Ground-fault pickup level, time delay, and I^2t response.
 - 4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
 - 5. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
 - 6. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).
 - 7. Arc-Fault Circuit Interrupter (AFCI) Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.
 - 8. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:
 - a. Standard frame sizes, trip ratings, and number of poles.
 - b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.

- c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
- d. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
- e. Communication Capability: Universal-mounted communication module with functions and features compatible with power monitoring and control system specified in Division 26 Section "Electrical Power Monitoring and Control."
- f. Shunt Trip: 120 -V trip coil energized from separate circuit, set to trip at 75 percent of rated voltage.
- g. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage with field-adjustable 0.1- to 0.6-second time delay.
- h. Auxiliary Contacts: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts and "b" contacts operate in reverse of circuit-breaker contacts.
- i. Alarm Switch: Single-pole, normally open contact that actuates only when circuit breaker trips.
- j. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
- k. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function with other upstream or downstream devices.
- l. Multipole units enclosed in a single housing or factory assembled to operate as a single unit.
- m. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in on or off position.
- n. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.

D. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.

- 1. Fuses, and Spare-Fuse Cabinet: Comply with requirements specified in Division 26 Section "Fuses."
- 2. Fused Switch Features and Accessories: Standard ampere ratings and number of poles.
- 3. Auxiliary Contacts: Two normally open and normally closed contact(s) that operate with switch handle operation.

2.6 ACCESSORY COMPONENTS AND FEATURES

- A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.
- B. Portable Test Set: For testing functions of solid-state trip devices without removing from panelboard. Include relay and meter test plugs suitable for testing panelboard meters and switchboard class relays.

2.7 APARTMENT LOAD CENTERS

- A. Panel shall be dead front circuit breaker type 120/240V, 1phase, 3 wire as shown. Panel shall be flush mounted of code gage steel cabinet and shall be rated as indicated on plans. Circuit breakers shall be of the plug-in type rated 10,000 A.C. min. or as indicated on schedules.
- B. Provide "ARC" fault circuit interrupter circuit breakers (AFCI) and comply with UL 1699-120/240V, single pole configuration.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Receive, inspect, handle, and store panelboards according to NECA 407 NEMA PB 1.1.
- B. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.
- C. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install panelboards and accessories according to NECA 407, NEMA PB 1.1.
- B. Equipment Mounting: Install panelboards on concrete bases, 4-inch (100-mm) nominal thickness. Comply with requirements for concrete base specified in Division 03 Section "Cast-in-Place Concrete".
 - 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around full perimeter of base.
 - 2. For panelboards, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 - 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 4. Install anchor bolts to elevations required for proper attachment to panelboards.
 - 5. Attach panelboard to the vertical finished or structural surface behind the panelboard.
- C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.
- D. Comply with mounting and anchoring requirements specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
- E. Mount top of trim 90 inches (2286 mm) above finished floor unless otherwise indicated.

- F. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- G. Install overcurrent protective devices and controllers not already factory installed.
 - 1. Set field-adjustable, circuit-breaker trip ranges.
- H. Install filler plates in unused spaces.
- I. Stub four 1-inch (27-GRC) empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch (27-GRC) empty conduits into raised floor space or below slab not on grade.
- J. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.
- K. Comply with NECA 1.

3.3 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Division 26 Section "Identification for Electrical Systems."
- B. Retain option in first paragraph below if retaining "Load Balancing" Paragraph in "Adjusting" Article.
- C. Create a directory to indicate installed circuit loads after balancing panelboard loads; incorporate Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.
- D. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
- E. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- C. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Acceptance Testing Preparation:

1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

E. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
3. Perform the following infrared scan tests and inspections and prepare reports:
 - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each panelboard. Remove front panels so joints and connections are accessible to portable scanner.
 - b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each panelboard 11 months after date of Substantial Completion.
 - c. Instruments and Equipment:
 - 1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

F. Panelboards will be considered defective if they do not pass tests and inspections.

G. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

- A. Adjust moving parts and operable component to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges as indicated.
- C. Circuit changes made during load balancing may negate color-coding of phases and circuits. If load balancing proves undesirable or is to be performed by others, delete paragraph below.
- D. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes.
 1. Measure as directed during period of normal system loading.

2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed. Avoid disrupting critical 24-hour services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.
4. Tolerance: Difference exceeding 20 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.

3.6 PROTECTION

- A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions.

END OF SECTION 262416

SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Receptacles, receptacles with integral GFCI, and associated device plates.
 - 2. Twist-locking receptacles.
 - 3. Receptacles with integral surge suppression units.
 - 4. Wall-box motion sensors.
 - 5. Wall-switch and exterior occupancy sensors.
 - 6. Communications outlets.
 - 7. Cord and plug sets.
- B. Related Sections include the following:
 - 1. Division 27 Section "Communications Horizontal Cabling" for workstation outlets.

1.3 DEFINITIONS

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

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.
- C. Samples: One for each type of device and wall plate specified, in each color specified.

- D. Field quality-control test reports.
- E. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing label warnings and instruction manuals that include labeling conditions.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of wiring device and associated wall plate through one source from a single manufacturer. Insofar as they are available, obtain all wiring devices and associated wall plates from a single manufacturer and one source.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NFPA 70.

1.6 COORDINATION

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

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

2.2 STRAIGHT BLADE RECEPTACLES

- A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 5351 (single), 5352 (duplex).

- b. Hubbell; HBL5351 (single), CR5352 (duplex).
- c. Leviton; 5891 (single), 5352 (duplex).
- d. Pass & Seymour; 5381 (single), 5352 (duplex).

2.3 GFCI RECEPTACLES

- A. General Description: Straight blade, feed-through type. Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 943, Class A, and include indicator light that is lighted when device is tripped.
- B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; GF20.
 - b. Pass & Seymour; 2084.

2.4 HAZARDOUS (CLASSIFIED) LOCATION RECEPTACLES

- A. Available Wiring Devices for Hazardous (Classified) Locations: Comply with NEMA FB 11 and UL 1010.
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cooper Crouse-Hinds.
 - b. EGS/Appleton Electric.
 - c. Killark; a division of Hubbell Inc.

2.5 TWIST-LOCKING RECEPTACLES

- A. Single Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration L5-20R, and UL 498.
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; L520R.
 - b. Hubbell; HBL2310.
 - c. Leviton; 2310.
 - d. Pass & Seymour; L520-R.

2.6 CORD AND PLUG SETS

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

2.7 SNAP SWITCHES

- A. Comply with NEMA WD 1 and UL 20.
- B. Switches, 120/277 V, 20 A:
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 2221 (single pole), 2222 (two pole), 2223 (three way), 2224 (four way).
 - b. Hubbell; CS1221 (single pole), CS1222 (two pole), CS1223 (three way), CS1224 (four way).
 - c. Leviton; 1221-2 (single pole), 1222-2 (two pole), 1223-2 (three way), 1224-2 (four way).
 - d. Pass & Seymour; 20AC1 (single pole), 20AC2 (two pole), 20AC3 (three way), 20AC4 (four way).
- C. Pilot Light Switches, 20 A:
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 2221PL for 120 V and 277 V.
 - b. Hubbell; HPL1221PL for 120 V and 277 V.
 - c. Leviton; 1221-PLR for 120 V, 1221-7PLR for 277 V.
 - d. Pass & Seymour; PS20AC1-PLR for 120 V.
 - 3. Description: Single pole, with neon-lighted handle, illuminated when switch is "ON."
- D. Key-Operated Switches, 120/277 V, 20 A:
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 2221L.

- b. Hubbell; HBL1221L.
 - c. Leviton; 1221-2L.
 - d. Pass & Seymour; PS20AC1-L.
 3. Description: Single pole, with factory-supplied key in lieu of switch handle.
- E. Single-Pole, Double-Throw, Momentary Contact, Center-Off Switches, 120/277 V, 20 A; for use with mechanically held lighting contactors.
 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 1995.
 - b. Hubbell; HBL1557.
 - c. Leviton; 1257.
 - d. Pass & Seymour; 1251.

2.8 OCCUPANCY SENSORS

A. Wall-Switch Sensors:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 6111 for 120 V, 6117 for 277 V.
 - b. Hubbell; WS1277.
 - c. Leviton; ODS 10-ID.
 - d. Pass & Seymour; WS3000.
 - e. Philips Lighting Controls.
3. Description: Passive-infrared type, 120/277 V, adjustable time delay up to 30 minutes, 180-degree field of view, with a minimum coverage area of 900 sq. ft. (84 sq. m).

B. Wall-Switch Sensors:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Hubbell; AT120 for 120 V, AT277 for 277 V.
 - b. Leviton; ODS 15-ID.
 - c. Philips Lighting Control LRS 2215
3. Description: Adaptive-technology type, 120/277 V, adjustable time delay up to 20 minutes, 180-degree field of view, with a minimum coverage area of 900 sq. ft. (84 sq. m).

C. Long-Range Wall-Switch Sensors:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Hubbell; ATP1600WRP.
 - b. Leviton; ODWWV-IRW.
 - c. Pass & Seymour; WA1001.
 - d. Watt Stopper (The); CX-100.
 - e. Philips Lighting Control LRM 500.
3. Description: Passive-infrared type, 120/277 V, adjustable time delay up to 30 minutes, 110-degree field of view, with a minimum coverage area of 1200 sq. ft. (111 sq. m).

D. Long-Range Wall-Switch Sensors:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Hubbell; ATD1600WRP.
 - b. Leviton; ODW12-MRW.
 - c. Watt Stopper (The); DT-200.
 - d. Philips Lighting Controls.
3. Description: Dual technology, with both passive-infrared- and ultrasonic-type sensing, 120/277 V, adjustable time delay up to 30 minutes, 110-degree field of view, and a minimum coverage area of 1200 sq. ft. (111 sq. m).

E. Wide-Range Wall-Switch Sensors:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Hubbell; ATP120HBRP.
 - b. Leviton; ODWHB-IRW.
 - c. Pass & Seymour; HS1001.
 - d. Watt Stopper (The); CX-100-3.
 - e. Philips Lighting Controls.
3. Description: Passive-infrared type, 120/277 V, adjustable time delay up to 30 minutes, 150-degree field of view, with a minimum coverage area of 1200 sq. ft. (111 sq. m).

2.9 COMMUNICATIONS OUTLETS

A. Telephone Outlet:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 3560-6.
 - b. Leviton; 40649.
 - c. Siemon.
3. Description: Single RJ-45 jack for terminating 100-ohm, balanced, four-pair UTP; TIA/EIA-568-B.1; complying with Category 5e. Comply with UL 1863.

B. Combination TV and Telephone Outlet:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 3562.
 - b. Leviton; 40595.
 - c. Siemon.
3. Description: Single RJ-45 jack for 100-ohm, balanced, four-pair UTP; TIA/EIA-568-B.1; complying with Category 5e; and one Type F coaxial cable connector.

2.10 WALL PLATES

- A. Single and combination types to match corresponding wiring devices.
1. Plate-Securing Screws: Metal with head color to match plate finish.
 2. Material for Finished Spaces: 0.035-inch- (1-mm-) thick, satin-finished stainless steel finish.
 3. Material for Unfinished Spaces: Galvanized steel.
 4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in "wet locations."
- B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with type 3R weather-resistant, die-cast aluminum with lockable cover.

2.11 FINISHES

- A. Color: Wiring device catalog numbers in Section Text do not designate device color.
1. Wiring Devices Connected to Normal Power System: As selected by Architect, unless otherwise indicated or required by NFPA 70 or device listing.
 2. Wiring Devices Connected to Emergency Power System: Red.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.
- B. Coordination with Other Trades:
 - 1. Take steps to insure that devices and their boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of the boxes.
 - 2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
 - 3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
 - 4. Install wiring devices after all wall preparation, including painting, is complete.
- C. Conductors:
 - 1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
 - 2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
 - 3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
- D. Device Installation:
 - 1. Replace all devices that have been in temporary use during construction or that show signs that they were installed before building finishing operations were complete.
 - 2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
 - 3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
 - 4. Connect devices to branch circuits using pigtails that are not less than 6 inches (152 mm) in length.
 - 5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw.
 - 6. Use a torque screwdriver when a torque is recommended or required by the manufacturer.
 - 7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
 - 8. Tighten unused terminal screws on the device.
 - 9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.
- E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles down, and on horizontally mounted receptacles to the right.
 2. Install hospital-grade receptacles in patient-care areas with the ground pin or neutral blade at the top.
- F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.
- G. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

3.2 IDENTIFICATION

- A. Comply with Division 26 Section "Identification for Electrical Systems."
1. Receptacles: Identify panelboard and circuit number from which served. Use hot, stamped or engraved machine printing with black]-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

3.3 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
1. Test Instruments: Use instruments that comply with UL 1436.
 2. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated LED indicators of measurement.
- B. Tests for Convenience Receptacles:
1. Line Voltage: Acceptable range is 105 to 132 V.
 2. Ground Impedance: Values of up to 2 ohms are acceptable.
 3. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
 4. Using the test plug, verify that the device and its outlet box are securely mounted.
 5. The tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

END OF SECTION 262726

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SECTION 262813 - FUSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

1. Cartridge fuses rated 600-V ac and less for use in control circuits enclosed switches panelboards switchboards enclosed controllers and motor-control centers.
2. Plug fuses rated 125-V ac and less for use in plug-fuse-type enclosed switches fuseholders and panelboards.
3. Plug-fuse adapters for use in Edison-base, plug-fuse sockets.
4. Spare-fuse cabinets.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material, dimensions, descriptions of individual components, and finishes for spare-fuse cabinets. Include the following for each fuse type indicated:

1. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.
 - a. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.
 - b. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.
2. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
3. Current-limitation curves for fuses with current-limiting characteristics.
4. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse.
5. Coordination charts and tables and related data.
6. Fuse sizes for elevator feeders and elevator disconnect switches.

- B. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Ambient temperature adjustment information.
2. Current-limitation curves for fuses with current-limiting characteristics.
3. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse.
4. Coordination charts and tables and related data.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with NEMA FU 1 for cartridge fuses.
- D. Comply with NFPA 70.
- E. Comply with UL 248-11 for plug fuses.

1.5 PROJECT CONDITIONS

- A. For fuses installed outdoors or in unusual environmental conditions, revise this article to indicate minimum and maximum ambient temperatures and expected humidity range. See Editing Instruction No. 4 in the Evaluations.
- B. Where ambient temperature to which fuses are directly exposed is less than 40 deg F (5 deg C) or more than 100 deg F (38 deg C) , apply manufacturer's ambient temperature adjustment factors to fuse ratings.

1.6 COORDINATION

- A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

1.7 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Cooper Bussmann, Inc.
 - 2. Edison Fuse, Inc.
 - 3. Ferraz Shawmut, Inc.
 - 4. Littelfuse, Inc.

2.2 CARTRIDGE FUSES

- A. Characteristics: NEMA FU 1, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.

2.3 PLUG FUSES

- A. Characteristics: UL 248-11, nonrenewable plug fuses; 125-V ac.

2.4 PLUG-FUSE ADAPTERS

- A. Characteristics: Adapters for using Type S, rejection-base plug fuses in Edison-base fuseholders or sockets; ampere ratings matching fuse ratings; irremovable once installed.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.
- B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.
- C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.
- D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FUSE APPLICATIONS

A. Cartridge Fuses:

1. Service Entrance: Class L, time delay Class RK1, time delay Class J, time delay.
2. Feeders: Class L, time delay, Class RK1, time delay Class RK5, time delay Class J, time delay.
3. Motor Branch Circuits: Class RK1 Class RK5, time delay.
4. Other Branch Circuits: Class RK1, time delay Class RK5, time delay Class J, time delay.
5. Control Circuits: Class CC, time delay.

B. Plug Fuses:

1. Motor Branch Circuits: Edison-base type, dual Type S, dual-element time delay.
2. Other Branch Circuits: Edison-base type, dual-element time delay Type S, dual-element time delay.

3.3 INSTALLATION

- A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.
- B. Install plug-fuse adapters in Edison-base fuseholders and sockets. Ensure that adapters are irremovable once installed.
- C. Install spare-fuse cabinet(s).

3.4 IDENTIFICATION

- A. Install labels complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems" and indicating fuse replacement information on inside door of each fused switch and adjacent to each fuse block, socket, and holder.

END OF SECTION 262813

SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Fusible switches.
 - 2. Non-fusible switches.
 - 3. Receptacle switches.
 - 4. Shunt trip switches.
 - 5. Molded-case circuit breakers (MCCBs).
 - 6. Molded-case switches.
 - 7. Enclosures.

1.3 DEFINITIONS

- A. NC: Normally closed.
- B. NO: Normally open.
- C. SPDT: Single pole, double throw.

1.4 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Enclosed switches and circuit breakers shall withstand the effects of earthquake motions determined according to [ASCE/SEI 7] <Insert requirement>.
 - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified[**and the unit will be fully operational after the seismic event**]."

1.5 SUBMITTALS

- A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.

1. Enclosure types and details for types other than NEMA 250, Type 1.
 2. Current and voltage ratings.
 3. Short-circuit current ratings (interrupting and withstand, as appropriate).
 4. Include evidence of NRTL listing for series rating of installed devices.
 5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
 6. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.[**Submit on translucent log-log graph paper.**]
- B. Shop Drawings: For enclosed switches and circuit breakers. Include plans, elevations, sections, details, and attachments to other work.
1. Wiring Diagrams: For power, signal, and control wiring.
- C. Qualification Data: For qualified testing agency.
- D. Seismic Qualification Certificates: For enclosed switches and circuit breakers, accessories, and components, from manufacturer.
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- E. Field quality-control reports.
1. Test procedures used.
 2. Test results that comply with requirements.
 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
- F. Manufacturer's field service report.
- G. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
 2. Time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.[**Submit on translucent log-log graph paper.**]

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.
- B. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single source from single manufacturer.
- C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- E. Comply with NFPA 70.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 1. Ambient Temperature: Not less than **minus 22 deg F (minus 30 deg C)** and not exceeding **104 deg F (40 deg C)**.
 2. Altitude: Not exceeding **6600 feet (2010 m)**.
- B. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
 1. Notify **[Architect] [Construction Manager] [Owner]** no fewer than **[seven]** **<Insert number>** days in advance of proposed interruption of electric service.
 2. Indicate method of providing temporary electric service.
 3. Do not proceed with interruption of electric service without **[Architect's] [Construction Manager's] [Owner's]** written permission.
 4. Comply with NFPA 70E.

1.8 COORDINATION

- A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

1.9 EXTRA MATERIALS

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

1. Fuses: Equal to [10] <Insert number> percent of quantity installed for each size and type, but no fewer than [three] <Insert number> of each size and type.
2. Fuse Pullers: [Two] <Insert number> for each size and type.
3. <Insert extra materials>.

PART 2 - PRODUCTS

2.1 FUSIBLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide [product indicated on Drawings] <Insert manufacturer's name; product name or designation> or comparable product by one of the following:
 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 3. Siemens Energy & Automation, Inc.
 4. Square D; a brand of Schneider Electric.
 5. <Insert manufacturer's name>.
- C. Type GD, General Duty, Single Throw, 240-V ac, 800 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with [cartridge] [plug] fuse interiors to accommodate [specified] [indicated] fuses, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.
- D. Type HD, Heavy Duty, Single Throw, [240] [600]-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate [specified] [indicated] fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- E. Type HD, Heavy Duty, Six Pole, Single Throw, [240] [600]-V ac, 200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate [specified] [indicated] fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- F. Type HD, Heavy Duty, Double Throw, [240] [600]-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate [specified] [indicated] fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- G. Accessories:
 1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.

2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Isolated Ground Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
4. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
5. Auxiliary Contact Kit: **[One]** **[Two]** NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.
6. Hookstick Handle: Allows use of a hookstick to operate the handle.
7. Lugs: **[Mechanical]** **[Compression]** type, suitable for number, size, and conductor material.
8. Service-Rated Switches: Labeled for use as service equipment.
9. Accessory Control Power Voltage: Remote mounted and powered; **[24-V ac]** **[120-V ac]** **[208-V ac]** **[240-V ac]** **[6-V dc]** **[12-V dc]** **[24-V dc]**.

2.2 NONFUSIBLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, **[provide products by one of the following]** **[available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:**
- B. Basis-of-Design Product: Subject to compliance with requirements, provide **[product indicated on Drawings]** **<Insert manufacturer's name; product name or designation>** or comparable product by one of the following:
 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 3. Siemens Energy & Automation, Inc.
 4. Square D; a brand of Schneider Electric.
 5. **<Insert manufacturer's name>**.
- C. Type GD, General Duty, Single Throw, 600 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.
- D. Type HD, Heavy Duty, Single Throw, **[240]** **[600]**-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- E. Type HD, Heavy Duty, Six Pole, Single Throw, **[240]** **[600]**-V ac, 200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- F. Type HD, Heavy Duty, Double Throw, **[240]** **[600]**-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- G. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Isolated Ground Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
4. Auxiliary Contact Kit: **[One] [Two]** NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.
5. Hookstick Handle: Allows use of a hookstick to operate the handle.
6. Lugs: **[Mechanical] [Compression]** type, suitable for number, size, and conductor material.
7. Accessory Control Power Voltage: Remote mounted and powered; **[24-V ac] [120-V ac] [208-V ac] [240-V ac] [6-V dc] [12-V dc] [24-V dc]**.

2.3 RECEPTACLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, **[provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:**
- B. Basis-of-Design Product: Subject to compliance with requirements, provide **[product indicated on Drawings] <Insert manufacturer's name; product name or designation>** or comparable product by one of the following:
 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 3. Siemens Energy & Automation, Inc.
 4. Square D; a brand of Schneider Electric.
 5. **<Insert manufacturer's name>**.
- C. Type HD, Heavy-Duty, Single-Throw Fusible Switch: **[240] [600]-V ac, [30] [60] [100] A;** UL 98 and NEMA KS 1; horsepower rated, with clips or bolt pads to accommodate **[specified] [indicated]** fuses; lockable handle with capability to accept three padlocks; interlocked with cover in closed position.
- D. Type HD, Heavy-Duty, Single-Throw Nonfusible Switch: **[240] [600]-V ac, [30] [60] [100] A;** UL 98 and NEMA KS 1; horsepower rated, lockable handle with capability to accept three padlocks; interlocked with cover in closed position.
- E. Interlocking Linkage: Provided between the receptacle and switch mechanism to prevent inserting or removing plug while switch is in the on position, inserting any plug other than specified, and turning switch on if an incorrect plug is inserted or correct plug has not been fully inserted into the receptacle.
- F. Receptacle: Polarized, three-phase, four-wire receptacle (fourth wire connected to enclosure ground lug).
 1. Receptacle Manufacturer and Catalog Number: **<Insert manufacturer and catalog number>**.

2.4 SHUNT TRIP SWITCHES

- A. Manufacturers: Subject to compliance with requirements, **[provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:**
- B. Basis-of-Design Product: Subject to compliance with requirements, provide **[product indicated on Drawings] <Insert manufacturer's name; product name or designation>** or comparable product by one of the following:
 - 1. Cooper Bussmann, Inc.
 - 2. Ferraz Shawmut, Inc.
 - 3. Littelfuse, Inc.
 - 4. **<Insert manufacturer's name>**.
- C. General Requirements: Comply with **[ASME A17.1,]** UL 50, and UL 98, with 200-kA interrupting and short-circuit current rating when fitted with Class J fuses.
- D. Switches: Three-pole, horsepower rated, with integral shunt trip mechanism and Class J fuse block; lockable handle with capability to accept three padlocks; interlocked with cover in closed position.
- E. Control Circuit: 120-V ac; obtained from **[integral control power transformer, with primary and secondary fuses,]** **<Insert source of control power>** with a control power **[transformer]** **[source]** of enough capacity to operate shunt trip, connected pilot, and indicating and control devices.
- F. Accessories:
 - 1. Oiltight key switch for key-to-test function.
 - 2. Oiltight **[red]** **[green]** **[white]** **[yellow]** ON pilot light.
 - 3. Isolated neutral lug; **[100]** **[200]** percent rating.
 - 4. Mechanically interlocked auxiliary contacts that change state when switch is opened and closed.
 - 5. Form C alarm contacts that change state when switch is tripped.
 - 6. Three-pole, double-throw, fire-safety and alarm relay; **[120-V ac]** **[24-V dc]** coil voltage.
 - 7. Three-pole, double-throw, fire-alarm voltage monitoring relay complying with NFPA 72.

2.5 MOLDED-CASE CIRCUIT BREAKERS

- A. Manufacturers: Subject to compliance with requirements, **[provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:**
- B. Basis-of-Design Product: Subject to compliance with requirements, provide **[product indicated on Drawings] <Insert manufacturer's name; product name or designation>** or comparable product by one of the following:
 - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.

2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 3. Siemens Energy & Automation, Inc.
 4. Square D; a brand of Schneider Electric.
 5. <Insert manufacturer's name>.
- C. General Requirements: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents.
- D. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
- E. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
- F. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:
1. Instantaneous trip.
 2. Long- and short-time pickup levels.
 3. Long- and short-time time adjustments.
 4. Ground-fault pickup level, time delay, and I^2t response.
- G. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller, and let-through ratings less than NEMA FU 1, RK-5.
- H. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker and trip activation on fuse opening or on opening of fuse compartment door.
- I. Ground-Fault, Circuit-Interrupter (GFCI) Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
- J. Ground-Fault, Equipment-Protection (GFEP) Circuit Breakers: With Class B ground-fault protection (30-mA trip).
- K. Features and Accessories:
1. Standard frame sizes, trip ratings, and number of poles.
 2. Lugs: **[Mechanical]** **[Compression]** type, suitable for number, size, trip ratings, and conductor material.
 3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.
 4. Ground-Fault Protection: Comply with UL 1053; **[integrally mounted, self-powered]** **[remote-mounted and powered]** type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
 5. Communication Capability: **[Circuit-breaker-mounted]** **[Universal-mounted]** **[Integral]** **[Din-rail-mounted]** communication module with functions and features

- compatible with power monitoring and control system, specified in Division 26 Section "Electrical Power Monitoring and Control."
6. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
 7. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
 8. Auxiliary Contacts: **[One SPDT switch] [Two SPDT switches]** with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.
 9. Alarm Switch: One **[NO] [NC]** contact that operates only when circuit breaker has tripped.
 10. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
 11. Zone-Selective Interlocking: Integral with **[electronic] [ground-fault]** trip unit; for interlocking ground-fault protection function.
 12. Electrical Operator: Provide remote control for on, off, and reset operations.
 13. Accessory Control Power Voltage: **[Integrally mounted, self-powered] [Remote mounted and powered]; [24-V ac] [120-V ac] [208-V ac] [240-V ac] [6-V dc] [12-V dc] [24-V dc]**.

2.6 MOLDED-CASE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, **[provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]**:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide **[product indicated on Drawings] <Insert manufacturer's name; product name or designation>** or comparable product by one of the following:
 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 3. Siemens Energy & Automation, Inc.
 4. Square D; a brand of Schneider Electric.
 5. **<Insert manufacturer's name>**.
- C. General Requirements: MCCB with fixed, high-set instantaneous trip only, and short-circuit withstand rating equal to equivalent breaker frame size interrupting rating.
- D. Features and Accessories:
 1. Standard frame sizes and number of poles.
 2. Lugs: **[Mechanical] [Compression]** type, suitable for number, size, trip ratings, and conductor material.
 3. Ground-Fault Protection: Comply with UL 1053; remote-mounted and powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
 4. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.

5. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
6. Auxiliary Contacts: [**One SPDT switch**] [**Two SPDT switches**] with "a" and "b" contacts; "a" contacts mimic switch contacts, "b" contacts operate in reverse of switch contacts.
7. Alarm Switch: One [**NO**] [**NC**] contact that operates only when switch has tripped.
8. Key Interlock Kit: Externally mounted to prohibit switch operation; key shall be removable only when switch is in off position.
9. Zone-Selective Interlocking: Integral with ground-fault shunt trip unit; for interlocking ground-fault protection function.
10. Electrical Operator: Provide remote control for on, off, and reset operations.
11. Accessory Control Power Voltage: [**Integrally mounted, self-powered**] [**Remote mounted and powered**]; [**24-V ac**] [**120-V ac**] [**208-V ac**] [**240-V ac**] [**6-V dc**] [**12-V dc**] [**24-V dc**].

2.7 ENCLOSURES

- A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.
 1. Indoor, Dry and Clean Locations: NEMA 250, [**Type 1**] <Insert type>.
 2. Outdoor Locations: NEMA 250, [**Type 3R**] <Insert type>.
 3. [**Kitchen**] [**Wash-Down**] Areas: NEMA 250, [**Type 4X**] <Insert type>, [**stainless steel**] <Insert material>.
 4. Other Wet or Damp, Indoor Locations: NEMA 250, [**Type 4**] <Insert type>.
 5. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.
 6. Hazardous Areas Indicated on Drawings: NEMA 250, [**Type 7**] [**Type 9**] <Insert type>.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.
- B. Comply with mounting and anchoring requirements specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

- C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- D. Install fuses in fusible devices.
- E. Comply with NECA 1.

3.3 IDENTIFICATION

- A. Comply with requirements in Division 26 Section "Identification for Electrical Systems."
 - 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
 - 2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.4 FIELD QUALITY CONTROL

- A. Testing Agency: [**Owner will engage**] [**Engage**] a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- C. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- D. Acceptance Testing Preparation:
 - 1. Test insulation resistance for each enclosed switch and circuit breaker, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- E. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
 - 3. Perform the following infrared scan tests and inspections and prepare reports:
 - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each enclosed switch and circuit breaker. Remove front panels so joints and connections are accessible to portable scanner.

- b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each enclosed switch and circuit breaker 11 months after date of Substantial Completion.
 - c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
- 4. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- F. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.
- G. Prepare test and inspection reports, including a certified report that identifies enclosed switches and circuit breakers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges[**as specified in Division 26 Section "Overcurrent Protective Device Coordination Study"**].

END OF SECTION 262816

SECTION 262913 - ENCLOSED CONTROLLERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes the following enclosed controllers rated 600 V and less:
 - 1. Full-voltage manual.
 - 2. Full-voltage magnetic.
 - 3. Reduced-voltage magnetic.
 - 4. Reduced-voltage solid state.
 - 5. Multispeed.
- B. Related Section:
 - 1. Division 26 Section "Variable-Frequency Motor Controllers" for general-purpose, ac, adjustable-frequency, pulse-width-modulated controllers for use on variable torque loads in ranges up to 200 hp.

1.3 DEFINITIONS

- A. CPT: Control power transformer.
- B. MCCB: Molded-case circuit breaker.
- C. MCP: Motor circuit protector.
- D. N.C.: Normally closed.
- E. N.O.: Normally open.
- F. OCPD: Overcurrent protective device.
- G. SCR: Silicon-controlled rectifier.

1.4 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Enclosed controllers shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified ."

1.5 SUBMITTALS

- A. Product Data: For each type of enclosed controller. Include manufacturer's technical data on features, performance, electrical characteristics, ratings, and enclosure types and finishes.
- B. Shop Drawings: For each enclosed controller. Include dimensioned plans, elevations, sections, details, and required clearances and service spaces around controller enclosures.
 1. Show tabulations of the following:
 - a. Each installed unit's type and details.
 - b. Factory-installed devices.
 - c. Nameplate legends.
 - d. Short-circuit current rating of integrated unit.
 - e. Listed and labeled for integrated short-circuit current (withstand) rating of OCPDs in combination controllers by an NRTL acceptable to authorities having jurisdiction.
 - f. Features, characteristics, ratings, and factory settings of individual OCPDs in combination controllers.
 2. Wiring Diagrams: For power, signal, and control wiring.
- C. Qualification Data: For qualified testing agency.
- D. Seismic Qualification Certificates: For enclosed controllers, accessories, and components, from manufacturer.
 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- E. Field quality-control reports.
- F. Operation and Maintenance Data: For enclosed controllers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
 1. Routine maintenance requirements for enclosed controllers and installed components.
 2. Manufacturer's written instructions for testing and adjusting circuit breaker and MCP trip settings.
 3. Manufacturer's written instructions for setting field-adjustable overload relays.
 4. Manufacturer's written instructions for testing, adjusting, and reprogramming reduced-voltage solid-state controllers.

- G. Load-Current and Overload-Relay Heater List: Compile after motors have been installed, and arrange to demonstrate that selection of heaters suits actual motor nameplate full-load currents.
- H. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed, and arrange to demonstrate that switch settings for motor running overload protection suit actual motors to be protected.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Member company of NETA or an NRTL.
 - 1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with NFPA 70.
- D. IEEE Compliance: Fabricate and test enclosed controllers according to IEEE 344 to withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store enclosed controllers indoors in clean, dry space with uniform temperature to prevent condensation. Protect enclosed controllers from exposure to dirt, fumes, water, corrosive substances, and physical damage.
- B. If stored in areas subject to weather, cover enclosed controllers to protect them from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and flammable materials from inside controllers; install temporary electric heating, with at least 250 W per controller.

1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - 1. Ambient Temperature: Not less than minus 22 deg F (minus 30 deg C) and not exceeding 104 deg F (40 deg C).
 - 2. Altitude: Not exceeding 6600 feet (2010 m).

1.9 COORDINATION

- A. Coordinate layout and installation of enclosed controllers with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- C. Coordinate installation of roof curbs, equipment supports, and roof penetrations.

1.10 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Fuses for Fused Switches: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
 - 2. Control Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.
 - 3. Indicating Lights: Two of each type and color installed.
 - 4. Auxiliary Contacts: Furnish one spare(s) for each size and type of magnetic controller installed.
 - 5. Power Contacts: Furnish three spares for each size and type of magnetic contactor installed.

PART 2 - PRODUCTS

2.1 FULL-VOLTAGE CONTROLLERS

- A. General Requirements for Full-Voltage Controllers: Comply with NEMA ICS 2, general purpose, Class A.
- B. Motor-Starting Switches: "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off or on.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings. or comparable product by one of the following:
 - a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - c. Rockwell Automation, Inc.; Allen-Bradley brand.
 - d. Siemens Energy & Automation, Inc.

- e. Square D; a brand of Schneider Electric.
 - 3. Configuration: Two speed.
 - 4. Surface mounting.
 - 5. Red pilot light.
 - 6. Additional Nameplates: HIGH and LOW for two-speed switches.
- C. Magnetic Controllers: Full voltage, across the line, electrically held.
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - c. Rockwell Automation, Inc.; Allen-Bradley brand.
 - d. Siemens Energy & Automation, Inc.
 - e. Square D; a brand of Schneider Electric.
 - 3. Configuration: Reversing.
 - 4. Contactor Coils: Pressure-encapsulated type.
 - a. Operating Voltage: Depending on contactor NEMA size and line-voltage rating, manufacturer's standard matching control power or line voltage.
 - 5. Power Contacts: Totally enclosed, double-break, silver-cadmium oxide; assembled to allow inspection and replacement without disturbing line or load wiring.
 - 6. Control Circuits: 120 -V ac.
 - 7. Bimetallic Overload Relays:
 - a. Inverse-time-current characteristic.
 - b. Class 30 tripping characteristic.
 - c. Heaters in each phase matched to nameplate full-load current of actual protected motor and with appropriate adjustment for duty cycle.
 - d. Ambient compensated.
 - e. Automatic resetting.
 - 8. N.C./ N.O., isolated overload alarm contact.
 - 9. External overload reset push button.
- D. Combination Magnetic Controller: Factory-assembled combination of magnetic controller, OCPD, and disconnecting means.
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - c. Rockwell Automation, Inc.; Allen-Bradley brand.
 - d. Siemens Energy & Automation, Inc.
 - e. Square D; a brand of Schneider Electric.
3. Fusible Disconnecting Means:
 - a. NEMA KS 1, heavy-duty, horsepower-rated, fusible switch with clips or bolt pads to accommodate Class J Class R fuses.
 - b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
4. Auxiliary Contacts: N.O./N.C., arranged to activate before switch blades open.
5. Nonfusible Disconnecting Means:
 - a. NEMA KS 1, heavy-duty, horsepower-rated, nonfusible switch.
 - b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
 - c. Auxiliary Contacts: N.O./N.C., arranged to activate before switch blades open.
6. MCP Disconnecting Means:
 - a. UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents, instantaneous-only circuit breaker with front-mounted, field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.
 - b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
 - c. Auxiliary contacts "a" and "b" arranged to activate with MCP handle.
 - d. N.C. /N.O. alarm contact that operates only when MCP has tripped.
 - e. Current-limiting module to increase controller short-circuit current (withstand) rating to 100 kA.
7. MCCB Disconnecting Means:
 - a. UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents; thermal-magnetic MCCB, with inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits.
 - b. Front-mounted, adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 - c. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
 - d. Auxiliary contacts "a" and "b" arranged to activate with MCCB handle.

- e. N.C./ N.O. alarm contact that operates only when MCCB has tripped.

2.2 MULTISPEED MAGNETIC CONTROLLERS

- A. General Requirements for Multispeed Magnetic Controllers: Comply with NEMA ICS 2, general purpose, Class A.
- B. Multispeed Magnetic Controllers: Two speed, full voltage, across the line, electrically held.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - c. Rockwell Automation, Inc.; Allen-Bradley brand.
 - d. Siemens Energy & Automation, Inc.
 - e. Square D; a brand of Schneider Electric.
 - 3. Configuration: Nonreversing.
 - 4. Contactor Coils: Pressure-encapsulated type.
 - a. Operating Voltage: Depending on contactor NEMA size and line-voltage rating, manufacturer's standard matching control power or line voltage.
 - 5. Power Contacts: Totally enclosed, double break, silver-cadmium oxide; assembled to allow inspection and replacement without disturbing line or load wiring.
 - 6. Control Circuits: 120 -V ac.
 - a. CPT Spare Capacity: 200 VA.
 - 7. Compelling relays shall ensure that motor will start only at low speed.
 - 8. Accelerating timer relays shall ensure properly timed acceleration through speeds lower than that selected.
 - 9. Decelerating timer relays shall ensure automatically timed deceleration through each speed.
 - 10. Antiplugging timer relays shall ensure a time delay when transferring from FORWARD to REVERSE and back.
 - 11. Bimetallic Overload Relays:
 - a. Inverse-time-current characteristic.
 - b. Class 30 tripping characteristic.
 - c. Heaters in each phase matched to nameplate full-load current of actual protected motor and with appropriate adjustment for duty cycle.
 - d. Ambient compensated.
 - e. Automatic resetting.

12. N.C./ N.O., isolated overload alarm contact.
 13. External overload reset push button.
- C. Combination Multispeed Magnetic Controller: Factory-assembled combination of reduced-voltage magnetic controller, OCPD, and disconnecting means.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - c. Rockwell Automation, Inc.; Allen-Bradley brand.
 - d. Siemens Energy & Automation, Inc.
 - e. Square D; a brand of Schneider Electric.
 2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - c. Rockwell Automation, Inc.; Allen-Bradley brand.
 - d. Siemens Energy & Automation, Inc.
 - e. Square D; a brand of Schneider Electric.
 3. Fusible Disconnecting Means:
 - a. NEMA KS 1, heavy-duty, horsepower-rated, fusible switch with clips or bolt pads to accommodate Class J Class R fuses.
 - b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
 - c. Auxiliary Contacts: N.O./N.C., arranged to activate before switch blades open.
 4. Nonfusible Disconnecting Means:
 - a. NEMA KS 1, heavy-duty, horsepower-rated, nonfusible switch.
 - b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
 - c. Auxiliary Contacts: N.O./N.C., arranged to activate before switch blades open.
 5. MCP Disconnecting Means:
 - a. UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents, instantaneous-only circuit breaker with front-mounted, field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.
 - b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
 - c. Auxiliary contacts "a" and "b" arranged to activate with MCP handle.
 - d. N.C. / N.O. alarm contact that operates only when MCP has tripped.
 - e. Current-limiting module to increase controller short-circuit current (withstand) rating to 100 kA.
 6. MCCB Disconnecting Means:

- a. UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents; thermal-magnetic MCCB, with inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits.
- b. Front-mounted, adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
- c. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
- d. Auxiliary contacts "a" and "b" arranged to activate with MCCB handle.
- e. N.C./ N.O. alarm contact that operates only when MCCB has tripped.

2.3 ENCLOSURES

- A. Enclosed Controllers: NEMA ICS 6, to comply with environmental conditions at installed location.
 1. Dry and Clean Indoor Locations: Type 1.
 2. Outdoor Locations: Type 3R .
 3. Kitchen Wash-Down Areas: Type 4X , stainless steel.
 4. Other Wet or Damp Indoor Locations: Type 4 .
 5. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: Type 12.
 6. Hazardous Areas Indicated on Drawings: Type 9.

2.4 ACCESSORIES

- A. General Requirements for Control Circuit and Pilot Devices: NEMA ICS 5; factory installed in controller enclosure cover unless otherwise indicated.
 1. Push Buttons, Pilot Lights, and Selector Switches: Heavy-duty type.
 - a. Push Buttons: Covered types; maintained as indicated.
 - b. Pilot Lights: LED types; colors as indicated: push to test.
 - c. Selector Switches: Rotary type.
 2. Elapsed Time Meters: Heavy duty with digital readout in hours; resettable.
 3. Meters: Panel type, 2-1/2-inch (64-mm) minimum size with 90- or 120-degree scale and plus or minus two percent accuracy. Where indicated, provide selector switches with an off position.
- B. N.C./ N.O. auxiliary contact(s).
- C. Control Relays: Auxiliary and adjustable solid-state time-delay relays.
- D. Phase-Failure, Phase-Reversal, and Undervoltage and Overvoltage Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connections. Provide adjustable undervoltage, overvoltage, and time-delay settings.

- E. Breather and drain assemblies, to maintain interior pressure and release condensation in Type 4 enclosures installed outdoors or in unconditioned interior spaces subject to humidity and temperature swings.
- F. Space heaters, with N.C. auxiliary contacts, to mitigate condensation in Type 12 enclosures installed outdoors or in unconditioned interior spaces subject to humidity and temperature swings.
- G. Sun shields installed on fronts, sides, and tops of enclosures installed outdoors and subject to direct and extended sun exposure.
- H. Cover gaskets for Type 1 enclosures.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and surfaces to receive enclosed controllers, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
- B. Examine enclosed controllers before installation. Reject enclosed controllers that are wet, moisture damaged, or mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Wall-Mounted Controllers: Install enclosed controllers on walls with tops at uniform height unless otherwise indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For controllers not at walls, provide freestanding racks complying with Division 26 Section "Hangers and Supports for Electrical Systems."
- B. Floor-Mounted Controllers: Install enclosed controllers on 4-inch (100-mm) nominal-thickness concrete base. Comply with requirements for concrete base specified in Division 03 Section "Cast-in-Place Concrete."
 - 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.
 - 2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 - 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 4. Install anchor bolts to elevations required for proper attachment to supported equipment.
- C. Seismic Bracing: Comply with requirements specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

- D. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- E. Install fuses in each fusible-switch enclosed controller.
- F. Install fuses in control circuits if not factory installed. Comply with requirements in Division 26 Section "Fuses."
- G. Install heaters in thermal overload relays. Select heaters based on actual nameplate full-load amperes after motors have been installed.
- H. Install, connect, and fuse thermal-protector monitoring relays furnished with motor-driven equipment.

3.3 IDENTIFICATION

- A. Identify enclosed controllers, components, and control wiring. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
 - 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
 - 2. Label each enclosure with engraved nameplate.
 - 3. Label each enclosure-mounted control and pilot device.

3.4 CONTROL WIRING INSTALLATION

- A. Install wiring between enclosed controllers and remote devices . Comply with requirements in Division 26 Section "Control-Voltage Electrical Power Cables."
- B. Bundle, train, and support wiring in enclosures.
- C. Connect selector switches and other automatic-control selection devices where applicable.
 - 1. Connect selector switches to bypass only those manual- and automatic-control devices that have no safety functions when switch is in manual-control position.
 - 2. Connect selector switches with enclosed-controller circuit in both manual and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- C. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- D. Acceptance Testing Preparation:
1. Test insulation resistance for each enclosed controller, component, connecting supply, feeder, and control circuit.
 2. Test continuity of each circuit.
- E. Tests and Inspections:
1. Inspect controllers, wiring, components, connections, and equipment installation.
 2. Test insulation resistance for each enclosed-controller element, component, connecting motor supply, feeder, and control circuits.
 3. Test continuity of each circuit.
 4. Verify that voltages at controller locations are within plus or minus 10 percent of motor nameplate rated voltages. If outside this range for any motor, notify Construction Manager before starting the motor(s).
 5. Test each motor for proper phase rotation.
 6. Perform each electrical test and visual and mechanical inspection stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 7. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
 8. Perform the following infrared (thermographic) scan tests and inspections and prepare reports:
 - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each multi-pole enclosed controller. Remove front panels so joints and connections are accessible to portable scanner.
 - b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each multi-pole enclosed controller 11 months after date of Substantial Completion.
 - c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 9. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- F. Enclosed controllers will be considered defective if they do not pass tests and inspections.
- G. Prepare test and inspection reports including a certified report that identifies enclosed controllers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.6 ADJUSTING

- A. Set field-adjustable switches, auxiliary relays, time-delay relays, timers, and overload-relay pickup and trip ranges.
- B. Adjust overload-relay heaters or settings if power factor correction capacitors are connected to the load side of the overload relays.
- C. Adjust the trip settings of MCPs and thermal-magnetic circuit breakers with adjustable instantaneous trip elements. Initially adjust to six times the motor nameplate full-load ampere ratings and attempt to start motors several times, allowing for motor cooldown between starts. If tripping occurs on motor inrush, adjust settings in increments until motors start without tripping. Do not exceed eight times the motor full-load amperes (or 11 times for NEMA Premium Efficient motors if required). Where these maximum settings do not allow starting of a motor, notify Construction Manager before increasing settings.
- D. Set the taps on reduced-voltage autotransformer controllers at 80 percent.
- E. Set field-adjustable switches and program microprocessors for required start and stop sequences in reduced-voltage solid-state controllers.
- F. Set field-adjustable circuit-breaker trip ranges.

3.7 PROTECTION

- A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions until enclosed controllers are ready to be energized and placed into service.
- B. Replace controllers whose interiors have been exposed to water or other liquids prior to Substantial Completion.

3.8 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain enclosed controllers, and to use and reprogram microprocessor-based, reduced-voltage solid-state controllers.

END OF SECTION 262913

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SECTION 265100 - INTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Interior lighting fixtures, lamps, and ballasts.
 - 2. Exit signs.
 - 3. Lighting fixture supports.
- B. Related Sections include the following:
 - 1. Division 26 Section "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.
 - 2. Division 26 Section "Modular Dimming Controls" for architectural dimming systems.
 - 3. Division 26 Section "Wiring Devices" for manual wall-box dimmers for incandescent lamps.
 - 4. Division 1 Section "Sustainable Building Requirements"

1.3 DEFINITIONS

- A. BF: Ballast factor.
- B. CRI: Color-rendering index.
- C. CU: Coefficient of utilization.
- D. HID: High-intensity discharge.
- E. LER: Luminaire efficacy rating.
- F. Luminaire: Complete lighting fixture, including ballast housing if provided.
- G. RCR: Room cavity ratio.

1.4 SUBMITTALS

- A. Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:
1. Physical description of lighting fixture including dimensions.
 2. Emergency lighting units including battery and charger.
 3. Ballast.
 4. Energy-efficiency data.
 5. Life, output, and energy-efficiency data for lamps.
 6. Photometric data, in IESNA format, based on laboratory tests of each lighting fixture type, outfitted with lamps, ballasts, and accessories identical to those indicated for the lighting fixture as applied in this Project.
 - a. For indicated fixtures, photometric data shall be certified by a qualified independent testing agency. Photometric data for remaining fixtures shall be certified by the manufacturer.
 - b. Photometric data shall be certified by a manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program (NVLAP) for Energy Efficient Lighting Products.
- B. Shop Drawings: Show details of nonstandard or custom lighting fixtures. Indicate dimensions, weights, methods of field assembly, components, features, and accessories.
1. Wiring Diagrams: Power wiring.
- C. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
1. Lighting fixtures.
 2. Suspended ceiling components.
 3. Structural members to which suspension systems for lighting fixtures will be attached.
 4. Other items in finished ceiling including the following:
 - a. Air outlets and inlets.
 - b. Speakers.
 - c. Sprinklers.
 - d. Smoke and fire detectors.
 - e. Occupancy sensors.
 - f. Access panels.
 5. Perimeter moldings.
- D. Samples for Verification: Interior lighting fixtures designated for sample submission in Interior Lighting Fixture Schedule. Each sample shall include the following:
1. Lamps: Specified units installed.
 2. Accessories: Cords and plugs.

- E. Product Certificates: For each type of ballast for bi-level and dimmer-controlled fixtures, signed by product manufacturer.
- F. Qualification Data: For agencies providing photometric data for lighting fixtures.
- G. Field quality-control test reports.
- H. Operation and Maintenance Data: For lighting equipment and fixtures to include in emergency, operation, and maintenance manuals.
- I. Warranties: Special warranties specified in this Section.

J. Energy Efficiency:

1. 5.5 Lighting

- a. Submit product data in accordance with 018113 under Criterion 5.5.

K. Operations, Maintenance and Resident Engagement:

1. 8.1 Building Maintenance Manual

- a. Submit maintenance & replacement guidance in accordance with the requirements of 018113 under Criterion 8.1.

1.5 QUALITY ASSURANCE

- A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.
- B. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. Comply with NFPA 70.
- E. FMG Compliance: Lighting fixtures for hazardous locations shall be listed and labeled for indicated class and division of hazard by FMG.
- F. Mockups: Provide interior lighting fixtures for room or module mockups, complete with power and control connections.
 - 1. Obtain Architect's approval of fixtures for mockups before starting installations.
 - 2. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.

3. Approved fixtures in mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 COORDINATION

- A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.

1.7 WARRANTY

- A. Special Warranty for Ballasts: Manufacturer's standard form in which ballast manufacturer agrees to repair or replace ballasts that fail in materials or workmanship within specified warranty period.
 1. Warranty Period for Electronic Ballasts: Five years from date of Substantial Completion.
 2. Warranty Period for Electromagnetic Ballasts: Three years from date of Substantial Completion.
- B. Special Warranty for T5 and T8 Fluorescent Lamps: Manufacturer's standard form, made out to Owner and signed by lamp manufacturer agreeing to replace lamps that fail in materials or workmanship, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.
 1. Warranty Period: Two year(s) from date of Substantial Completion.

1.8 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Lamps: 10 for every 100 of each type and rating installed. Furnish at least one of each type.
 2. Plastic Diffusers and Lenses: 1 for every 100 of each type and rating installed. Furnish at least one of each type.
 3. Ballasts: 1 for every 100 of each type and rating installed. Furnish at least one of each type.
 4. Globes and Guards: 1 for every 20 of each type and rating installed. Furnish at least one of each type.

PART 2 - PRODUCTS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

B. In Interior Lighting Fixture Schedule where titles below are column or row headings that introduce lists, the following requirements apply to product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
3. Basis-of-Design Product: The design for each lighting fixture is based on the product named. Subject to compliance with requirements, provide either the named product or a comparable product by one of the other manufacturers specified.

C. Energy Efficiency

1. 5.5 Lighting

- a. Use products that meet requirements in 018113 under Criterion 5.5.

2.2 LIGHTING FIXTURES AND COMPONENTS, GENERAL REQUIREMENTS

- A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.
- B. Incandescent Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5A.
- C. Fluorescent Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5 and NEMA LE 5A as applicable.
- D. HID Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5B.
- E. Metal Parts: Free of burrs and sharp corners and edges.
- F. Sheet Metal Components: Steel, unless otherwise indicated. Form and support to prevent warping and sagging.
- G. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.
- H. Reflecting surfaces shall have minimum reflectance as follows, unless otherwise indicated:
 1. White Surfaces: 85 percent.
 2. Specular Surfaces: 83 percent.
 3. Diffusing Specular Surfaces: 75 percent.
 4. Laminated Silver Metallized Film: 90 percent.
- I. Plastic Diffusers, Covers, and Globes:

1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
 - a. Lens Thickness: At least 0.125 inch (3.175 mm) minimum unless different thickness is indicated.
 - b. UV stabilized.
 2. Glass: Annealed crystal glass, unless otherwise indicated.
- J. Electromagnetic-Interference Filters: Factory installed to suppress conducted electromagnetic-interference as required by MIL-STD-461E. Fabricate lighting fixtures with one filter on each ballast indicated to require a filter.

2.3 BALLASTS FOR LINEAR FLUORESCENT LAMPS

- A. Electronic Ballasts: Comply with ANSI C82.11; instant -start type, unless otherwise indicated, and designed for type and quantity of lamps served. Ballasts shall be designed for full light output unless dimmer or bi-level control is indicated.
1. Sound Rating: A .
 2. Total Harmonic Distortion Rating: Less than 10 percent.
 3. Transient Voltage Protection: IEEE C62.41, Category A or better.
 4. Operating Frequency: 42 kHz or higher.
 5. Lamp Current Crest Factor: 1.7 or less.
 6. BF: 0.85 or higher.
 7. Power Factor: 0.98 or higher.
 8. Parallel Lamp Circuits: Multiple lamp ballasts shall comply with ANSI C 82.11 and shall be connected to maintain full light output on surviving lamps if one or more lamps fail.
- B. Electronic Programmed-Start Ballasts for T5 and T5HO Lamps: Comply with ANSI C82.11 and the following:
1. Lamp end-of-life detection and shutdown circuit for T5 diameter lamps.
 2. Automatic lamp starting after lamp replacement.
 3. Sound Rating: A.
 4. Total Harmonic Distortion Rating: Less than 20 percent.
 5. Transient Voltage Protection: IEEE C62.41, Category A or better.
 6. Operating Frequency: 20 kHz or higher.
 7. Lamp Current Crest Factor: 1.7 or less.
 8. BF: 0.95 or higher, unless otherwise indicated.
 9. Power Factor: 0.98 or higher.
- C. Electromagnetic Ballasts: Comply with ANSI C82.1; energy saving, high-power factor, Class P, and having automatic-reset thermal protection.
1. Ballast Manufacturer Certification: Indicated by label.

- D. Single Ballasts for Multiple Lighting Fixtures: Factory-wired with ballast arrangements and bundled extension wiring to suit final installation conditions without modification or rewiring in the field.
- E. Ballasts for Low-Temperature Environments:
 - 1. Temperatures 0 Deg F (Minus 17 Deg C) and Higher: Electronic or electromagnetic type rated for 0 deg F (minus 17 deg C) starting and operating temperature with indicated lamp types.
 - 2. Temperatures Minus 20 Deg F (Minus 29 Deg C) and Higher: Electromagnetic type designed for use with indicated lamp types.
- F. Ballasts for Low Electromagnetic-Interference Environments: Comply with 47 CFR, Chapter 1, Part 18, Subpart C, for limitations on electromagnetic and radio-frequency interference for consumer equipment.
- G. Ballasts for Dimmer-Controlled Lighting Fixtures: Electronic type.
 - 1. Dimming Range: 100 to 5 percent of rated lamp lumens.
 - 2. Ballast Input Watts: Can be reduced to 20 percent of normal.
 - 3. Compatibility: Certified by manufacturer for use with specific dimming control system and lamp type indicated.
- H. Ballasts for Bi-Level Controlled Lighting Fixtures: Electronic type.
 - 1. Operating Modes: Ballast circuit and leads provide for remote control of the light output of the associated lamp between high- and low-level and off.
 - a. High-Level Operation: 100 percent of rated lamp lumens.
 - b. Low-Level Operation: 50 percent of rated lamp lumens.
 - 2. Ballast shall provide equal current to each lamp in each operating mode.
 - 3. Compatibility: Certified by manufacturer for use with specific bi-level control system and lamp type indicated.

2.4 BALLASTS FOR COMPACT FLUORESCENT LAMPS

- A. Description: Electronic programmed rapid-start type, complying with ANSI C 82.11, designed for type and quantity of lamps indicated. Ballast shall be designed for full light output unless dimmer or bi-level control is indicated:
 - 1. Lamp end-of-life detection and shutdown circuit.
 - 2. Automatic lamp starting after lamp replacement.
 - 3. Sound Rating: A.
 - 4. Total Harmonic Distortion Rating: Less than 20 percent.
 - 5. Transient Voltage Protection: IEEE C62.41, Category A or better.
 - 6. Operating Frequency: 20 kHz or higher.
 - 7. Lamp Current Crest Factor: 1.7 or less.
 - 8. BF: 0.95 or higher, unless otherwise indicated.

9. Power Factor: 0.98 or higher.
10. Interference: Comply with 47 CFR, Chapter 1, Part 18, Subpart C, for limitations on electromagnetic and radio-frequency interference for nonconsumer equipment.
11. Ballast Case Temperature: 75 deg C, maximum.

B. Ballasts for Dimmer-Controlled Lighting Fixtures: Electronic type.

1. Dimming Range: 100 to 5 percent of rated lamp lumens.
2. Ballast Input Watts: Can be reduced to 20 percent of normal.
3. Compatibility: Certified by manufacturer for use with specific dimming control system and lamp type indicated.

2.5 BALLASTS FOR HID LAMPS

A. Electromagnetic Ballast for Metal-Halide Lamps: Comply with ANSI C82.4 and UL 1029. Include the following features, unless otherwise indicated:

1. Ballast Circuit: Constant-wattage autotransformer or regulating high-power-factor type.
2. Minimum Starting Temperature: Minus 22 deg F (Minus 30 deg C) for single-lamp ballasts.
3. Normal Ambient Operating Temperature: 104 deg F (40 deg C).
4. Open-circuit operation that will not reduce average life.
5. Low-Noise Ballasts: Manufacturers' standard epoxy-encapsulated models designed to minimize audible fixture noise.

B. Electronic Ballast for Metal-Halide Lamps: Include the following features unless otherwise indicated:

1. Lamp end-of-life detection and shutdown circuit.
2. Sound Rating: A.
3. Total Harmonic Distortion Rating: Less than 15 percent.
4. Transient Voltage Protection: IEEE C62.41, Category A or better.
5. Lamp Current Crest Factor: 1.5 or less.
6. Power Factor: .90 or higher.
7. Interference: Comply with 47 CFR, Chapter 1, Part 18, Subpart C, for limitations on electromagnetic and radio-frequency interference for nonconsumer equipment.
8. Protection: Class P thermal cutout.
9. Retain subparagraph and associated subparagraphs below for bi-level ballasts.
10. Bi-Level Dimming Ballast: Ballast circuit and leads provide for remote control of the light output of the associated fixture between high- and low-level and off.
 - a. High-Level Operation: 100 percent of rated lamp lumens.
 - b. Low-Level Operation: 50 percent of rated lamp lumens.
 - c. Compatibility: Certified by ballast manufacturer for use with specific bi-level control system and lamp type indicated. Certified by lamp manufacturer that ballast operating modes are free from negative effect on lamp life and color-rendering capability.

11. Continuous Dimming Ballast: Dimming range shall be from 100 to 35 percent of rated lamp lumens without flicker.
 - a. Ballast Input Watts: Reduced to a maximum of 50 percent of normal at lowest dimming setting.
 - b. Compatibility: Certified by manufacturer for use with specific dimming control system and lamp type indicated. Certified by lamp manufacturer that ballast operating modes are free from negative effect on lamp life and color-rendering capability.
- C. Auxiliary Instant-On Quartz System: Factory-installed feature automatically switches quartz lamp on when fixture is initially energized and when power outages occur. System automatically turns quartz lamp off when HID lamp reaches approximately 60 percent light output.

2.6 EXIT SIGNS

- A. Description: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.
- B. Internally Lighted Signs:
 1. Lamps for AC Operation: Fluorescent, 2 for each fixture, 20,000 hours of rated lamp life.
 2. Lamps for AC Operation: LEDs, 70,000 hours minimum rated lamp life.

2.7 FLUORESCENT LAMPS

- A. Low-Mercury Lamps: Comply with EPA's toxicity characteristic leaching procedure test; shall yield less than 0.2 mg of mercury per liter when tested according to NEMA LL 1.
- B. T8 rapid-start low-mercury lamps, rated 32 W maximum, nominal length of 48 inches (1220 mm), 2800 initial lumens (minimum), CRI 75 (minimum), color temperature 3500 K, and average rated life 20,000 hours, unless otherwise indicated.
- C. T8 rapid-start low-mercury lamps, rated 17 W maximum, nominal length of 24 inches (610 mm), 1300 initial lumens (minimum), CRI 75 (minimum), color temperature 3500 K, and average rated life of 20,000 hours, unless otherwise indicated.
- D. T5 rapid-start low-mercury lamps, rated 28 W maximum, nominal length of 45.2 inches (1150 mm), 2900 initial lumens (minimum), CRI 85 (minimum), color temperature 3000 K, and average rated life of 20,000 hours, unless otherwise indicated.
- E. T5HO rapid-start, high-output low-mercury lamps, rated 54 W maximum, nominal length of 45.2 inches (1150 mm), 5000 initial lumens (minimum), CRI 85 (minimum), color temperature 4100 K, and average rated life of 20,000 hours, unless otherwise indicated.

- F. Compact Fluorescent Lamps: 4-Pin, low mercury, CRI 80 (minimum), color temperature 3500 K, average rated life of 10,000 hours at 3 hours operation per start, and suitable for use with dimming ballasts, unless otherwise indicated.

1. 13 W: T4, double or triple tube, rated 900 initial lumens (minimum).
2. 18 W: T4, double or triple tube, rated 1200 initial lumens (minimum).
3. 26 W: T4, double or triple tube, rated 1800 initial lumens (minimum).
4. 32 W: T4, triple tube, rated 2400 initial lumens (minimum).
5. 42 W: T4, triple tube, rated 3200 initial lumens (minimum).
6. 55 W: T4, triple tube, rated 4300 initial lumens (minimum).

2.8 HID LAMPS

- A. Metal-Halide Lamps: ANSI C78.1372, with a minimum CRI 65 and color temperature 4000 K.
- B. Pulse-Start, Metal-Halide Lamps: Minimum CRI 65, and color temperature 4000 K.
- C. Ceramic, Pulse-Start, Metal-Halide Lamps: Minimum CRI 80 and color temperature 4000 K.

2.9 LIGHTING FIXTURE SUPPORT COMPONENTS

- A. Comply with Division 26 Section "Hangers and Supports for Electrical Systems" for channel- and angle-iron supports and nonmetallic channel and angle supports.
- B. Single-Stem Hangers: 1/2-inch (13-mm) steel tubing with swivel ball fittings and ceiling canopy. Finish same as fixture.
- C. Twin-Stem Hangers: Two, 1/2-inch (13-mm) steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.
- D. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, 12 gage (2.68 mm).
- E. Wires for Humid Spaces: ASTM A 580/A 580M, Composition 302 or 304, annealed stainless steel, 12 gage (2.68 mm).
- F. Rod Hangers: 3/16-inch (5-mm) minimum diameter, cadmium-plated, threaded steel rod.
- G. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.

2.10 REQUIREMENTS FOR INDIVIDUAL LIGHTING FIXTURES

- A. Fixture Type :
1. Basis-of-Design Product: Insert manufacturer's name; product name or designation or a comparable product by one of the following:
 2. Available Manufacturers:

3. Voltage: 120-V ac.
4. Mounting: Recessed ceiling Pendant Surface ceiling Surface wall Suspended shall be as per contract documents.
5. Nominal Dimensions: See light fixture schedule.
6. Lamps: See lighting fixture schedules.
7. Ballast Type: Electronic instant start Electromagnetic Low temperature.
8. BF: Insert value.
9. Quantity of Ballasts per Fixture: See light fixture schedule.
10. Ballast Type: Electronic Electromagnetic, compatible with lamp type indicated.
11. Ballast Fuse: Factory installed, slow-blow type rated between 2.65 and 3.0 times the line current.
12. Lens: Describe types, materials, and features not indicated elsewhere.
13. External Finish: As per lighting fixtures schedules.
14. Trim and Hardware: As per lighting fixture schedules.
15. Special Environmental Conditions: As per lighting fixture schedules.
16. Other Features: As per lighting fixture schedules.
17. Minimum CU for typical RCR shall be as follows (typical cavity reflectances are ceiling, 80 percent; wall, 50 percent; and floor, 20 percent): RCR 7 CU.
18. Other Requirements: None.
19. Submit Sample.
20. Provide lighting fixtures as needed for mockups.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Lighting fixtures: Set level, plumb, and square with ceilings and walls. Install lamps in each fixture.
- B. Support for Lighting Fixtures in or on Grid-Type Suspended Ceilings: Use grid as a support element.
 1. Install a minimum of four ceiling support system rods or wires for each fixture. Locate not more than 6 inches (150 mm) from lighting fixture corners.
 2. Support Clips: Fasten to lighting fixtures and to ceiling grid members at or near each fixture corner with clips that are UL listed for the application.
 3. Fixtures of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two 3/4-inch (20-mm) metal channels spanning and secured to ceiling tees.
 4. Install at least one independent support rod or wire from structure to a tab on lighting fixture. Wire or rod shall have breaking strength of the weight of fixture at a safety factor of 3.
- C. Suspended Lighting Fixture Support:
 1. Pendants and Rods: Where longer than 48 inches (1200 mm), brace to limit swinging.
 2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.

- 3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.
- D. Adjust aimable lighting fixtures to provide required light intensities.
- E. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.2 FIELD QUALITY CONTROL

- A. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery and retransfer to normal.
- B. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

END OF SECTION 265100

SECTION 283111 - DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Fire-alarm control unit.
 - 2. Manual fire-alarm boxes.
 - 3. System smoke detectors.
 - 4. Nonsystem smoke detectors.
 - 5. Heat detectors.
 - 6. Notification appliances.
 - 7. Firefighters' two-way telephone communication service.
 - 8. Magnetic door holders.
 - 9. Remote annunciator.
 - 10. Addressable interface device.
 - 11. Digital alarm communicator transmitter.
 - 12. Radio alarm transmitter.
 - 13. System printer.

1.3 DEFINITIONS

- A. LED: Light-emitting diode.
- B. NICET: National Institute for Certification in Engineering Technologies.

1.4 SYSTEM DESCRIPTION

- A. Noncoded, [UL-certified] [FMG-placarded] addressable system, with multiplexed signal transmission, dedicated to fire-alarm service only.
- B. Noncoded addressable system, with automatic sensitivity control of certain smoke detectors and multiplexed signal transmission, dedicated to fire-alarm service only.

1.5 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Fire-alarm control unit and raceways shall withstand the effects of earthquake motions determined according to [SEI/ASCE 7] <Insert requirement>.

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

1.6 SUBMITTALS

A. General Submittal Requirements:

1. Submittals shall be approved by authorities having jurisdiction prior to submitting them to Architect.
2. Shop Drawings shall be prepared by persons with the following qualifications:
 - a. Trained and certified by manufacturer in fire-alarm system design.
 - b. NICET-certified fire-alarm technician, [Level III] [Level IV] minimum.
 - c. Licensed or certified by authorities having jurisdiction.

B. Product Data: For each type of product indicated.

C. Shop Drawings: For fire-alarm system. Include plans, elevations, sections, details, and attachments to other work.

1. Comply with recommendations in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72.
2. Include voltage drop calculations for notification appliance circuits.
3. Include battery-size calculations.
4. Include performance parameters and installation details for each detector, verifying that each detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
5. Include plans, sections, and elevations of heating, ventilating, and air-conditioning ducts, drawn to scale and coordinating installation of duct smoke detectors and access to them. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators. Locate detectors according to manufacturer's written recommendations.
6. Include voice/alarm signaling-service equipment rack or console layout, grounding schematic, amplifier power calculation, and single-line connection diagram.
7. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits.

D. Delegated-Design Submittal: For smoke and heat detectors indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Drawings showing the location of each smoke and heat detector, ratings of each, and installation details as needed to comply with listing conditions of the detector.
2. Design Calculations: Calculate requirements for selecting the spacing and sensitivity of detection, complying with NFPA 72.

E. Qualification Data: For qualified Installer.

F. Seismic Qualification Certificates: For fire-alarm control unit, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- G. Field quality-control reports.
- H. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
1. Comply with the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
 2. Provide "Record of Completion Documents" according to NFPA 72 article "Permanent Records" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter.
 3. Record copy of site-specific software.
 4. Provide "Maintenance, Inspection and Testing Records" according to NFPA 72 article of the same name and include the following:
 - a. Frequency of testing of installed components.
 - b. Frequency of inspection of installed components.
 - c. Requirements and recommendations related to results of maintenance.
 - d. Manufacturer's user training manuals.
 5. Manufacturer's required maintenance related to system warranty requirements.
 6. Abbreviated operating instructions for mounting at fire-alarm control unit.
 7. Copy of NFPA 25.
- I. Software and Firmware Operational Documentation:
1. Software operating and upgrade manuals.
 2. Program Software Backup: On magnetic media or compact disk, complete with data files.
 3. Device address list.
 4. Printout of software application and graphic screens.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.
- B. Installer Qualifications: Installation shall be by personnel certified by NICET as fire-alarm [Level II] [Level III] [Level IV] technician.
- C. Source Limitations for Fire-Alarm System and Components: Obtain fire-alarm system from single source from single manufacturer. Components shall be compatible with, and operate as, an extension of existing system.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- E. NFPA Certification: Obtain certification according to NFPA 72 by an NRTL.
- F. NFPA Certification: Obtain certification according to NFPA 72 by a UL-listed alarm company.

- G. NFPA Certification: Obtain certification according to NFPA 72 in the form of a placard by an FMG-approved alarm company.
- H. NFPA Certification: Obtain certification according to NFPA 72 by <Insert certification agency>.

1.8 PROJECT CONDITIONS

- A. Interruption of Existing Fire-Alarm Service: Do not interrupt fire-alarm service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary guard service according to requirements indicated:
 - 1. Notify [Architect] [Construction Manager] [Owner] no fewer than [two] <Insert number> days in advance of proposed interruption of fire-alarm service.
 - 2. Do not proceed with interruption of fire-alarm service without [Architect's] [Construction Manager's] [Owner's] written permission.

1.9 SEQUENCING AND SCHEDULING

- A. Existing Fire-Alarm Equipment: Maintain existing equipment fully operational until new equipment has been tested and accepted. As new equipment is installed, label it "NOT IN SERVICE" until it is accepted. Remove labels from new equipment when put into service and label existing fire-alarm equipment "NOT IN SERVICE" until removed from the building.
- B. Equipment Removal: After acceptance of new fire-alarm system, remove existing disconnected fire-alarm equipment and wiring.

1.10 SOFTWARE SERVICE AGREEMENT

- A. Comply with UL 864.
- B. Technical Support: Beginning with Substantial Completion, provide software support for [two] <Insert number> years.
- C. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within [two] <Insert number> years from date of Substantial Completion. Upgrading software shall include operating system. Upgrade shall include new or revised licenses for use of software.
 - 1. Provide [30] <Insert number> days' notice to Owner to allow scheduling and access to system and to allow Owner to upgrade computer equipment if necessary.

1.11 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Lamps for Remote Indicating Lamp Units: Quantity equal to [10] <Insert number> percent of amount installed, but no fewer than 1 unit.
 - 2. Lamps for Strobe Units: Quantity equal to [10] <Insert number> percent of amount installed, but no fewer than 1 unit.

3. Smoke Detectors, Fire Detectors[, and Flame Detectors]: Quantity equal to [10] <Insert number> percent of amount of each type installed, but no fewer than 1 unit of each type.
4. Detector Bases: Quantity equal to [2] <Insert number> percent of amount of each type installed, but no fewer than 1 unit of each type.
5. Keys and Tools: One extra set for access to locked and tamperproofed components.
6. Audible and Visual Notification Appliances: [One] <Insert number> of each type installed.
7. Fuses: [Two] <Insert number> of each type installed in the system.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide [product indicated on Drawings] <Insert manufacturer's name; product name or designation> or comparable product by one of the following:
 1. Amseco - a Potter brand; Potter Electric Signal Company.
 2. Bosch Security Systems.
 3. Commercial Products Group/CPG Life Safety Signals.
 4. Faraday; Siemens Building Technologies, Inc.
 5. Federal Signal Corporation.
 6. Fire Control Instruments, Inc.; a Honeywell company.
 7. Fire Lite Alarms; a Honeywell company.
 8. Gamewell; a Honeywell company.
 9. GE Infrastructure; a unit of General Electric Company.
 10. Gentex Corporation.
 11. Harrington Signal, Inc.
 12. NOTIFIER; a Honeywell company.
 13. Siemens Building Technologies, Inc.; Fire Safety Division.
 14. Silent Knight; a Honeywell company.
 15. SimplexGrinnell LP; a Tyco International company.
 16. <Insert manufacturer's name>.

2.2 SYSTEMS OPERATIONAL DESCRIPTION

- A. Fire-alarm signal initiation shall be by one or more of the following devices[and systems]:
 1. Manual stations.
 2. Heat detectors.
 3. Flame detectors.
 4. Smoke detectors.
 5. Duct smoke detectors.
 6. Verified automatic alarm operation of smoke detectors.
 7. Automatic sprinkler system water flow.
 8. Heat detectors in elevator shaft and pit.
 9. Fire-extinguishing system operation.
 10. Fire standpipe system.
 11. <Insert alarm-initiating devices and systems>.

B. Fire-alarm signal shall initiate the following actions:

1. Continuously operate alarm notification appliances.
2. Identify alarm at fire-alarm control unit[and remote annunciators].
3. Transmit an alarm signal to the remote alarm receiving station.
4. Unlock electric door locks in designated egress paths.
5. Release fire and smoke doors held open by magnetic door holders.
6. Activate voice/alarm communication system.
7. Switch heating, ventilating, and air-conditioning equipment controls to fire-alarm mode.
8. Activate smoke-control system (smoke management) at firefighter smoke-control system panel.
9. Activate stairwell and elevator-shaft pressurization systems.
10. Close smoke dampers in air ducts of designated air-conditioning duct systems.
11. Recall elevators to primary or alternate recall floors.
12. Activate emergency lighting control.
13. Activate emergency shutoffs for gas and fuel supplies.
14. Record events in the system memory.
15. Record events by the system printer.
16. <Insert signal-initiating actions>.

C. Supervisory signal initiation shall be by one or more of the following devices and actions:

1. Valve supervisory switch.
2. Low-air-pressure switch of a dry-pipe sprinkler system.
3. Elevator shunt-trip supervision.
4. <Insert supervisory signal-initiating devices and actions>.

D. System trouble signal initiation shall be by one or more of the following devices and actions:

1. Open circuits, shorts, and grounds in designated circuits.
2. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
3. Loss of primary power at fire-alarm control unit.
4. Ground or a single break in fire-alarm control unit internal circuits.
5. Abnormal ac voltage at fire-alarm control unit.
6. Break in standby battery circuitry.
7. Failure of battery charging.
8. Abnormal position of any switch at fire-alarm control unit or annunciator.
9. Fire-pump power failure, including a dead-phase or phase-reversal condition.
10. Low-air-pressure switch operation on a dry-pipe or preaction sprinkler system.
11. <Insert trouble signal-initiating devices and actions>.

E. System Trouble and Supervisory Signal Actions: Initiate notification appliance and annunciate at fire-alarm control unit[and remote annunciators]. Record the event on system printer.

2.3 FIRE-ALARM CONTROL UNIT

A. General Requirements for Fire-Alarm Control Unit:

1. Field-programmable, microprocessor-based, modular, power-limited design with electronic modules, complying with UL 864 and listed and labeled by an NRTL.

- a. System software and programs shall be held in flash electrically erasable programmable read-only memory (EEPROM), retaining the information through failure of primary and secondary power supplies.
 - b. Include a real-time clock for time annotation of events on the event recorder and printer.
 2. Addressable initiation devices that communicate device identity and status.
 - a. Smoke sensors shall additionally communicate sensitivity setting[and allow for adjustment of sensitivity at fire-alarm control unit].
 - b. Temperature sensors shall additionally test for and communicate the sensitivity range of the device.
 3. Addressable control circuits for operation of mechanical equipment.
- B. Alphanumeric Display and System Controls: Arranged for interface between human operator at fire-alarm control unit and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.
 1. Annunciator and Display: Liquid-crystal type, [1] [2] [3] line(s) of [40] [80] characters, minimum.
 2. Keypad: Arranged to permit entry and execution of programming, display, and control commands[and to indicate control commands to be entered into the system for control of smoke-detector sensitivity and other parameters].
- C. Circuits:
 1. Initiating Device, Notification Appliance, and Signaling Line Circuits: NFPA 72, Class A.
 - a. Initiating Device Circuits: [Style D] [Style E].
 - b. Notification Appliance Circuits: Style Z.
 - c. Signaling Line Circuits: [Style 2] [Style 5] [Style 6] [Style 7].
 - d. Install no more than [50] <Insert number> addressable devices on each signaling line circuit.
 2. Initiating Device, Notification Appliance, and Signaling Line Circuits: NFPA 72, Class B.
 - a. Initiating Device Circuits: [Style A] [Style B] [Style C].
 - b. Notification Appliance Circuits: [Style W] [Style X] [Style Y].
 - c. Signaling Line Circuits: [Style 0.5] [Style 1] [Style 3] [Style 3.5] [Style 4] [Style 4.5].
 - d. Install no more than [50] <Insert number> addressable devices on each signaling line circuit.
 3. Serial Interfaces: [Two] <Insert number> RS-232 ports for printers.
- D. Stairwell Pressurization: Provide an output signal using an addressable relay to start the stairwell pressurization system. Signal shall remain on until alarm conditions are cleared and fire-alarm system is reset. Signal shall not stop in response to alarm acknowledge or signal silence commands.
 1. Pressurization starts when any alarm is received at fire-alarm control unit.
 2. Alarm signals from smoke detectors at pressurization air supplies have a higher priority than other alarm signals that start the system.

E. Smoke-Alarm Verification:

1. Initiate audible and visible indication of an "alarm-verification" signal at fire-alarm control unit.
2. Activate an NRTL-listed and -approved "alarm-verification" sequence at fire-alarm control unit and detector.
3. Record events by the system printer.
4. Sound general alarm if the alarm is verified.
5. Cancel fire-alarm control unit indication and system reset if the alarm is not verified.

F. Notification Appliance Circuit: Operation shall sound in a <Insert pattern>.

G. Elevator Recall:

1. Smoke detectors at the following locations shall initiate automatic elevator recall.[Alarm-initiating devices, except those listed, shall not start elevator recall.]
 - a. Elevator lobby detectors except the lobby detector on the designated floor.
 - b. Smoke detector in elevator machine room.
 - c. Smoke detectors in elevator hoistway.
2. Elevator lobby detectors located on the designated recall floors shall be programmed to move the cars to the alternate recall floor.
3. Water-flow alarm connected to sprinkler in an elevator shaft and elevator machine room shall shut down elevators associated with the location without time delay.
 - a. Water-flow switch associated with the sprinkler in the elevator pit may have a delay to allow elevators to move to the designated floor.

H. Door Controls: Door hold-open devices that are controlled by smoke detectors at doors in smoke barrier walls shall [be] [not be] connected to fire-alarm system.

I. Remote Smoke-Detector Sensitivity Adjustment: Controls shall select specific addressable smoke detectors for adjustment, display their current status and sensitivity settings, and change those settings. Allow controls to be used to program repetitive, time-scheduled, and automated changes in sensitivity of specific detector groups. Record sensitivity adjustments and sensitivity-adjustment schedule changes in system memory, and print out the final adjusted values on system printer.

J. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to a remote alarm station.

K. Voice/Alarm Signaling Service: Central emergency communication system with redundant microphones, preamplifiers, amplifiers, and tone generators provided [in a separate cabinet located in the fire command center] [as a special module that is part of fire-alarm control unit].

1. Indicated number of alarm channels for automatic, simultaneous transmission of different announcements to different zones or for manual transmission of announcements by use of the central-control microphone. Amplifiers shall comply with UL 1711 and be listed by an NRTL.
 - a. Allow the application of and evacuation signal to indicated number of zones and, at same time, allow voice paging to the other zones selectively or in any combination.
 - b. Programmable tone and message sequence selection.
 - c. Standard digitally recorded messages for "Evacuation" and "All Clear."

- d. Generate tones to be sequenced with audio messages of type recommended by NFPA 72 and that are compatible with tone patterns of notification appliance circuits of fire-alarm control unit.
- 2. Status Annunciator: Indicate the status of various voice/alarm speaker zones and the status of firefighters' two-way telephone communication zones.
- 3. Preamplifiers, amplifiers, and tone generators shall automatically transfer to backup units, on primary equipment failure.
- L. Printout of Events: On receipt of signal, print alarm, supervisory, and trouble events. Identify zone, device, and function. Include type of signal (alarm, supervisory, or trouble) and date and time of occurrence. Differentiate alarm signals from all other printed indications. Also print system reset event, including same information for device, location, date, and time. Commands initiate the printing of a list of existing alarm, supervisory, and trouble conditions in the system and a historical log of events.
- M. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, [supervisory signals] [supervisory and digital alarm communicator transmitters] [and] [digital alarm radio transmitters] shall be powered by 24-V dc source.
 - 1. Alarm current draw of entire fire-alarm system shall not exceed 80 percent of the power-supply module rating.
- N. Secondary Power: 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch.
 - 1. Batteries: [Sealed lead calcium] [Sealed, valve-regulated, recombinant lead acid] [Vented, wet-cell pocket, plate nickel cadmium].
- O. Instructions: Computer printout or typewritten instruction card mounted behind a plastic or glass cover in a stainless-steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe the functional operation of the system under normal, alarm, and trouble conditions.

2.4 MANUAL FIRE-ALARM BOXES

- A. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes shall be finished in red with molded, raised-letter operating instructions in contrasting color; shall show visible indication of operation; and shall be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.
 - 1. Single-action mechanism, [breaking-glass or plastic-rod] [pull-lever] type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.
 - 2. Double-action mechanism requiring two actions to initiate an alarm, [breaking-glass or plastic-rod] [pull-lever] type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.
 - 3. Station Reset: Key- or wrench-operated switch.
 - 4. Indoor Protective Shield: Factory-fabricated clear plastic enclosure hinged at the top to permit lifting for access to initiate an alarm. Lifting the cover actuates an integral battery-powered audible horn intended to discourage false-alarm operation.
 - 5. Weatherproof Protective Shield: Factory-fabricated clear plastic enclosure hinged at the top to permit lifting for access to initiate an alarm.

2.5 SYSTEM SMOKE DETECTORS

A. General Requirements for System Smoke Detectors:

1. Comply with UL 268; operating at 24-V dc, nominal.
2. Detectors shall be [four] [two]-wire type.
3. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
4. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.
5. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
6. Integral Visual-Indicating Light: LED type indicating detector has operated[and power-on status].
7. Remote Control: Unless otherwise indicated, detectors shall be analog-addressable type, individually monitored at fire-alarm control unit for calibration, sensitivity, and alarm condition and individually adjustable for sensitivity by fire-alarm control unit.
 - a. Rate-of-rise temperature characteristic shall be selectable at fire-alarm control unit for 15 or 20 deg F (8 or 11 deg C) per minute.
 - b. Fixed-temperature sensing shall be independent of rate-of-rise sensing and shall be settable at fire-alarm control unit to operate at 135 or 155 deg F (57 or 68 deg C).
 - c. Provide multiple levels of detection sensitivity for each sensor.

B. Photoelectric Smoke Detectors:

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
 - a. Primary status.
 - b. Device type.
 - c. Present average value.
 - d. Present sensitivity selected.
 - e. Sensor range (normal, dirty, etc.).

C. Ionization Smoke Detector:

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
 - a. Primary status.
 - b. Device type.
 - c. Present average value.
 - d. Present sensitivity selected.
 - e. Sensor range (normal, dirty, etc.).

D. Duct Smoke Detectors: Photoelectric type complying with UL 268A.

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
 - a. Primary status.
 - b. Device type.
 - c. Present average value.
 - d. Present sensitivity selected.
 - e. Sensor range (normal, dirty, etc.).
3. Weatherproof Duct Housing Enclosure: NEMA 250, Type 4X; NRTL listed for use with the supplied detector.
4. Each sensor shall have multiple levels of detection sensitivity.
5. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.
6. Relay Fan Shutdown: Rated to interrupt fan motor-control circuit.

2.6 NONSYSTEM SMOKE DETECTORS

A. Single-Station Smoke Detectors:

1. Comply with UL 217; suitable for NFPA 101, residential occupancies; operating at 120-V ac[with 9-V dc battery as the secondary power source. Provide with "low" or "missing" battery chirping-sound device].
2. Auxiliary Relays: One [Form C rated at 0.5 A] [Form A and one Form C, both rated at 0.5 A].
3. Audible Notification Appliance: Piezoelectric sounder rated at 90 dBA at 10 feet (3 m) according to UL 464.
4. Visible Notification Appliance: 177-cd strobe.
5. Heat sensor, 135 deg F (57 deg C) [combination rate-of-rise and]fixed temperature.
6. Test Switch: Push to test; simulates smoke at rated obscuration.
7. Tandem Connection: Allow tandem connection of number of indicated detectors; alarm on one detector shall actuate notification on all connected detectors.
8. Plug-in Arrangement: Detector and associated electronic components shall be mounted in a plug-in module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.
9. Self-Restoring: Detectors shall not require resetting or readjustment after actuation to restore them to normal operation.
10. Integral Visual-Indicating Light: LED type indicating detector has operated[and power-on status].

B. Single-Station Duct Smoke Detectors:

1. Comply with UL 268A; operating at 120-V ac.
2. Sensor: LED or infrared light source with matching silicon-cell receiver.
 - a. Detector Sensitivity: Smoke obscuration between 2.5 and 3.5 percent/foot (0.008 and 0.011 percent/mm) when tested according to UL 268A.
3. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. The fixed base shall be designed for mounting directly to air duct. Provide terminals in the fixed base for connection to building wiring.

- a. Weatherproof Duct Housing Enclosure: NEMA 250, Type 4X; NRTL listed for use with the supplied detector.
4. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.
5. Relay Fan Shutdown: Rated to interrupt fan motor-control circuit.

2.7 HEAT DETECTORS

- A. General Requirements for Heat Detectors: Comply with UL 521.
- B. Heat Detector, Combination Type: Actuated by either a fixed temperature of [135 deg F (57 deg C)] <Insert temperature> or a rate of rise that exceeds [15 deg F (8 deg C)] <Insert temperature> per minute unless otherwise indicated.
 1. Mounting: [Adapter plate for outlet box mounting] [Twist-lock base interchangeable with smoke-detector bases].
 2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
- C. Heat Detector, Fixed-Temperature Type: Actuated by temperature that exceeds a fixed temperature of [190 deg F (88 deg C)] <Insert temperature>.
 1. Mounting: [Adapter plate for outlet box mounting] [Twist-lock base interchangeable with smoke-detector bases].
 2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
- D. Continuous Linear Heat-Detector System:
 1. Detector Cable: Rated detection temperature [155 deg F (68 deg C)] <Insert temperature>. NRTL listed for "regular" service and a standard environment. Cable includes two steel actuator wires twisted together with spring pressure, wrapped with protective tape, and finished with PVC outer sheath. Each actuator wire is insulated with heat-sensitive material that reacts with heat to allow the cable twist pressure to short-circuit wires at the location of elevated temperature.
 2. Control Unit: Two-zone or multizone unit as indicated. Provide same system power supply, supervision, and alarm features as specified for fire-alarm control unit.
 3. Signals to Fire-Alarm Control Unit: Any type of local system trouble shall be reported to fire-alarm control unit as a composite "trouble" signal. Alarms on each detection zone shall be individually reported to central fire-alarm control unit as separately identified zones.
 4. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

2.8 NOTIFICATION APPLIANCES

- A. General Requirements for Notification Appliances: Individually addressed, connected to a signaling line circuit, equipped for mounting as indicated and with screw terminals for system connections.

- B. General Requirements for Notification Appliances: Connected to notification appliance signal circuits, zoned as indicated, equipped for mounting as indicated and with screw terminals for system connections.
 - 1. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly, equipped for mounting as indicated and with screw terminals for system connections.
- C. Chimes, Low-Level Output: Vibrating type, 75-dBA minimum rated output.
- D. Chimes, High-Level Output: Vibrating type, 81-dBA minimum rated output.
- E. Horns: Electric-vibrating-polarized type, 24-V dc; with provision for housing the operating mechanism behind a grille. Comply with UL 464. Horns shall produce a sound-pressure level of 90 dBA, measured 10 feet (3 m) from the horn, using the coded signal prescribed in UL 464 test protocol.
- F. Visible Notification Appliances: Xenon strobe lights comply with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch- (25-mm-) high letters on the lens.
 - 1. Rated Light Output:
 - a. [15] [30] [75] [110] [177] <Insert value> cd.
 - b. 15/30/75/110 cd, selectable in the field.
 - 2. Mounting: Wall mounted unless otherwise indicated.
 - 3. For units with guards to prevent physical damage, light output ratings shall be determined with guards in place.
 - 4. Flashing shall be in a temporal pattern, synchronized with other units.
 - 5. Strobe Leads: Factory connected to screw terminals.
 - 6. Mounting Faceplate: Factory finished, [red] [white].
- G. Voice/Tone Notification Appliances:
 - 1. Appliances shall comply with UL 1480 and shall be listed and labeled by an NRTL.
 - 2. High-Range Units: Rated 2 to 15 W.
 - 3. Low-Range Units: Rated 1 to 2 W.
 - 4. Mounting: [Flush] [semirecessed] [or] [surface mounted and bidirectional].
 - 5. Matching Transformers: Tap range matched to acoustical environment of speaker location.

2.9 FIREFIGHTERS' TWO-WAY TELEPHONE COMMUNICATION SERVICE

- A. Dedicated, two-way, supervised, telephone voice communication links between fire-alarm control unit[, the fire command center,] and remote firefighters' telephone stations. Supervised telephone lines shall be connected to talk circuits by controls in a control module. Provide the following:
 - 1. Common-talk type for firefighter use only.
 - 2. Selective-talk type for use by firefighters and fire wardens.
 - 3. Controls to disconnect phones from talk circuits if too many phones are in use simultaneously.

4. Audible Pulse and Tone Generator, and High-Intensity Lamp: When a remote telephone is activated, it causes audible signal to sound and high-intensity lamp to flash.
5. Selector panel controls shall provide for simultaneous operation of up to six telephones in selected zones. Indicate ground faults and open or shorted telephone lines on the panel front by individual LEDs.
6. Display: [Graphic] [Liquid-crystal digital] to indicate location of caller.
7. Remote Telephone Cabinet: Flush- or surface-mounted cabinet as indicated, factory-standard red finish, with handset.
 - a. Install one-piece handset to cabinet with vandal-resistant armored cord. Silk-screened or engraved label on cabinet door, designating["Fire Warden Phone" or] "Fire Emergency Phone."
 - b. With "break-glass" type door access lock.
8. Remote Telephone Jack Stations: Single-gang, stainless-steel-plate mounted plug, engraved["Fire Warden Phone" or] "Fire Emergency Phone."
9. Handsets: <Insert number> [push-to-talk-type] sets[with noise-canceling microphone] stored in a cabinet [adjacent to fire-alarm control unit] [in the fire command center].

2.10 MAGNETIC DOOR HOLDERS

- A. Description: Units are equipped for wall or floor mounting as indicated and are complete with matching doorplate.
 1. Electromagnet: Requires no more than 3 W to develop 25-lbf (111-N) holding force.
 2. Wall-Mounted Units: Flush mounted unless otherwise indicated.
 3. Rating: 24-V ac or dc.
 4. Rating: 120-V ac.
- B. Material and Finish: Match door hardware.

2.11 REMOTE ANNUNCIATOR

- A. Description: Annunciator functions shall match those of fire-alarm control unit for alarm, supervisory, and trouble indications. Manual switching functions shall match those of fire-alarm control unit, including acknowledging, silencing, resetting, and testing.
 1. Mounting: [Flush] [Surface] cabinet, NEMA 250, Type 1.
- B. Display Type and Functional Performance: Alphanumeric display and LED indicating lights shall match those of fire-alarm control unit. Provide controls to acknowledge, silence, reset, and test functions for alarm, supervisory, and trouble signals.

2.12 ADDRESSABLE INTERFACE DEVICE

- A. Description: Microelectronic monitor module, NRTL listed for use in providing a system address for alarm-initiating devices for wired applications with normally open contacts.
- B. Integral Relay: Capable of providing a direct signal [to elevator controller to initiate elevator recall] [to circuit-breaker shunt trip for power shutdown] <Insert functions>.

2.13 DIGITAL ALARM COMMUNICATOR TRANSMITTER

- A. Digital alarm communicator transmitter shall be acceptable to the remote central station and shall comply with UL 632 and be listed and labeled by an NRTL.
- B. Functional Performance: Unit shall receive an alarm, supervisory, or trouble signal from fire-alarm control unit and automatically capture [one] [two] telephone line(s) and dial a preset number for a remote central station. When contact is made with central station(s), signals shall be transmitted. If service on[either] line is interrupted for longer than 45 seconds, transmitter shall initiate a local trouble signal and transmit the signal indicating loss of telephone line to the remote alarm receiving station over the remaining line. Transmitter shall automatically report telephone service restoration to the central station. If service is lost on both telephone lines, transmitter shall initiate the local trouble signal.
- C. Local functions and display at the digital alarm communicator transmitter shall include the following:
 - 1. Verification that both telephone lines are available.
 - 2. Programming device.
 - 3. LED display.
 - 4. Manual test report function and manual transmission clear indication.
 - 5. Communications failure with the central station or fire-alarm control unit.
 - 6. <Insert local function>.
- D. Digital data transmission shall include the following:
 - 1. Address of the alarm-initiating device.
 - 2. [Address] [Zone] of the supervisory signal.
 - 3. [Address] [Zone] of the trouble-initiating device.
 - 4. Loss of ac supply or loss of power.
 - 5. Low battery.
 - 6. Abnormal test signal.
 - 7. Communication bus failure.
 - 8. <Insert signal to be transmitted>.
- E. Secondary Power: Integral rechargeable battery and automatic charger.
- F. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

2.14 RADIO ALARM TRANSMITTER

- A. Transmitter shall comply with NFPA 1221 and shall be listed and labeled by an NRTL.
- B. Comply with 47 CFR 90.
- C. Description: Manufacturer's standard commercial product; factory assembled, wired, tested, and ready for installation and operation.
 - 1. Packaging: A single, modular, NEMA 250, Type 1 metal enclosure with a tamper-resistant flush tumbler lock.
 - 2. Signal Transmission Mode and Frequency: VHF or UHF 2-W power output, coordinated with operating characteristics of the established remote alarm receiving station designated by Owner.
 - 3. Normal Power Input: 120-V ac.

4. Secondary Power: Integral-sealed, rechargeable, 12-V battery and charger. Comply with NFPA 72 requirements for battery capacity; submit calculations.
 5. Antenna: Omnidirectional, coaxial half-wave, dipole type with driving point impedance matched to transmitter and antenna cable output impedance. Wind-load strength of antenna and mounting hardware and supports shall withstand [100 mph (160 km/h)] <Insert wind speed> with a gust factor of 1.3 without failure.
 6. Antenna Cable: Coaxial cable with impedance matched to the transmitter output impedance.
 7. Antenna-Cable Connectors: Weatherproof.
 8. Alarm Interface Devices: Circuit boards, modules, and other auxiliary devices, integral to the transmitter, matching fire-alarm and other system outputs to message-generating inputs of the transmitter that produce required message transmissions.
- D. Functional Performance: Unit shall receive an alarm, supervisory, or trouble signal from fire-alarm control unit or from its own internal sensors or controls and shall automatically transmit signal along with a unique code that identifies the transmitting station to the remote alarm receiving station. Transmitted messages shall correspond to standard designations for fire-reporting system to which the signal is being transmitted and shall include separately designated messages in response to the following events or conditions:
1. Transmitter Low-Battery Condition: Sent when battery voltage is below 85 percent of rated value.
 2. System Test Message: Initiated manually by a test switch within the transmitter cabinet, or automatically at an optionally preselected time, once every 24 hours, with transmission time controlled by a programmed timing device integral to transmitter controls.
 3. Transmitter Trouble Message: Actuated by failure, in excess of one-minute duration, of the transmitter normal power source, derangement of the wiring of the transmitter, or any alarm input interface circuit or device connected to it.
 4. Local Fire-Alarm-System Trouble Message: Initiated by events or conditions that cause a trouble signal to be indicated on the building system.
 5. Local Fire-Alarm-System Alarm Message: Actuated when the building system goes into an alarm state. Identifies device that initiated the alarm.
 6. Local Fire-Alarm-System Supervisory-Alarm Message: [Actuated when the building alarm system indicates a supervisory alarm] <Insert condition>.

2.15 SYSTEM PRINTER

- A. Printer shall be listed and labeled by an NRTL as an integral part of fire-alarm system.

2.16 DEVICE GUARDS

- A. Description: Welded wire mesh of size and shape for the manual station, smoke detector, gong, or other device requiring protection.
1. Factory fabricated and furnished by manufacturer of device.
 2. Finish: Paint of color to match the protected device.

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION

- A. Comply with NFPA 72 for installation of fire-alarm equipment.
- B. Equipment Mounting: Install fire-alarm control unit on concrete base with tops of cabinets not more than 72 inches (1830 mm) above the finished floor. Comply with requirements for concrete base specified in Division 03 Section "[Cast-in-Place Concrete] [Miscellaneous Cast-in-Place Concrete]."
 - 1. Install seismic bracing. Comply with requirements in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
 - 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.
 - 3. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 - 4. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 5. Install anchor bolts to elevations required for proper attachment to supported equipment.
- C. Equipment Mounting: Install fire-alarm control unit on finished floor with tops of cabinets not more than 72 inches (1830 mm) above the finished floor.
 - 1. Comply with requirements for seismic-restraint devices specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
 - 2. Comply with requirements for seismic-restraint devices specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
- D. Connecting to Existing Equipment: Verify that existing fire-alarm system is operational before making changes or connections.
 - 1. Connect new equipment to existing control panel in existing part of the building.
 - 2. Connect new equipment to existing monitoring equipment at the supervising station.
 - 3. Expand, modify, and supplement existing [control] [monitoring] equipment as necessary to extend existing [control] [monitoring] functions to the new points. New components shall be capable of merging with existing configuration without degrading the performance of either system.
- E. Smoke- or Heat-Detector Spacing:
 - 1. Comply with NFPA 72, "Smoke-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for smoke-detector spacing.
 - 2. Comply with NFPA 72, "Heat-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for heat-detector spacing.
 - 3. Smooth ceiling spacing shall not exceed [30 feet (9 m)] <Insert distance>.
 - 4. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas shall be determined according to Appendix A [or Appendix B] in NFPA 72.
 - 5. HVAC: Locate detectors not closer than [3 feet (1 m)] [5 feet (1.5 m)] from air-supply diffuser or return-air opening.
 - 6. Lighting Fixtures: Locate detectors not closer than 12 inches (300 mm) from any part of a lighting fixture.

- F. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of duct.
- G. Heat Detectors in Elevator Shafts: Coordinate temperature rating and location with sprinkler rating and location.
- H. Single-Station Smoke Detectors: Where more than one smoke alarm is installed within a dwelling or suite, they shall be connected so that the operation of any smoke alarm causes the alarm in all smoke alarms to sound.
- I. Remote Status and Alarm Indicators: Install near each smoke detector and each sprinkler water-flow switch and valve-tamper switch that is not readily visible from normal viewing position.
- J. Audible Alarm-Indicating Devices: Install not less than 6 inches (150 mm) below the ceiling. Install bells and horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille.
- K. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and at least 6 inches (150 mm) below the ceiling.
- L. Device Location-Indicating Lights: Locate in public space near the device they monitor.
- M. Fire-Alarm Control Unit: Surface mounted, with tops of cabinets not more than 72 inches (1830 mm) above the finished floor.
- N. Annunciator: Install with top of panel not more than 72 inches (1830 mm) above the finished floor.
- O. Antenna for Radio Alarm Transmitter: Mount to building structure where indicated. Use mounting arrangement and substrate connection that will resist [100-mph (160-km/h)] <Insert wind speed> wind load with a gust factor of 1.3 without damage.

3.2 CONNECTIONS

- A. For fire-protection systems related to doors in fire-rated walls and partitions and to doors in smoke partitions, comply with requirements in Division 08 Section "Door Hardware." Connect hardware and devices to fire-alarm system.
 - 1. Verify that hardware and devices are NRTL listed for use with fire-alarm system in this Section before making connections.
- B. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 3 feet (1 m) from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.
 - 1. Alarm-initiating connection to smoke-control system (smoke management) at firefighter smoke-control system panel.
 - 2. Alarm-initiating connection to stairwell and elevator-shaft pressurization systems.
 - 3. Smoke dampers in air ducts of designated air-conditioning duct systems.
 - 4. Alarm-initiating connection to elevator recall system and components.
 - 5. Alarm-initiating connection to activate emergency lighting control.
 - 6. Alarm-initiating connection to activate emergency shutoffs for gas and fuel supplies.

7. Supervisory connections at valve supervisory switches.
8. Supervisory connections at low-air-pressure switch of each dry-pipe sprinkler system.
9. Supervisory connections at elevator shunt trip breaker.
10. Supervisory connections at fire-pump power failure including a dead-phase or phase-reversal condition.
11. Supervisory connections at fire-pump engine control panel.
12. <Insert connections>.

3.3 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
- B. Install framed instructions in a location visible from fire-alarm control unit.

3.4 GROUNDING

- A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.

3.5 FIELD QUALITY CONTROL

- A. Field tests shall be witnessed by [Architect] [authorities having jurisdiction] <Insert names or titles of witnesses>.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- C. Perform tests and inspections.
 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- D. Tests and Inspections:
 1. Visual Inspection: Conduct visual inspection prior to testing.
 - a. Inspection shall be based on completed Record Drawings and system documentation that is required by NFPA 72 in its "Completion Documents, Preparation" Table in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter.
 - b. Comply with "Visual Inspection Frequencies" Table in the "Inspection" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.
 2. System Testing: Comply with "Test Methods" Table in the "Testing" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
 3. Test audible appliances for the public operating mode according to manufacturer's written instructions. Perform the test using a portable sound-level meter complying with Type 2 requirements in ANSI S1.4.

4. Test audible appliances for the private operating mode according to manufacturer's written instructions.
 5. Test visible appliances for the public operating mode according to manufacturer's written instructions.
 6. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
- E. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.
- F. Fire-alarm system will be considered defective if it does not pass tests and inspections.
- G. Prepare test and inspection reports.
- H. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.
- I. Annual Test and Inspection: One year after date of Substantial Completion, test fire-alarm system complying with visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.

3.6 DEMONSTRATION

- A. [Engage a factory-authorized service representative to train] [Train] Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system.

END OF SECTION 283111

SECTION 311000

SITE CLEARING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This Section specifies requirements for site clearing including demolition of site structures.
- B. The work includes:
 - 1. Protection of existing vegetation to remain.
 - 2. Clearing and grubbing.
 - 3. Selective clearing and thinning.
 - 4. Site demolition of structures, retaining walls, signage, light standards, foundations and appurtenances.
 - 5. Removal and abandonment of utilities.
 - 6. Filling or removal of underground tanks and piping.
 - 7. Disposal of material from clearing, grubbing, thinning and demolition in approved off-site disposal areas.
 - 8. Filling of voids and excavations resulting from the work.

1.2 RELATED SECTIONS

- A. Other Specification Sections which directly relate to the work of this Section include:
 - 1. Section 312500 – EROSION AND SEDIMENTATION CONTROLS.
 - 2. Section 323113 - CHAIN LINK FENCES AND GATES.

1.3 SITE CONDITIONS

- A. Site conditions existing during the bidding period will be maintained by the Owner insofar as practical.
- B. Actual site condition variations that differ from those of the bidding period and which affect site clearing operations shall be brought to the attention of the Owner prior to the commencement of any site work.

1.4 SUBMITTALS

- A. The Contractor shall submit the following information to the Engineer for review before commencing work:

1. All permits and notices authorizing site clearing and demolition.
2. Certificates of utility service severances.
3. Permits for transport and disposal of debris.
4. Demolition procedures and operational sequence.
5. Calculations.
6. DEP Form BWP AQ06 Notification Prior to Construction or Demolition.

PART 2 - PRODUCTS

2.1 TREE PROTECTION FENCING

- A. Tree protection fencing shall be an orange plastic web fence, 4 feet high minimum. Wood stakes shall be six (6) foot long by 1 inch by 1 inch square driven a minimum of two (2) feet into the ground. Posts shall be spaced eight (8) feet on center, maximum.

PART 3 - EXECUTION

3.1 PROTECTION

- A. The Contractor shall flag the limits of clearing shown on the drawings by accurate field survey with marked stakes or other means acceptable to the Engineer. Trees to remain and trees to be saved and transplanted shall be clearly identified during this staking process. The Engineer shall be notified a minimum of five (5) working days prior to scheduled commencement of clearing operations to review the flagged limits. Adjust the clearing limits as directed by the Engineer.
- B. Before clearing begins, protect designated trees to remain with tree protection fencing to the approximate diameter of foliage (dripline of the tree) to prevent damage to the trunk, foliage and root system by construction equipment and procedures.
- C. Place tree protection fencing as required to protect other plants, adjacent property areas to remain uncleared, monuments, and existing improvements from damage.
- D. The Contractor shall repair or replace immediately any damage to existing trees or root systems that are to remain and to trees that are to be transplanted. The Contractor shall employ an arborist licensed in the jurisdiction of the Project to determine the repair and replacement needs and methods for approval by the Engineer.
- E. Replace damaged shrubs and other vegetation designated to remain with the same size and species.
- F. The tree protection fencing shall be maintained for the duration of construction operations. The work shall include immediate replacement of any damaged fence. Fencing shall be removed from the site at the completion of construction operations. The fencing disposal shall be in accordance with local, state, and federal laws and regulations for the disposal of the material.

3.2 UTILITIES

- A. Notify all corporations, companies, individuals, or local authorities owning or having jurisdiction over utilities running to, through, or across areas to be affected by site clearing operations.
- B. Locate and identify existing utilities that are to remain and protect them from damage.
- C. For utilities to be disconnected, have utility services disconnected in accordance with the requirements of the utility owner.

3.3 CLEARING AND GRUBBING

- A. Clearing shall include cutting, removal, and off-site disposal of trees, bushes, shrubs, stumps, fallen timber, brush, refuse, trash, fencing and other incidental materials not required for reuse on the site.
- B. The Contractor shall grub the area within the clearing limits to completely remove stumps and root systems, except for those to remain or those to be transplanted.
- C. Depressions, excavations and voids resulting from the removal of stumps or roots shall be filled with suitable material and compacted as specified under Section 310000 – EARTHWORK.

3.4 SELECTIVE CLEARING AND THINKING

- A. Selective clearing and thinning shall be completed as directed by the Engineer. Approximate limits of selective clearing and thinning are shown on the Drawings.
- B. The work shall include the removal of dead and diseased tree limbs and plants, and pruning and removal of live vegetation that interferes with the growth of other trees and plants. Areas of dense growth shall be thinned to provide room for healthy growth.

3.5 DEMOLITION REQUIREMENTS

- A. Conduct demolition operations in a manner that will prevent damage to adjacent structures, utilities, pavements, and other facilities to remain.
- B. Cease operations immediately if any damage, settlement or other adverse effect on adjacent structures occurs. However, if an obvious unsafe condition is created that would potentially cause injury to persons or undue harm to properties, the Contractor shall take whatever measures are warranted to prevent such injury or harm. Immediately notify the Engineer and regulatory authorities. Do not resume operations until conditions are corrected, damage repaired and approval has been received from the appropriate authorities and the Owner's Representative.
- C. Obtain written permission from adjacent property owners when demolition equipment will traverse, infringe upon, or affect access to their property. Copies of the permission documents shall be submitted to the Engineer.
- D. Provide hoses and water connections. Spray water on demolition debris to minimize dust.
- E. Clean adjacent structures and improvements of dust, dirt, and debris caused by demolition operations. Return adjacent areas to condition which existed prior to start of work.

- F. All hazardous waste removal shall be performed by a hazardous waste contractor qualified and duly licensed in the jurisdiction of the Project to remove, transport, and dispose of each type of hazardous substance.
- G. Comply with federal, state, and local regulations pertaining to the crushing, processing, and reuse of Asphalt Pavement, Brick and Concrete Rubble.

3.6 DEMOLITION

- A. Demolish buildings completely and remove from site, or remove intact, in accordance with the approved permits, procedures and operational sequence.
- B. Locate demolition equipment and remove materials in a manner that prevents excessive loading to supporting walls, floors, or framing.
- C. Remove all debris and other materials from basement areas.
- D. The Contractor may break up and leave in place concrete floor slabs that are 4 or more feet below finished grade. Remove all concrete foundations and floors within 4 feet of finished grade.

3.7 FILLING BASEMENT AND VOIDS

- A. Completely fill all voids including, but not limited to: basement areas, excavation areas, and voids resulting from demolition or removal of structures including underground fuel storage tanks, wells, and cisterns with suitable material as specified in Section 310000 – EARTHWORK.
- B. Areas to be filled shall be free of standing water, frost, frozen, and unsuitable material prior to fill placement.
- C. Place and compact fill materials in conformance with the requirements of Section 310000 – EARTHWORK.
- D. Grade surface of filled areas to match adjacent grades and slope to provide surface drainage.

3.8 REMOVAL AND ABANDONMENT OF UTILITIES

- A. All existing structures, utilities, and appurtenances of any kind shall be completely removed within the limits of excavation for the new buildings and for a distance of 10 feet beyond. Remove all utilities beneath exterior columns and for a distance of 10 feet beyond.
- B. Outside the limits of excavation for the new buildings, all abandoned utilities and utility structures greater than 8 inches in diameter located at least 4 feet below bottom of finished grade shall be sealed with concrete or brick masonry at the limit of excavation. All utilities shall be entirely removed within 4 feet of finished grade.
- C. Manholes and catch basins designated to be abandoned shall have all lines plugged with brick and mortar prior to filling with sand or gravel. The top 4 feet of these structures shall be removed and the bottom slab broken up to permit drainage prior to filling.
- D. The Contractor shall remove frames, covers, and grates from manholes, catch basins and gate valves and satisfactorily store and protect them until they are required for reuse in the work. Existing frames, covers, and grates determined by the Engineer to be unsuitable for reuse shall be removed from the site.

3.9 DISPOSAL OF DEMOLISHED MATERIALS

- A. Remove from site all materials resulting from site clearing and demolition operations.
- B. No burning of any material will be allowed.

END OF SECTION

SECTION 312319

DEWATERING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This Section specifies the dewatering requirements for control of surface and subsurface water within the site.
- B. The work includes:
 - 1. Control of surface water runoff to prevent flooding of excavations, trenches, and adjacent properties, and the saturation and loosening of soils.
 - 2. Removal of subsurface water from excavations and trenches.
 - 3. Provision of equipment and facilities to remove sediment and control the rates and volumes of disposal of surface and subsurface waters removed from the work areas.
 - 4. Provisions for the protection of adjacent and downgradient properties and environmental resources.

1.2 RELATED SECTIONS

- A. Sections which directly relate to the work of this Section include:
 - 1. Section 311000 — SITE CLEARING.
 - 2. Section 312500 - EROSION AND SEDIMENTATION CONTROLS.
 - 3. Section 333900 - SANITARY UTILITY SEWERAGE STRUCTURES.
 - 4. Section 334000 - STORM DRAINAGE UTILITIES.
 - 5. Geotechnical Report prepared by Carlin Simpson & Associates.

1.3 DEWATERING SYSTEM REQUIREMENTS

- A. The Contractor shall design the dewatering systems to:
 - 1. Effectively reduce the hydrostatic pressure and lower the groundwater levels to a minimum of 2 feet below the bottom of excavations;
 - 2. Develop a substantially dry and stable subgrade for the proposed work;
 - 3. Prevent damage to adjacent properties, buildings, structures, utilities and other facilities;
 - 4. Ensure that, after 12 hours of initial pumping, no soil particles will be present in the discharge;
 - 5. Retain all sediments on-site within the work area.

- B. Locate dewatering facilities where they will not interfere with utilities and construction work to be done by others.
- C. Modify dewatering equipment and procedures when operations threaten to cause damage to new or existing facilities or adjacent areas not within the Limits of Work.

1.4 SUBMITTALS

- A. Prior to installation of the dewatering system, submit working drawings and design data prepared by a registered professional engineer licensed in the jurisdiction of the Project, with the following information:
 - 1. The proposed types of dewatering systems;
 - 2. Arrangement, location and depths of system components;
 - 3. Complete description of equipment and instrumentation to be used including installation, operation, and maintenance procedures;
 - 4. Types and sizes of filters;
 - 5. Design calculations demonstrating adequacy of the proposed system and equipment;
 - 6. Provisions and methods of sediment removal and disposal of water; and
 - 7. All permits required for the work.
- B. Submit records required in Article 3.03.

PART 2 - PRODUCTS

(Not Applicable)

PART 3 - EXECUTION

3.1 SURFACE AND WATER CONTROL

- A. Intercept and divert surface water runoff away from excavations through the use of dikes, curbing, walls, ditches, pipes, sumps or other approved means.
- B. Provide and maintain ditches of adequate size to collect and prevent surface and subsurface water seepage from entering the excavations. Divert the water to settling basins or other approved equipment required to reduce the amount of fine particles before discharge into drainage pipes and natural water courses. If a drainage system or water course is silted or becomes blocked due to dewatering operation, it shall be cleaned by the Contractor at no additional cost to the Owner. Any enforcement actions or fines resulting from improper dewatering and/or discharge of turbid water and sediment to protected areas shall be the sole responsibility of the Contractor.

3.2 DEWATERING EXCAVATIONS

- A. Accomplish dewatering in accordance with the means and methods submitted as required in Article 1.04. Keep the Engineer advised of any changes required to accommodate field

conditions and, on completion of the dewatering system installation, revise and resubmit the information required to show the installed system.

- B. Perform dewatering operations to lower the groundwater level in excavations as required to provide a stable, dry subgrade for the prosecution of the proposed work.
- C. Maintain dewatering operations in a manner that prevents buildup of excessive hydrostatic pressure and damage to structures and the subgrade.
- D. Do not allow water to accumulate in excavations. Contractor shall provide and maintain ample means and devices to remove promptly, and to dispose of properly, all water entering excavations and to keep them dry until the proposed work is completed.
- E. Do not discharge water to protected environmental resources without treatment to remove suspended solids and sediments.
- F. No pipe shall be laid in water. No masonry shall be laid in water, and no water shall be allowed to inundate new concrete and new brick masonry within 48 hours after installation. Contractor shall constantly guard against the possibility of flotation of pipe or structures after installation. Backfill or other means shall be placed promptly to prevent this occurrence.

3.3 RECORDS FOR WELL SYSTEMS

- A. When well point or other type of well systems are used for dewatering, the following information shall be obtained and recorded:
 - 1. The average flow rate and time of operation of each pump used in the dewatering system. Provide appropriate devices, such as flow meters, for observing the flow rates. Submit the data, in tabular form, during the period that the dewatering system is in operation.
 - 2. The groundwater elevations during the period that the dewatering system is in operation. Submit observation records daily within 24 hours of reading.
 - 3. During the initial period of the dewatering, make required observations on a daily basis. If, after a specified period, dewatering operations have stabilized, observations may be changed to longer intervals as accepted by the Engineer.

END OF SECTION

SECTION 312500

EROSION AND SEDIMENTATION CONTROLS

GENERAL

DESCRIPTION

This Section specifies requirements for temporary and permanent erosion and sedimentation control provisions as they relate to the construction process.

The work includes:

Providing and maintaining all temporary erosion and sedimentation control measures shown on the Drawings and required by the Engineer during the life of the Contract to control soil erosion and water pollution.

The installation and maintenance of additional silt fence, berms, ditches, sedimentation basins, construction exits, fiber mats, catch basin filters, straw, netting, gravel, trenches, mulches, grasses, slope drains, and other approved erosion control devices or methods, needed to protect any areas on or off site in accordance with the Storm Water Pollution Prevention Plan (SWPPP) to be developed by the Contractor which is required by the NYSDEC or its' locally designated agency.

RELATED SECTIONS

Sections which directly relate to the work of this Section include:

Section 311000 – SITE CLEARING.

Section 312319 – DEWATERING.

Section 329000 – PLANTING.

Section 329220 – SEEDING AND SODDING.

Geotechnical Report prepared by Carlin Simpson & Associates.

DEFINITION AND COORDINATION OF EROSION AND SEDIMENTATION CONTROL PROVISIONS

Permanent erosion and sedimentation control measures are defined as those elements that are to be incorporated into the final project product, including but not necessarily limited to such items as: finish paving and landscape, detention basin forebays, sedimentation control structures (Vortechs, Stormceptor, catch basins, etc.), swales and ditches, berms, and other such items.

Temporary erosion and sedimentation control measures are defined as those elements that are required by permit approvals and necessary to be installed by the Contractor to meet federal, state and local regulations for the construction program, including, but not necessarily limited to, such items as: silt fences, berms, portable sedimentation basins, straw bales, check dams, and other such items, all of which shall be removed by the Contractor after installation of permanent

erosion and sedimentation control measures, stabilization of the site, and prior to final completion of the project.

The temporary control provisions shall be coordinated with the permanent erosion and sedimentation control features to the extent practical to ensure economical, effective, and continuous erosion and sedimentation controls throughout the construction and post-construction periods.

LAWS AND REGULATIONS

City of New Rochelle site plan approval and conditions are hereby incorporated into these Specifications.

Compliance with the NYSDEC SPDES General Permit Regulations is the responsibility of the Contractor.

PRIOR TO CONSTRUCTION

Prior to the start of the construction, the Contractor shall submit to the Engineer the following: schedules for the construction of required stormwater detention basins, temporary and permanent erosion and sediment control work, clearing and grubbing, grading, structures at watercourses, construction, and paving. No work shall be started until control schedules and methods of operations have been submitted to the Engineer.

This project disturbs more than one acre of land and falls within the State Pollutant Discharge Elimination System (SPDES) Program and New York State Department of Environmental Conservation (NYSDEC) jurisdiction. Prior to the start of construction, a Notice of Intent (NOI) shall be filed with the NYSDEC and a stormwater pollution prevention plan (SWPPP) shall be prepared in accordance with the SPDES regulations. The contractor shall implement erosion and sediment control measures in accordance with the SWPPP and NYSDEC SPDES Regulations.

CONSTRUCTION OPERATIONS

When in the opinion of the Engineer it becomes necessary, the Engineer will inform the Contractor of construction procedures and operations that jeopardize erosion and sedimentation control provisions. If these construction procedures and operations are not corrected promptly, the Owner may suspend the performance of any or all construction until corrections have been made, and such suspension shall not be the basis of any claim by the Contractor for additional compensation from the Owner nor for an extension of time to complete the Work.

PRODUCTS

MATERIALS

Temporary erosion control seed for quick growing grasses such as wheat, rye or oats shall be planted only when permanent grasses (See Section 329220 - SEEDING AND SODDING) cannot be planted due to the growing season. All permanent grass areas planted with temporary erosion control seed shall be replaced with permanent seed. Apply seed mixture at a rate of 100 pounds per acre.

Percent Germination

Seed	Percent by Weight	Minimum
Winter Rye	80 Minimum	85
Red Fescue(Creeping)	4 Minimum	80
Perennial Rye Grass	3 Minimum	90
Red Clover	3 Minimum	90
Other Crop Grass	0.5 Maximum	
Noxious Weed Seed	0.5 Maximum	
Inert Matter	1.0 Maximum	

Erosion Control Blanket/Fabric Netting - See Section 329220 - SEEDING AND SODDING.

Curlex blankets, as manufactured by American Excelsior Company.

Erosion Control Blankets as manufactured by North American Green.

Straw bale sediment traps consisting of straw bales banded with wire or nylon tape (minimum two bands for bale) approximately two-feet, six-inches in length.

Stakes for straw bales shall be 1-1/2 inch by 1-1/2 inch by 4 feet long, or approved equal.

Silt fence fabric shall be 100X, as manufactured by Mirafi.

Filter fabric at construction entrance shall be 600X, as manufactured by Mirafi.

Silt Sacks and Sediment Control Devices

Silt sacks shall be a woven polypropylene geotextile fabric with strength per ASTM D4884 manufactured to fit the opening of the catch basin. Silt sacks shall be Siltsack ® as manufactured by ACF Environmental, Inc., or approved equal.

Silt sacks shall be manufactured with a high flow bypass weir for large inflow events. Field modification, including cutting or puncturing of the fabric, will not be allowed.

Install at locations indicated on the Drawings.

EXECUTION

EROSION AND SEDIMENTATION CONTROL – STRAW BALES

Straw bales shall be installed at the locations, shown on the Drawings and in general as follows:

Toe of slope of embankment construction to filter all runoff flowing to off-site discharges.

Toe of temporary earthwork stockpile slopes.

Across construction ditches prior to entry into drainage system or waterway, and at 50 foot intervals along the remainder of the ditch.

Surrounding completed drainage inlets.

Other locations shown on the Contract Drawings and required by laws, regulations, and permits.

Straw bales shall be installed in line with each bale installed tight against the previous bale to form a continuous barrier. Secure bales in place with two (2) stakes per bale. The bales shall be set in a trench approximately 4 inches into the ground. Soil shall be placed on the upside slope of the bales. Deteriorated, destroyed, or rotted bales shall be replaced immediately. Sediment shall be removed and disposed of periodically from behind the straw bales. The accumulated sediment shall not be allowed to rise above the mid-height of the bale. All sediment, straw bales, and appurtenances shall be removed and disposed of at the completion of the Contract.

TEMPORARY EROSION CONTROL MATS

Erosion control mats shall be installed in accordance with the manufacturer's recommendations.

Areas to receive mats shall be smooth graded and compacted. Remove all rocks, dirt clods, vegetation, and other obstructions that may cause damage to the mats.

Unroll mats parallel to the direction of water flow and lay flat against the ground. Overlap roll ends a minimum of 1 foot with upslope mat on the top to prevent uplift of mat end by water flow. Overlay adjacent edges of mat by six (6) inches. Extend mat a minimum of 2 feet above the crest of steep slopes and anchor by excavating a 6 inch deep trench, and secure end of mat in trench using staples or pins furnished by manufacturer of mat. After securing mat end in place, backfill and compact trench.

SILT FENCE

Silt fence shall be installed at locations as shown on the Drawings.

Supporting posts shall be spaced 4 feet on center, and driven at least 1 foot into the ground. Posts shall be 1-1/2 inch square or heavier wood posts or standard steel posts.

Fabric shall be anchored in a 4-inch deep trench dug on the upslope side of the posts. The trench shall be at least 4 inches wide. The fabric shall be laid in the trench, backfilled, and compacted.

Fabric rolls shall be spliced at posts. The fabric shall be overlapped 6 inches, folded over, and then securely fastened to posts.

Silt fences shall be inspected immediately after each storm event and at least daily during prolonged rainfall.

CONSTRUCTION REQUIREMENTS – TEMPORARY EROSION AND SEDIMENTATION CONTROL

The Contractor shall construct all permanent erosion and sedimentation control features at the earliest practical time as outlined in the accepted schedule. Temporary erosion and sedimentation control measures shall be used to correct conditions that develop during construction which were unforeseen, but are needed prior to installation of permanent erosion and sedimentation control features, or that are needed temporarily to control erosion or sedimentation which develops during construction operations.

Where erosion is likely to be a problem, clearing and grubbing operations shall be scheduled and performed so that grading operations and permanent erosion and sedimentation control features can follow immediately thereafter, if conditions permit; otherwise, temporary erosion and sedimentation control measures will be required between successive construction stages.

Contractor shall be responsible for controlling erosion within the project area and retaining sediment on-site away from sensitive environmental resources. Any fines, construction delays, remedial actions, or incarceration resulting from the Contractor's failure to comply with these provisions shall be the responsibility of the Contractor and not the Owner.

Failure by the Contractor to control erosion, pollution, and siltation shall be cause for the Owner to employ outside assistance to provide the necessary corrective measures. The cost of such assistance, including engineering costs, will be charged to the Contractor and appropriate deductions made from the Contractor's monthly progress payment.

The Contractor shall remove and properly dispose of sediment from control facilities as required by the Engineer. The Contractor shall modify and improve erosion and sedimentation control facilities and replace deteriorated straw bales and other devices as required by the Engineer.

Minimum temporary and permanent erosion and sedimentation control measures are shown on the Drawings. The Contractor shall strictly adhere to the minimum provisions shown. Additionally, temporary measures shall be selected and constructed by the Contractor in consultation with the Engineer to accommodate changing field conditions that develop during construction.

The temporary sedimentation basins shall be maintained from the start of construction until construction of the permanent detention basins and/or stormwater system is completed and perimeter areas are stabilized. A temporary outlet shall be constructed above the expected sediment levels. Construction of the basins shall be sequenced so that the temporary outlet is installed and basin embankment is constructed with the material available from the initial site excavations.

Per SPDES Permit requirements, in disturbed areas where construction has permanently or temporarily ceased, the area must be stabilized within 14 days. If earth-disturbing activities will resume within 14 days, temporary stabilization is not required.

All disturbed areas shall be re-vegetated by loaming and seeding unless otherwise noted on the approved plan.

MAINTENANCE OF EROSION AND SEDIMENTATION CONTROL MEASURES

The Contractor shall check the condition of erosion and sedimentation control devices daily and maintain them in good operating condition. Straw bales shall be replaced when deteriorated.

The Contractor shall inspect the condition of diversion dikes and ditches, filter berms, interceptor dikes, sediment basins, and other erosion and sedimentation control devices after each rainstorm and during major storm events. Repairs shall be made as necessary.

During construction, temporary outlets of the drainage systems shall direct the flow to temporary or permanent sedimentation basins.

Temporary soil erosion and sedimentation control devices shall be removed and adjacent areas outside the limits of grading restored upon completion of the work or when required by the Engineer

END OF SECTION



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13 August 2020

The NRP Group LLC
1228 Euclid Ave. #400
Cleveland, OH 44125

Attn: Mr. Donald Fix
Senior Horizontal Design & Entitlements Manager

Re: Report on Subsurface Soil, Groundwater and Foundation Investigation
Proposed Parking Garage
116 Guion Place & 64 Lincoln Avenue
New Rochelle, NY (CSA Job No. 20-30)
NRP Phase Code 51.110

Dear Mr. Fix:

In accordance with our proposal revised 13 March 2020 and your subsequent authorization, we have completed a Subsurface Soil and Foundation Investigation for the referenced site. The purpose of this study was to determine the nature and engineering properties of the subsurface soil and the groundwater conditions for the new construction, to recommend a practical foundation scheme, and to determine the allowable bearing capacity of the site soils. We understand that the planned construction will consist of a new 5 tier parking garage.

Our scope of work for this project included the following:

1. Reviewed the proposed layout, the existing site conditions, the expected soil conditions, and planned this study.
2. Retained General Borings Inc. to advance ten (10) test borings in the area of the residential building.
3. Laid out the boring locations in the field, provided full time inspection of the explorations, obtained soil samples, and prepared detailed logs and a Boring Location Plan.
4. Performed soil identification tests on selected soil samples in our laboratory.

5. Analyzed the field and laboratory test data and prepared this report containing the results of this study.

1.0 SITE DESCRIPTION

The project site is located at 116 Guion Place, New Rochelle, New York. The site is currently occupied by a single-story Boys & Girls Club, parking lots, sidewalks, and grass landscape area. Site grades are relatively flat. Elevations vary from approximately +63.0 to +60.0.

2.0 PROPOSED CONSTRUCTION

We understand that the planned construction will consist of a new 5 tier parking garage. The ground tier or lower level will have a finished floor elevation of approximately +61.75. The provided structural drawings indicate the garage footings will bear at the following elevations: +59.25, +58.75, and +57.75.

The following evaluation is based on information that has been provided to our office as of the date of this report. Once the planned construction has been further completed, a copy of the final plans should be forwarded to our office so that we can review them along with the recommendations in this report. At that time, any changes or additional recommendations can be provided, if required.

3.0 SUBSURFACE CONDITIONS

To determine the subsurface soil and groundwater conditions in the area of the proposed residential building, seven (7) test borings were advanced by General Borings, Inc. The boring locations are shown on the enclosed Boring Location Plan. The borings were performed using hollow stem augers, rock coring, and split spoon sampling. Detailed boring logs have been prepared and are included in this report. The borings were completed in May 2020 under the full-time inspection of Carlin-Simpson & Associates. Our field engineer visually identified all of the soil samples obtained during the boring operations and selected samples were tested in our laboratory. The results of these tests are also included in this report. In addition, two (2) borings were completed by Haley Aldrich in the proposed building footprint in January 2019.

3.1 Soils

The soil descriptions shown on the boring logs are based on the Burmister Classification System. In this system, the soil is divided into three components: Sand (S), Silt (S) and Gravel (G). The major component is indicated in all capital letters, the lesser in lower case letters. The following modifiers indicate the quantity of each lesser component:

<u>Modifier</u>	<u>Quantity</u>
trace (t)	0 -10%
little (l)	10% - 20%
some (s)	20% - 35%
and (a)	35% - 50%

The subsurface soil conditions encountered in the test borings at the site can be summarized as follows:

Stratum 1A
Topsoil At the surface in several borings is topsoil that ranges from approximately 5 to 6 inches in thickness.

Stratum 1B
Asphalt/Concrete At the surface in the remaining borings is asphalt or concrete pavement that ranges from approximately 2 to 6 inches in thickness.

Stratum 2
Existing Fill Below the surface layers in each of the borings is existing fill that generally consists of loose to medium dense brown or gray brown coarse to fine SAND, little (to some) Silt, little coarse to fine Gravel. Debris, such as cinders, concrete, asphalt, wood, glass, and brick, was encountered within the fill layer at select locations. At the boring locations, the existing fill layer was encountered to depths ranging from 0'6" to 11'0" below the existing ground surface.

Stratum 3
Silty Sand Beneath the existing fill in boring B-105 and B-106 is loose to medium dense brown or light gray coarse to fine SAND, and Silt that continued to a depth of 6'0" below the ground surface.

Stratum 4
Sandy Clayey
Silt Beneath the existing fill in boring B-111 and B-112 is soft dark gray Clayey SILT little medium to fine Sand, with trace organics that continued to depths of 6'6" and 7'0" below the ground surface, respectively.

Stratum 5
Sand with Gravel Below the Sandy Clayey Silt layer in borings B-111 and B-112 is medium dense gray coarse to fine SAND, trace (to little) Silt, trace coarse to fine Gravel that continued to depths of 12'0" and 8'0" below the ground surface, respectively.

Stratum 6
Weathered
Bedrock Underlying the above soil layers is dense to very dense brown or gray brown coarse to fine SAND, little Silt, little coarse to fine Gravel or completely weathered rock. At the boring locations, this layer continued to depths ranging from 9'6" to 14'0" below the existing ground surface.

Stratum 7
Schist Bedrock

The completely weathered rock transitions to Schist bedrock. The borings were terminated at auger refusal on the probable bedrock surface or after coring to verify the bedrock quality. Final boring depths ranged from 9'6" to 27'0" beneath the existing ground surface.

The upper 5 to 15 feet of bedrock was cored at several boring locations. The core recoveries ranged from 70% to 100%. The rock quality designations (RQD) ranging from 29% to 83%. Based on the RQD and visual inspection, the recovered cores ranged shattered, very blocky and seamy to blocky and seamy.

3.2 Bedrock

Schist bedrock ranging from vary dense completely weathered rock to blocky and seamy rock was encountered in each of the borings performed within the planned parking garage footprint. Bedrock was encountered throughout the proposed parking garage footprint at depths ranging from 2'0" to 14'0" (elevations +61.5 to +49.0) below the existing ground surface.

At this time the site grades had not been finalized, but we anticipate that harder bedrock will be encountered during construction. We anticipate that the "rippability" of the bedrock will be variable and very limited. The use of hydraulic hammers will be required to excavate the harder, intact rock. Additional issues related to foundations bearing on rock are discussed in Sections 5.2 of this report.

3.3 Groundwater

Groundwater was encountered in the test borings at depths ranging from 3'10" to 5'6" beneath the existing ground surface as shown in Table 1. These depths correlate to groundwater levels ranging between approximately elevation +58.7 and elevation +57.0.

Groundwater on the subject site will be controlled by the topography and the underlying bedrock surface. As surface water infiltrates the ground, the water will travel along the soil/rock interface and through fractures in the bedrock. During construction, we expect that water will be encountered in the site excavations, within the silty site soils, and/or along the soil/rock interface, especially during wet periods. Proper groundwater control measures will be required where water is encountered in the site excavations. Variations in the location of the long-term water table may occur as a result of changes in precipitation, evaporation, surface water runoff, and other factors not immediately apparent at the time of this exploration.

3.4 Summary of Boring Observations

A summary of the observations is provided in Tables 1 below.

Table 1 – Summary of Boring Observations

Boring No.	Approximate Ground Surface Elevation	Observed Depth to Groundwater (Elevation)	Depth to Bottom of Existing Fill (Elevation)	Depth to Bedrock (Elevation)
B-3	+62.0	No Reading	4'0" (+58.0)	CWR @ 8'0" (+54.0)
B-4	+62.5	No Reading	0'6" (+62.0)	CWR @ 5'6" (+57.0)
B-105	+62.5	4'0" (+58.5)	3'6" (+59.0)	CWR @ 6'0" (+56.5) AR @ 9'6" (+53.0)
B-106	+64.0	No Reading	3'0" (+61.0)	CWR @ 6'0" (+58.0) C @ 11'0" (+53.0)
B-107	+63.5	5'6" (+58.0)	2'0" (+61.5)	CWR @ 2'0" (+61.5) AR @ 9'6" (+54.0)
B-108	+62.5	3'10" (+58.7)	10'6" (+52.0)	CWR @ 10'6" (+52.0) C @ 11'6" (+51.0)
B-109	+62.5	No Reading	7'6" (+55.0)	C @ 7'6" (+55.0)
B-110	+62.5	No Reading	11'0" (+51.5)	CWR @ 11'0" (+51.5) AR @ 14'0" (+48.5)
B-111	+61.5	4'6" (+57.0)	5'0" (+56.5)	AR @ 11'0" (+50.5) C @ 12'0" (+49.5)
B-112	+61.5	4'6" (+57.0)	3'6" (+58.0)	CWR @ 8'0" (+53.5) AR @ 12'6" (+49.0)

CWR – Completely Weathered Bedrock

C – Cored Bedrock

AR – Auger Refusal

4.0 SUMMARY OF DESIGN RECOMMENDATIONS

Below is a summary of the major design and construction considerations for this project. Additional recommendations are provided in the following sections of this report.

- Subsurface Conditions (Section 3.0)
 - Existing fill at the site was encountered to depths of 0'6" to 11'0" (elevations +62.0 to +51.5) below the existing ground surface.
 - Bedrock was encountered at depths ranging from 2'0" to 14'0" (elevations +61.5 to +49.0) below the existing ground surface.
 - Groundwater was encountered at depths ranging from 3'10" to 5'6" beneath the existing ground surface (elevations +58.7 to +57.0).
 - A summary of the subsurface observations is performed in the new building areas and throughout the site are provided in Table 1.

- *Western New Garage Foundations – Footings On Rock (Section 5.2)*
 - The existing fill is unsuitable for support of the new garage foundations.
 - The new garage footings in the western portion of the garage may be designed as shallow spread footings lowered to bear on bedrock.
 - Based on the proposed bottom of footing elevations, we anticipate that the proposed footings will need to be lowered approximately 1 to 2 feet to achieve the required bearing capacity.
 - The new foundations may be designed as spread footing type foundations bearing on approved subgrade or bedrock using an allowable bearing pressure of 8,000 psf.
 - Minimum depth for frost protection = 42 inches.
- *Eastern Garage Foundations – Piles or Parking Garage Foundation (Section 5.3)*
 - The existing fill is unsuitable for support of the new garage foundations.
 - It is our understanding that the design team would like to minimize excavation spoils and dewatering. In addition, lowering the perimeter footings would require extensive SOE along the adjacent property line.
 - As a result, we anticipate that the foundations in the eastern portion of the garage will be supported on pile foundations or a ground improvement system.
 - A sketch of the footings requiring piles or ground improvement are shown on the attached FIG-1.
 - Foundation alternatives:
 - *Drilled Micropiles:* The pile foundations can be designed as drilled micropiles with a bond zone formed entirely in bedrock. We anticipate that allowable pile capacities ranging from 80 to 120 tons will be suitable for this project.
 - *Ground Improvement:* Alternatively, the foundations can be designed as shallow spread footings with an allowable bearing capacity of 8,000 psf. The footings must be supported on rammed aggregate piers or grouted rigid inclusions.
- *New Floor Slab Recommendations (Section 5.4)*
 - It is our understanding that the proposed floor slab will be designed as a slab on grade in portions of the new garage footprint. In the remainder of the garage footprint, the slab will be designed as an elevated structural slab.
 - In most of the garage footprint, the slab can be designed as a slab on grade bearing on densified site soils and new compacted fill using a subgrade of modulus reaction of 200 pci.
 - However, areas of unsuitable existing fill are present in the southern portion of the garage. If a slab on grade will be used in this area, preparation of the subgrade with overexcavation 3 feet below the proposed subgrade and the installation of geogrid will be required.
 - Test pits should be performed after demolition of the existing structures to verify the extent of the unsuitable existing fill.

5.0 PARKING GARAGE EVALUATION

We understand that the planned construction will consist of a new 5 tier parking garage. The ground tier or lower level will have a finished floor elevation of approximately +61.75. The provided structural drawings indicate the garage foundations will bear at the following elevations: +59.25, +58.75, and +57.75. A summary of the encountered subsurface conditions for each boring are provided above in Table 1 above.

Existing fill was encountered throughout the proposed garage area to depths ranging from 0'6" to 11'0" (elevations +62.0 to +51.0) below the existing ground surface. The existing fill is not an acceptable bearing material for the new foundations. The consistency and density of the soil fill are not predictable. Certain areas may contain clean dense soils while other areas may contain loose material, void spaces, and/or debris. The existing soil fill creates the possibility of intolerable differential settlements under loading. The existing fill is unsuitable for support of the proposed garage foundations.

Anticipated Western Foundation System

In the western portion of the proposed parking garage, column lines 1 and 2 on the current foundation plan, we expect that the majority of the existing fill will be removed from below the proposed footing subgrade elevation. In addition, some of the virgin site soils are not suitable for support of the required bearing pressures. We anticipate that footings in these areas will need to be further lowered, on the order of 1 to 2 feet below the current proposed bottom of footing elevations to bear on bedrock capable of supporting the required bearing pressures. Foundation recommendations for the proposed garage are provided in Sections 5.2 below.

Anticipated Eastern Foundation System

The proposed parking garage footprint is primarily occupied by an existing building between lines 3 and 5 on the proposed foundation plan. Borings could not be performed in the existing building footprint. As a result, the depth of existing fill and bedrock are generally not known in this portion of the parking garage footprint. However, based on the subsurface observations, the depth to bedrock and depth of existing fill generally increases from west to east in the proposed garage footprint.

We performed a Limited Phase II Environmental Site Investigation dated 20 July 2020. The Phase II assessment indicates that some of the site soils and groundwater are contaminated. It is our understanding that the design team aims to limit the handling of the contaminated soils and groundwater. In addition, lowering the perimeter footings to bear on bedrock in the western portion of the garage is not possible without extensive support of excavation (SOE) along the adjacent property line.

As a result, we anticipate the foundations in lines 3 through 7 cannot be designed as shallow spread footings lowered to bear on bedrock. We anticipate two foundation system alternatives will be suitable for transferring the western garage footing loads through the existing fill. Both alternatives will limit foundation excavation spoils. The first foundation alternative

consists of drilled micropiles with bond zones formed entirely in bedrock. Micropile designs for 80 to 120-ton capacities are provided in Section 5.3.1. Alternatively, the western garage foundations can be designed supported on a ground improvement system as discussed in Section 5.3.2. The foundations for this alternative can be designed as shallow spread footings with allowable bearing pressure of 8,000 psf supported on ground improvement systems consisting of grouted rigid inclusions or controlled modulus columns. The optimal foundation system will depend on an economic analysis.

Garage Floor Slab

It is our understanding that the proposed garage lower level will primarily be elevated above the existing ground surface. However, slabs on grade are anticipated in portions of the proposed garage, particularly in the area of the proposed stairwells and garage entrances.

The non-elevated portions of the proposed garage slab may be designed as a slab on grade bearing on the densified and approved existing fill, densified virgin soils, or new compacted fill. Stabilization of the slab subgrade with triaxial grid and dense graded aggregate in the southern portion of the garage may be necessary. Additional slab on grade recommendations can be found in Section 5.4.

5.1 Parking Garage Area Preparation

As part of the site development, the existing structures, on the site will be demolished. All debris resulting from the demolition of these structures must be completely removed from the new construction areas, extending at least ten (10) feet beyond the new garage limits, where practical. This shall include the complete removal of all foundations, floor slabs, curbs, utilities, pavement, and miscellaneous debris. Where the removal of existing structures or associated materials extends below the planned structures, the resulting excavations shall be backfilled with new compacted fill as described below.

Existing utilities, where they are encountered within the planned building area, should be either abandoned or rerouted around the new structure. Once the utility has been rerouted or abandoned, the section of pipe and any associated structure within the building area should be completely removed. The removal of the pipe and structure must also include any loose fill around the pipe or structure. After the pipe, associated structure, and associated loose backfill have been removed, the resulting excavation shall be backfilled with new controlled fill as described below.

Densification of Subgrade Soils (Proofrolling)

Existing fill was encountered throughout the proposed garage area to depths ranging from 0'6" to 11'0" (elevations +62.0 to +51.0) below the existing ground surface. The extents and quality of the existing fill could not be confirmed in the existing building footprint. Supplemental test pits should be performed after the demolition of the existing building to further evaluate the extent and properties of the existing fill.

After the demolition of the existing structures and the surface materials are removed as outlined above; the exposed subgrade shall be proofrolled with at least five (5) passes of a large vibratory drum roller (i.e. Dynapac CA 250 or equivalent). The proofrolling is necessary to densify the underlying soils. The proofrolling must be performed prior to the excavation for new foundations and the placement of new fill in the building areas. In areas where the existing subgrade is to be cut, the proofrolling of the subgrade in those areas should be performed once the proposed subgrade is achieved.

A representative from Carlin-Simpson & Associates or qualified geotechnical engineering firm shall observe the proofrolling operation. If any excessive movement is noted during the proofrolling, the soft soil shall be removed and replaced with new compacted fill. The Carlin-Simpson & Associates representative or a qualified geotechnical engineering firm shall be responsible for determining what material, if any, is to be removed and will direct the Contractor during this operation.

Handling Wet and Sensitive Subgrades

Groundwater was encountered at depths ranging from 3'10" to 5'6" beneath the existing ground surface (elevations +58.7 to +57.0). Groundwater will be encountered in the site excavations.

Where groundwater is encountered, dewatering will be required to construct the foundations and to prepare the subgrade. We anticipate that the use of sump pits and pumps for dewatering will only be effective where the groundwater level is within a few feet of the planned bottom of the excavation. Where sumps and pumps can be used, the sump pits shall consist of a perforated pipe at least 8-inches in diameter, surrounded by crushed stone and filter fabric. Multiple sump pumps may be required to effectively control and lower the water level. The sump pits should be installed just outside the planned excavation area and at least two (2) feet below the anticipated bottom of the lowest excavation. Electric pumps equipped with an automatic shut off and capable of operating 24 hours a day will be required. Temporary dewatering must be maintained continuously by the contractor during construction.

To prepare the subgrade surface for the geotextile filter fabric and new fill, all surface water and soft soil should be removed from the limits of the excavation, extending a minimum of three (3) feet beyond the new structure limits where practical. Where necessary, sump pits and pumps should be used to remove the standing water and to control the groundwater during construction. All unsuitable surface materials should be removed to expose the underlying natural soil subgrade surface. This should be performed under the full-time observation of a Carlin-Simpson & Associates field representative. An undercut of 12 to 18 inches below the planned foundation or slab subgrade elevation is anticipated.

After the subgrade is prepared, the geotextile filter fabric should be laid out on the exposed subgrade. The geotextile filter fabric shall consist of Mirafi 500X or equivalent. Adjacent layers of geotextile filter fabric should be overlapped a minimum of 18 inches. As necessary, approximately 12 to 18 inches of 3/4-inch clean crushed stone will be installed on top

of the filter fabric layer to provide a firm working surface, provide protection for the geotextile filter fabric, and minimize pumping of the subgrade soil.

The stone should be spread across the geotextile filter fabric and densified with lightweight tracked equipment. Care should be taken to avoid contact of the tracked equipment with the geotextile fabric. Alternatively, the placement of the stone fill could be achieved by placing the material with the bucket of a large excavator and densifying the material with a heavy vibratory plate tamper (i.e. Wacker BPU 3545A or equivalent). If subgrade pumping does occur, the filling operation should be halted until Carlin-Simpson & Associates can evaluate the cause of the instability and make further recommendations.

Installation of New Structural Fill

New fill required to achieve final grades shall consist of either engineer-approved on-site soil or imported sand and gravel. Imported sand and gravel shall contain less than 20% by weight passing a No. 200 sieve. The new fill shall be placed in layers not exceeding one (1) foot in thickness and each layer shall be compacted to at least 95% of its Maximum Modified Dry Density (ASTM D1557). Each layer must be compacted, tested, and approved the Carlin-Simpson & Associates field representative prior to placing subsequent layers. The suitability of the excavated soil for reuse as compacted structural fill is discussed in Section 6.4 below.

If imported structural fill will be required during construction, the imported structural fill shall meet the following specified gradation:

<u>US Standard Sieve Size</u>	<u>Percent Finer By Weight</u>
3 inch	100
No. 4	30-80
No. 40	10-50
No. 200	0-20

5.2 Eastern Garage Foundations – Shallow Spread Footings Bearing on Bedrock

Once the planned garage area has been prepared as described Section 5.1 above, the new eastern garage foundations may be constructed on bedrock. The new garage foundations in the eastern portion of the garage (Column Lines 1 and 2) may be designed as a shallow spread footings lowered to bear below the existing fill on approved bedrock capable of supporting the required bearing pressures. Foundation design parameters are provided in Table 3 below.

Based on the current bedrock elevations and proposed bottom of footing elevations, we anticipate that lowering the proposed footings on the order of 1 to 2 feet below the current bottom of footing elevation may be necessary.

Bedrock Special Construction Procedures

If rock is encountered in the foundation excavations, “Special Construction Procedures” must be employed. When continuous wall footings or closely spaced column footings (20 feet or

less) bear on dissimilar material (i.e. rock and soil) the potential for differential movement exists. A footing bearing in rock will not move, whereas a footing bearing on soil will settle slightly due to the compressive nature of all soils when subjected to new loads. The area between movement and non-movement will develop a (shear) stress point. Cracks in foundations and walls will be the result from such movement. Therefore, continuous wall footings must bear either entirely on rock or entirely on soil for any individual structure. Alternatively, for larger structures, transition zones can be constructed to create a gradual transition from a soil to a rock bearing subgrade.

Where rock and soil both exist at the bearing elevation in a foundation excavation, the footings must either be lowered to bear entirely on rock, or a minimum of 18 inches of rock must be removed from below planned footing bottom. The over-excavated 18 inches must then be filled with a granular material having a maximum particle size of 1/2-inch and containing at least 10% but not more than 30% material by weight passing a No. 200 sieve. The fill shall be placed in six (6) inch layers and each layer shall be compacted to at least 95% of its Maximum Modified Dry Density (ASTM D-1557). This procedure will create a “cushion” atop the rock and reduce the potential for differential movement. For soft, rippable rock, this procedure will not be required.

Adjacent column footings greater than 20 feet apart may bear on dissimilar material (i.e. soil and rock). Any individual column footing must bear entirely on the same type bearing material (i.e. all soil or all rock). In addition, new footings constructed on sloping bedrock must be keyed into the bedrock surface.

If during the excavation for continuous foundations, the transition from soil to rock is gradual (i.e. from medium dense soil to dense weathered rock to very dense rock) over a distance of 20 feet or more, the “Special Construction Procedures” may not be required. This would have to be evaluated in the field on a case-by-case basis by the representative from Carlin-Simpson & Associates or a qualified geotechnical engineer at the time of construction.

Where the transition from rock to soil is abrupt within the excavation for continuous wall foundations, transition zones can be constructed by over-excavating the rock in steps and increasing the “soil cushion” thickness over a distance of 24 feet or more. To construct the transition zone, the bedrock is over-excavated in a series of steps, each step being six (6) inches in depth and at least eight (8) feet in length. The first step is six (6) inches deep, the second step is 12 inches deep, and the final step is 18 inches deep. The over-excavation is then backfilled with the soil cushion material described above. A detail showing a typical transition zone (FIG-3) is attached in the appendix of this report.

Prior to the placement of formwork, reinforcement steel, and concrete, the bearing subgrade soil shall be cleaned of all loose soil and where soil is encountered at the subgrade elevation, it shall be compacted with several passes of a small vibratory drum trench compactor (i.e. Wacker Model RT560), a heavy vibratory plate tamper (i.e. Wacker BPU 3545A or equivalent), or “jumping jack” style tamper (i.e. Wacker Model BS 600). This must be performed under the observation of Carlin-Simpson & Associates or a qualified geotechnical engineer. If instability is observed during the compaction of the bearing subgrade, the soft soil shall be removed and replaced with new compacted fill.

Foundation Design Parameters

All foundations shall be lowered to bear on weathered or intact bedrock capable of supporting the allowable bearing pressure in Table 2 below. Carlin-Simpson must be retained to inspect the bottom of the foundation excavations and to ensure the exposed subgrade is capable of supporting the required bearing pressures. In some cases, further lowering footings to bear on suitable bedrock may be required.

All of the exterior footings bearing on soil shall bear at the minimum depth listed below for protection from frost. Footings on rock may bear at shallower depths since rock is not frost susceptible. The footings shall have minimum dimensions as listed below. The parameters in Table 2 shall be used for design.

Table 2 – Foundation Design Parameters

Description	Value
Foundation Bearing Material	Weathered to Intact Bedrock
Net Design Bearing Pressures: Completely Weathered/Intact Bedrock	8,000 psf
Minimum Frost Depth	42 inches
Minimum Column Dimension	30 inches
Minimum Wall Dimension	18 inches

The excavations for the new foundations shall be performed under the full-time inspection of Carlin-Simpson & Associates or a qualified geotechnical engineering firm. The on-site representative shall confirm that the foundation bearing material is capable of supporting the design bearing pressure.

Prior to the installation of the reinforcement steel and concrete, the bottoms of the foundation excavations should be cleaned of all loose material. The foundation subgrade shall be compacted with a small vibratory drum trench compactor (i.e. Wacker Model RT560), a heavy vibratory plate tamper (i.e. Wacker BPU 3545A or equivalent), or a “jumping jack” style tamper (i.e. Wacker Model BS 600). The preparation of the footing bearing subgrade should be performed under the observation of a representative from Carlin-Simpson & Associates. If instability is observed during the compaction of the bearing subgrade, the soft soil shall be removed and replaced with new compacted fill.

5.3 Western Parking Garage Foundations

The depth to the bedrock surface and depth of existing fill generally increases from west to east across the footprint of the proposed garage. The existing fill and virgin soils are not suitable for support of the new garage foundations. Due to project constraints such as the desire to minimize excavation spoils, dewatering requirements, and extent of SOE, lowering footings to bear on bedrock in the western portion of the parking garage is not a desirable foundation solution. Instead, the foundations in the western portion of the building can be supported by on a drilled micropile or ground improvement system. These foundation systems will limit the extent

of the required excavations. The optimal foundation system will depend on an economic analysis.

5.3.1 Alternative – Drilled Micropile Foundations

A drilled micropile foundation system may be considered for support of the new western garage foundations. The micropiles must be designed in accordance with the NY State Building Code. The micropiles shall be installed with a pressure grouted bond zone formed entirely in bedrock. The micropiles shall be designed by a specialty micropile contractor to meet the required loading conditions. Preliminary micropile recommendations for varying loading conditions are provided in Table 3, below.

Table 3 – Preliminary Micropile Length Designs

Allowable Pile Capacity (tons)	Pile Diameter	Cased Length (feet)	Estimated Bond Length (feet)	Estimated Total Pile Length (feet)
80	10-inch	5 to 10	7.5	12.5 to 17.5
100	10-inch		10	15 to 20
120	12-inch		12.5	17.5 to 22.5

Obstructions (cobbles, boulders, brick, concrete, wood, etc.) are present within the existing fill. Depending upon the depth of the obstruction below the bottom of the pile cap or grade beam, the contractor shall either remove the obstruction or clear away the obstruction by excavating or other means, or abandon the pile and install an additional pile at the locations determined by the project structural engineer.

For this project, we recommend that the steel pipe casing have a minimum nominal wall thickness of at least 3/8-inch. The casing shall extend at least one (1) foot into the bond zone upon the completion of the grouting and shall remain in place permanently. The micropiles shall be filled with cement grout having a minimum 28-day compressive strength of at least 5,000 psi. The grout mix shall be designed and proportioned so as to produce a pumpable mixture. A maximum water/cement ratio of 0.44, by weight is recommended. Center to center spacing shall be at least three times the outside diameter of the steel casing but not less than 30 inches. The project structural engineer shall determine the number of piles required and their locations.

Reinforcing extending to the bond zone shall be placed in the casing to the bottom of the bond zone prior to placing grout. The full length of the micropile shall contain either a steel pipe and/or steel reinforcement. Reinforcement steel shall be in accordance with ASTM A 615 Grade 60 or 75 or ASTM A 722 Grade 150. As required for structural design, steel reinforcement bars shall extend from the micropile and up into the pile cap or grade beam.

Compressive Load Tests and Inspection

A compressional load test will be required per the New York State Building Code to confirm the foundation specialty contractor's pile design. The test may be performed on either a

production pile or a sacrificial pile. Production piles may not be used as reaction piles for the required load test. The pile load test(s) must be performed under the full time inspection of a Carlin-Simpson & Associates representative.

The piles shall be installed under the full time inspection of a representative from Carlin-Simpson & Associates. At the completion of the pile installation, Carlin-Simpson & Associates will provide a letter of compliance stating that the piles have been installed in general accordance with our recommendations and the project specifications, and that they are capable of supporting the design loads.

5.3.2 Alternative – Ground Improvement

As an alternative, we anticipate that the garage foundations can be designed as shallow spread footings supported on one of the following ground improvement systems. The system shall be selected and designed by the specialty ground improvement contractor with feedback from Carlin-Simpson & Associates.

Rammed Aggregate Piers Overview

A rammed aggregate pier (RAP) system such as the Geopier Impact® system creates RAP elements using a patented displacement mandrel to reinforce the underlying soils. The RAP elements are constructed by driving the mandrel and tamper foot into the ground to the design bearing depth. The displacement process allows for installation with no spoils and eliminates the need for casing of the RAP element hole to prevent collapse. Dense graded aggregate or clean crushed stone is placed into the hopper at the top of the hollow mandrel. The hollow mandrel is withdrawn approximately three feet allowing the aggregate to discharge at the bottom of the mandrel. The tamper is then driven back down two feet, which compacts the stone in approximately one-foot lifts. Compaction is achieved through static down force and dynamic vertical ramming from the hammer. The beveled tamper head densifies the aggregate vertically and expands the stone bulb horizontally which increase the lateral confining stress on the soil cavity. The vertical and lateral displacement properties of this method result in stiff bearing elements as well as improved surrounding soils.

Rigid Inclusion System Overview

A grouted rigid inclusion (RI) or controlled modulus column (CMC) system can also be selected for support of the western parking garage foundations. Multiple ground improvement contractors such as GeoStructures, Manard, or Hayward Baker are capable of installing RI/CMC systems. There are subtle differences between the proprietary systems used by each specialty contractor. However, the systems are generally installed with a displacement mandrel that is advanced through weak soil strata to a desired bearing depth. From the bearing depth, the mandrel is withdrawn and the cavity filled with grout forming a continuous grouted column. The grouted ground improvement systems have the advantages of allowing the new structure foundations to be designed as shallow spread footings. These ground improvement methods also limit spoils while providing improvement of the weak soil strata and allowance for high footing bearing pressures.

Ground Improvement Design Parameters

The ground improvement systems described above are proprietary and a design must be completed by the specialty contractor with feedback from Carlin-Simpson & Associates. *Pre-augering through the existing fill and debris as well as casing of the element hole to prevent collapse may be necessary.* The designer will develop the required element length, element diameter and spacing, and allowable foundation loads to limit total settlement to less than 1 inch and differential settlements to less than ½ inch. Preliminarily, we anticipate that the ground improvement system will have the following design parameters.

Table 4 – Anticipated Ground Improvement Design Parameters

Description	Value
Maximum Total Settlement	1 inch
Maximum Differential Settlement	½ inch
Element Length	5 to 10 feet
Anticipated Allowable Foundation Bearing Capacity	8,000 psf

The final ground improvement system and foundation design will be completed by the specialty contractor with input from Carlin-Simpson & Associates. In addition, a modulus test will be required to verify the performance of the specialty contractor's design.

5.4 Floor Slabs on Grade

It is our understanding that the proposed garage slab will be designed as a combination of a slab on grade and elevated structural slab. Generally, the existing site soils are suitable for support of the new slab on grade except for the deep unsuitable existing fill in the southern portion of the proposed garage. If a slab on grade is being considered in these areas, the following additional subgrade preparation will be required.

Area of Deep Unsuitable Existing Fill

Deep existing fill and debris was encountered in the area of borings B-108, B-109, and B-110. Borings could not be performed in the existing building footprint, so the extent of the unsuitable existing fill is not known. We recommend a series of supplemental test pits be performed after demolition of the existing building to verify the extent of the unsuitable soils. The approximate extent of the unsuitable soils is indicated on the attached FIG-1. If a slab on grade will be used in the highlighted area, the unsuitable existing fill must be prepared as described below.

The exposed subgrade shall be overexcavated a minimum of three (3) feet below the planned subgrade elevation. The bottom of the excavation should be cleaned of all loose material and compacted with a small vibratory drum trench compactor (i.e. Wacker Model RT560), a heavy vibratory plate tamper (i.e. Wacker BPU 3545A or equivalent), or a “jumping jack” style tamper (i.e. Wacker Model BS 600). This must be performed under the inspection of a Carlin-Simpson & Associates representative. If instability is observed during the compaction of the

bearing subgrade, the soft soil shall be removed and replaced with geotextile fabric and stone or new compacted fill as described in the previous section of this report.

Once the subgrade has been approved by Carlin-Simpson & Associates, a layer of triaxial geogrid reinforcement (Tensar TX-140 or equivalent) shall then be placed at the bottom of the excavation. The excavation shall then be backfilled with dense graded aggregate (DGA) that conforms to the NYDOT gradation requirements provided below. The dense graded aggregate (DGA) shall be placed in loose lifts with a maximum thickness of twelve (12) inches. Each fill layer shall be compacted with a small vibratory drum trench compactor (i.e. Wacker Model RT560), a heavy vibratory plate tamper (i.e. Wacker BPU 3545A or equivalent), or a “jumping jack” style tamper (i.e. Wacker Model BS 600). Each lift shall be compacted to at least 92% of its Maximum Modified Dry Density (ASTM D-1557). Fill layers shall be tested and approved before placing subsequent fill layers.

Dense Graded Aggregate (DGA) Gradation Requirements

<u>Sieve Size</u>	<u>Percent Passing</u>
1-1/2"	100
3/4"	55 - 90
No. 4	25 - 50
No. 50	5 - 20
No. 200	3 - 10

Floor Slab Design Parameters

The floor slab may be designed as a slab on grade bearing on densified virgin soil, densified and approved existing fill, or on new engineer-approved structural fill. Floor slab design parameters are provided in Table 5 below. A minimum of 6 inches of 3/4-inch clean crushed stone is recommended beneath the concrete slab for additional support and drainage.

Table 5 – Building Floor Slab Design Parameters

Description	Value
Slab Subgrade Material	Densified Site Soils or New Structural Fill
Modulus of Subgrade Reaction (k)	200 pci
Crushed Stone Cushion Thickness	6 inches

After the foundations are installed, fill will be required to backfill the excavations and to raise grades in the building area to the slab subgrade elevations. New fill for the floor slabs shall consist of either suitable on-site soil or imported sand and gravel. Imported sand and gravel shall contain less than 20% by weight passing a No. 200 sieve. The fill shall be placed in layers not exceeding one (1) foot in loose thickness and each layer shall be compacted to at least 92% of its Maximum Modified Dry Density (ASTM D-1557). Fill layers shall be compacted, tested, and approved before placing subsequent layers

5.5 Garage Settlement

Settlement of individual footings, designed in accordance with recommendations presented in this report, is expected to be within tolerable limits for the proposed structure. For footings placed on natural soils or new compacted fill approved by Carlin-Simpson & Associates and constructed in accordance with the requirements outlined in this report, maximum total settlement is expected to be on the order of 1-inch or less. Maximum differential settlement between adjacent columns or load bearing walls is expected to be half the total settlement.

The above settlement values are based on our engineering experience with similar soil conditions and the anticipated structural loading, and are to guide the structural engineer with his design. To minimize difficulties during the foundation installation phase, it is critical that Carlin-Simpson & Associates be retained to observe the foundation bearing surfaces and to confirm the recommended bearing pressures and that the existing fill and unsuitable materials have been removed from beneath the new foundations.

5.6 Seismic Design Considerations

From site-specific test boring data, the Site Class was determined from Table 1613.5.2 of the New York State Building Code. The site-specific data used to determine the Site Class typically includes soil test borings to determine Standard Penetration resistances (N-values). Based on estimated average N-values in the upper 100 feet of soil profile, the site can be classified as Site Class C – Very Dense Soil and Soft Rock.

New structures should be designed to resist stress produced by lateral forces computed in accordance with Section 1613 of the New York State Building Code. The values in Table 6 shall be used for this project.

Table 6 – Seismic Design Values

Description	Value
Mapped Spectral Response Acceleration for Short Periods, [Fig 1613.5 (1)]	$S_S=0.290g$
Mapped Spectral Response Acceleration at 1-Second Period, [Fig 1613.5 (2)]	$S_1=0.060g$
Site Coefficient [Table 1613.5.3 (1)]	$F_a= 1.3$
Site Coefficient [Table 1613.5.3 (2)]	$F_v= 1.5$
Max Considered Earthquake Spectral Response for Short Periods [Eq 16-37]	$S_{MS}=0.377g$
Max Considered Earthquake Spectral Response at 1-Second Period [Eq 16-38]	$S_{M1}=0.091g$
Design Spectral Response Acceleration for Short Periods [Eq 16-39]	$S_{DS}=0.251g$
Design Spectral Response Acceleration for 1-Second Period [Eq 16-40]	$S_{D1}=0.060g$

6.0 SITE EVALUATION

We understand that the site developments will include new utilities, parking lots and driveways. A summary of the subsurface conditions encountered throughout the site are provided in Table 1 above.

6.1 Utilities

New utilities may bear in the existing site soils, bedrock, or new compacted fill. The bottom of all trenches should be excavated clean and shaped so a hard bottom is provided for the pipe support. If any soft or unsuitable soil conditions are encountered during construction, the unsuitable materials must be removed and replaced with new compacted fill.

The use of hydraulic hammering may be required for rock removal in isolated areas. Where rock is encountered in the utility excavations, it must be removed to at least six (6) inches below planned pipe invert. The over-excavated six (6) inches shall then be filled with new sandy fill and compacted to at least 92% of its Maximum Modified Dry Density (ASTM D-1557) to act as a cushion on the rock.

In the event that the trench bottom becomes soft due to the inflow of surface or trapped water, the soft soil shall be removed and the excavation filled with a minimum of six (6) inches of 3/4-inch clean crushed stone to provide a firm base for support of the pipe. Sump pits and pumps should be adequate to keep the excavations dry.

After the utility is installed, the trench must be backfilled with compacted fill. The fill shall consist of suitable on-site soil or imported sand and gravel. Imported fill shall contain less than 20% by weight passing a No. 200 sieve. Large rock fragments and boulders must not be placed directly against the pipe. Controlled compacted fill shall be placed in one (1) foot loose layers and each layer shall be compacted to at least 92% of its Maximum Modified Dry Density (ASTM D-1557). The backfill must be free of topsoil, debris, and large boulders or rock fragments.

6.2 Pavement

We understand that the proposed construction will also include new asphalt paved parking driveways. We expect that small cuts and fills will be required to achieve the planned subgrade elevations in the new pavement areas. Densified existing fill (where encountered) or virgin site soils, and new compacted fill may be used to support the pavement.

To prepare the new pavement areas, the existing surface materials (i.e. topsoil, vegetation, etc.) must be removed from the planned pavement areas. Areas where existing fill is encountered shall be compacted in place. Carlin-Simpson & Associates must evaluate these areas for the presence of soft or unsuitable material within the existing fill matrix. Portions of this fill may have to be removed and replaced with new compacted fill. Carlin-Simpson & Associates will determine this during construction.

After all surface materials have been removed, the area can be excavated to the planned subgrade elevation. Where soil is encountered at the subgrade elevation, the subgrade shall be proofrolled with a large vibratory drum roller (i.e. Dynapac 250 or equivalent) to densify the underlying soils. The on-site representative from Carlin-Simpson & Associates shall witness the proofrolling operation. If any excessive movement is noted during the proofrolling, the soft or unsuitable soil shall be removed and replaced with new compacted fill.

Where new fill is required to achieve final grades, it shall consist of either suitable on-site soil or imported sand and gravel. Imported sand and gravel shall contain less than 20% by weight passing a No. 200 sieve. New fill shall be placed in layers not exceeding one (1) foot in loose thickness and each layer shall be compacted to at least 92% of its Maximum Modified Dry Density (ASTM D-1557). After the planned subgrade has been proofrolled and new compacted fill has been placed as required, the new pavement subbase may be placed on the existing site soils and new compacted fill.

A minimum of six (6) inches of dense graded aggregate (DGA) or crushed stone is recommended for sub-pavement drainage and additional pavement support. We recommend that the following pavement sections be used for the parking lots and driveways. This pavement section is subject to local government approval.

Asphalt Pavement Section

The new pavement subbase may be placed on engineer-approved densified existing fill, virgin soil, or new compacted fill. A minimum of six (6) inches of dense graded aggregate (DGA) is recommended for the subbase layer for drainage and additional pavement support. We recommend that the following pavement section be used for the parking lots and driveways. This pavement section is subject to local government approval.

2"	Asphalt Top Course	NYSDOT, Type 6F
4"	Asphalt Base Course	NYSDOT, Type 3
8"	Stone Subbase (DGA)	NYSDOT, Type 1
	Approved Compacted Subgrade (Minimum CBR = 10)	

Rigid (Concrete) Pavement

We understand that concrete pavement will be used in portions of the site. Typically, a six (6) inch thick, 4,000-psi concrete section supported on six (6) inches of dense graded aggregate (DGA) base and an approved compacted subgrade is adequate for passenger vehicle traffic and occasional truck traffic.

Based on the boring data and the laboratory test results, we anticipate that the densified site soils and new compacted fill will provide a CBR value that is equal to or greater than 10, which can adequately support the above pavement sections.

6.3 Temporary Construction Excavations and Excavation Protection

Temporary construction excavations should be conducted in accordance with the most recent OSHA guidelines or applicable federal, state or local codes. A qualified person should evaluate the excavations at the time of construction to determine the appropriate soil type and allowable

slope configuration. Based on the boring data, we believe the site soils and rock would have the following classifications as defined by the OSHA guidelines.

<u>Soil/Rock Type</u>	<u>Possible Classification</u>	<u>Maximum Slope or Bench</u>
Existing Fill	Type “C”	1½H:1V
Virgin Soil	Type “B” or “C”	1H:1V to 1½H:1V
Intact Bedrock	Type “A” or Stable Rock	3/4H:1V

Temporary support (i.e. trench boxes, sheeting and shoring, etc.) should be used for any excavation that cannot be sloped or benched in accordance with the applicable regulations, where necessary to protect adjacent utilities and structures, or where saturated soils or water seepage is encountered within the excavation.

A New York State licensed professional engineer must design all temporary and permanent support systems. The contractor will select the shoring type and submit design calculations for the proposed shoring method to Carlin-Simpson & Associates for review. The soil adjacent to the temporary support system will exert a horizontal pressure against the system. This pressure is based on the soil unit weight, coefficient of active earth pressure, and depth of the excavation. Support of Excavation design parameters are listed in Table 7 below.

Table 7 – Temporary Sheet piling and Shoring Design Parameters

Description	Value
Moist Unit Weight (pcf)	130
Friction Angle (ϕ , deg)	30
Cohesion (c, psf)	0
Active Earth Pressure Coefficient (k_a) ¹	0.33
Equivalent Fluid Pressure (pcf)	40.3
Passive Earth Pressure Coefficient (k_p) ¹	3.0

6.4 Suitability of the In-Situ Soils for Use as Compacted Fill

The suitability of each soil stratum for use as compacted fill is discussed below.

Stratum 2 The existing fill generally consists of loose to medium dense brown or gray
Existing Fill brown coarse to fine SAND, little (to some) Silt, little coarse to fine Gravel. Debris, such as cinders, concrete, asphalt, wood, glass, and brick, was encountered within the fill layer at select locations.

The existing fill is generally unsuitable for reuse as compacted fill due to the presence of large amounts of debris.

In addition, some of the existing site soils are contaminated as shown by our Limited Phase II Environmental Site Investigation dated 20 July 2020. The existing site soils must be handled in accordance with the applicable environmental regulations.

The boring observations indicate that the on-site soils contain a low to high percentage of silt (13.3% to >50%). The moderate to high silt content soils will be moisture sensitive. If the soil becomes too wet, it will be difficult to achieve adequate compaction. In addition, the site soils that extend below the groundwater table are completely saturated and therefore, unsuitable for reuse.

Proper moisture conditioning of the soil will be required. New compacted fill should be within 2% (+/-) of its optimum moisture content at the time of placement. In the event that the on-site material is too wet at the time of placement and cannot be adequately compacted, the soil should be aerated and allowed to dry or the material removed and a drier cleaner fill material used. In the event that the on-site material is too dry at the time of placement and cannot be adequately compacted, water may be needed to increase the soil moisture content for proper compaction.

The in-situ soils which exist throughout the site may become soft and weave if exposed to excessive moisture and construction traffic. The instability will occur quickly when exposed to these elements and it will be difficult to stabilize the subgrade. We recommend that adequate site drainage be implemented early in the construction schedule and if the subgrade becomes wet, the contractor should limit construction activity until the soil has dried. The minimum compaction requirements for the various areas of the site are summarized in Table 8 below.

Table 8 – Minimum Compaction Requirements

Area	Maximum Modified Dry Density (ASTM D-1557)
Garage (below foundations)	95%
Garage Slab (above foundations)	92%
Adjacent to Foundation Walls	92%
Pavement Areas	92%
Exterior Slabs and Sidewalks	92%
Utility Trenches	92%
Landscape Areas	90%

7.0 GENERAL

The findings, conclusions and recommendations presented in this report represent our professional opinions concerning subsurface conditions at the site. The opinions presented are relative to the dates of our site work and should not be relied on to represent conditions at later dates or at locations not explored. The opinions included herein are based on information provided to us, the data obtained at specific locations during the study and our past experience. If additional information becomes available that might impact our geotechnical opinions, it will be necessary for Carlin-Simpson & Associates to review the information, reassess the potential concerns, and re-evaluate our conclusions and recommendations.

Regardless of the thoroughness of a geotechnical exploration, there is the possibility that conditions between borings and test pits will differ from those encountered at specific boring or

test pit locations, that conditions are not as anticipated by the designers and/or the contractors, or that either natural events or the construction process have altered the subsurface conditions. These variations are an inherent risk associated with subsurface conditions in this region and the approximate methods used to obtain the data. These variations may not be apparent until construction.

The professional opinions presented in this geotechnical report are not final. Field observations and foundation installation monitoring by the geotechnical engineer, as well as soil density testing and other quality assurance functions associated with site earthwork and foundation construction, are an extension of this report. Therefore, Carlin-Simpson & Associates should be retained by the Owner to observe all earthwork and foundation construction, to document that the conditions anticipated in this study actually exist, and to finalize or amend our conclusions and recommendations. Carlin-Simpson & Associates is not responsible or liable for the conclusions and recommendations presented in this report if Carlin-Simpson & Associates does not perform the observation and testing services.

Therefore, in order to preserve continuity in this project, the Owner must retain the services of Carlin-Simpson & Associates to provide full time geotechnical related monitoring and testing during construction. At a minimum, this shall include the observation and testing of the following: 1) the removal of existing fill and unsuitable soil, where required; 2) the proofrolling of the subgrade soil prior to the placement of new compacted fill; 3) evaluation of the foundation bearing material; 4) the placement and compaction of controlled fill; and 4) the inspection and oversight of pile and ground improvement installation and testing.

This report has been prepared in accordance with generally accepted geotechnical engineering practice. No other warranty is expressed or implied. The evaluations and recommendations presented in this report are based on the available project information, as well as on the results of the exploration. Carlin-Simpson & Associates should be given the opportunity to review the final drawings and site plans for this project to determine if changes to the recommendations outlined in this report are needed. Should the nature of the project change, these recommendations should be re-evaluated.

This report is provided for the exclusive use of NRP Group LLC and the project specific design team and may not be used or relied upon in connection with other projects or by other third parties. Carlin-Simpson & Associates disclaims liability for any such third party use or reliance without express written permission. Use of this report or the findings, conclusions or recommendations by others will be at the sole risk of the user. Carlin-Simpson & Associates is not responsible or liable for the interpretation by others of the data in this report, nor their conclusions, recommendations or opinions.

If the conditions encountered during construction vary significantly from those stated in this report, this office should be notified immediately so that additional recommendations can be made.

Very truly yours,

CARLIN-SIMPSON & ASSOCIATES

Stephen Rossi

STEPHEN ROSSI, P.E.

Project Engineer



A handwritten signature in dark ink, appearing to be 'R.B. Simpson', written over a horizontal line.


ROBERT B. SIMPSON, P.E.



File No. 20-30



-  - 2019 BORING LOCATION BY OTHERS
-  - 2020 BORING LOCATION BY CSA

<p align="center">ROBERT B. SIMPSON, P.E. PROFESSIONAL ENGINEER</p>			
<p align="center">BORING LOCATION PLAN</p>			
<p align="center">PROPOSED DEVELOPMENT 116 GUION PLACE & 64 LINCOLN AVENUE NEW ROCHELLE, NEW YORK</p>			
DRAWN MW/MRA	SCALE AS SHOWN	CARLIN-SIMPSON AND ASSOCIATES 61 Main Street Sayreville, NJ 08872 Consulting Geotechnical and Environmental Engineers	
CHECKED RBS	DATE 11-AUG-20		
PROJECT NO. 20-30	DWG NO. FIG-1		
APPROVED			

CARLIN-SIMPSON & ASSOCIATES Sayreville, NJ				TEST BORING LOG					BORING NUMBER B-105	
Project: Proposed Development, Guion Place & Lincoln Avenue, New Rochelle NY									SHEET NO.: 1 of 1	
Client: The NRP Group									JOB NUMBER: 20-30	
Drilling Contractor: General Borings Inc.									ELEVATION: +62.5	
GROUNDWATER					CASING	SAMPLE	CORE	TUBE	DATUM: Topo	
DATE	TIME	DEPTH	CASING	TYPE	HSA	SS			START DATE: 5/May/20	
5/May/20	1050	7'3"	HSA	DIA.	4 1/4"	1 3/8"			FINISH DATE: 5/May/20	
5/May/20	1100	5'9"	HSA	WGHT		140#			DRILLER: T McGovern	
5/May/20	1115	5'0"	HSA	FALL		30"			INSPECTOR: MW	
Depth (ft.)	PID Rdg (ppm)	Sample Number	Blows on Sample Spoon per 6"	S y m	IDENTIFICATION				REMARKS	
1		S-1			Asphalt				0'6"	
2	0		2		FILL (Br cf S, s \$, l mf G) <u>FILL (Brown coarse to fine SAND, some Silt, little medium to fine Gravel)</u>				Rec = 14" moist	
3			3							
4	0	4	same							
5		S-2	2		Lt gr, or br cf S, a \$ <u>Light gray, orange brown coarse to fine SAND, and Silt</u>				Rec = 14" moist to wet	
6	0		3							
7		S-3A	4		same				Rec = 18" moist	
8	0		7							
9		S-3B	3		Br, gr cf S, l \$, l (+) mf G, completely weathered rock				Rec = 12" wet Very dense drilling 7'6"-9'6" Auger refusal @ 9'6"	
10	0		13							
11		S-4	30		same <u>Brown, gray coarse to fine SAND, little Silt, little (+) medium to fine Gravel, completely weathered rock</u>				9'6"	
12	0		27							
13			28		<u>End of Boring @ 9'6"</u>				Installed well W105 Screen interval is 4'6"-9'6"	
14			39							
15			30/2"							
16										
17										
18										
19										
20										
21										
22										

CARLIN - SIMPSON & ASSOCIATES Sayreville, N.J.					TEST BORING LOG					BORING NUMBER B-106		
Project: Proposed Development, Guion Place & Lincoln Avenue, New Rochelle NY					SHEET NO.:		1 of 2					
Client: The NRP Group					JOB NUMBER:		20-30					
Drilling Contractor: General Borings Inc.					ELEVATION:		+64.0					
GROUNDWATER						CASING	SAMPLE	CORE	TUBE	DATUM: Topo		
DATE	TIME	DEPTH	CASING	TYPE	HSA	SS			START DATE: 5/May/20			
No Groundwater Reading					DIA.	3 1/4"	1 3/4"			FINISH DATE: 5/May/20		
				WGHT		140#			DRILLER: T McGovern			
				FALL		30"			INSPECTOR: MW			
Depth (ft.)	PID Rdg (ppm)	Sample Number	Blows on Sample Spoon per 6"	S Y M	IDENTIFICATION					REMARKS		
1		S-1			Asphalt 0'6"					Rec = 14" moist		
2	0		11		FILL (Bk, dk gr cf S, s \$, l cf G, w/few cinders, concrete)							
3			9		<u>FILL (Black, dark gray coarse to fine SAND, some Silt, little coarse to fine Gravel, with few cinders and concrete)</u> 3'0"							
4	0	S-2	5							Rec = 20" moist to wet		
5			6									
6			4									
7	0	S-3	2		Br cf S, a \$					Rec = 20" wet		
8			4		<u>Brown coarse to fine SAND, and Silt</u>							
9			6									
10	0	S-4	3		same, or br, lt gr slightly mttld 6'0"					Rec = 3" wet		
11			17		Br cf S, l (-) \$, l (-) mf G							
12			30									
13	0	S-5	50/3"		<u>Brown coarse to fine SAND, little (-) Silt, little (-) medium to fine Gravel completely weathered rock</u>					Rec = 3" wet Auger refusal @ 10'6"		
14												
15												
16		Run #1	100/4"		same, br, gr 11'0"					Run #1 11'0"-16'0" Run = 60" Rec = 42/60 = 70% RQD = 23/60 = 38%		
17												
18												
19		Run #2			<u>Dark gray, light gray Schist, shattered very blocky and seamy, slightly to moderately weathered</u>					Run #2 16'0"-21'0" Run = 60" Rec = 58/60 = 96% RQD = 39/60 = 65%		
20												
21												
22		Run #3			<u>Dark gray, light gray Schist, massive moderately jointed, fresh to slightly weathered</u>							

CARLIN - SIMPSON & ASSOCIATES Sayreville, NJ				TEST BORING LOG		BORING NUMBER B-106
Project: Proposed Development, Guion Place & Lincoln Avenue, New Rochelle NY				SHEET NO.: 2 of 2		
Client: The NRP Group				JOB NUMBER: 20-30		
Depth (ft.)	Casing Blows pre Foot	Sample Number	Blows on Sample Spoon per 6"	S y m	IDENTIFICATION	REMARKS
23		Run #3			<u>Dark gray, light gray Schist, massive moderately jointed, fresh to slightly weathered</u>	<u>Run #3</u> 21'0"-26'0" Run = 60" Rec = 55/60 = 92% RQD = 50/60 = 83%
24						
25						
26						
27					<u>End of Boring @ 26'0"</u>	Driller noted core broke high piece remained in hole
28						
29						
30						
31						
32						
33						
34						
35						
36						
37						
38						
39						
40						
41						
42						
43						
44						
45						
46						
47						

CARLIN-SIMPSON & ASSOCIATES Sayreville, NJ				TEST BORING LOG					BORING NUMBER B-107	
Project: Proposed Development, Guion Place & Lincoln Avenue, New Rochelle NY									SHEET NO.: 1 of 1	
Client: The NRP Group									JOB NUMBER: 20-30	
Drilling Contractor: General Borings Inc.									ELEVATION: +63.5	
GROUNDWATER					CASING	SAMPLE	CORE	TUBE	DATUM: Topo	
DATE		TIME	DEPTH	CASING	TYPE	HSA	SS			START DATE: 6/May/20
6/May/20		9:10	8'6"	HSA	DIA.	3 1/4"	1 3/8"			FINISH DATE: 6/May/20
6/May/20		9:15	5'6"	OPEN	WGHT		140#			DRILLER: T McGovern
					FALL		30"			INSPECTOR: MW
Depth (ft.)	PID Rdg (ppm)	Sample Number	Blows on Sample Spoon per 6"	S y m	IDENTIFICATION					REMARKS
1		S-1			<u>Asphalt</u>					0'6"
			10		<u>FILL (Brown coarse to fine SAND, little Silt, little medium to fine Gravel)</u>					
2	0		19		FILL (Br cf S, l \$, l mf G)					2'0"
		S-2	34		Br, gr cf S, l \$, l (-) mf G, compelely weathered rock					
3			55		same					Rec = 12"
			60							moist
4	0	S-3	20/1"		same					Rec = 6"
					<u>Brown, gray coarse to fine SAND, little Silt, little (-) medium to fine</u>					moist to wet
5										
	0	S-3	50/4"		same					Rec = 4"
6					<u>Gravel, completely weathered rock</u>					wet
										dense drilling 6'6" to 9'6"
7										possible unrippable rock
8										start @ 7'
9										
										9'6"
10					<u>End of Boring @ 9'6"</u>					Auger refusal @ 9'6"
11										
12										
13										
14										
15										
16										
17										
18										
19										
20										
21										
22										

CARLIN - SIMPSON & ASSOCIATES Sayreville, N.J.				TEST BORING LOG					BORING NUMBER B-108	
Project: Proposed Development, Guion Place & Lincoln Avenue, New Rochelle NY				SHEET NO.:					1 of 1	
Client: The NRP Group				JOB NUMBER:					20-30	
Drilling Contractor: General Borings Inc.				ELEVATION:					+62.5	
GROUNDWATER					CASING	SAMPLE	CORE	TUBE	DATUM: Topo	
DATE	TIME	DEPTH	CASING	TYPE	HSA	SS			START DATE: 06 May 20	
5/6/2020	1030	5'0"	HSA	DIA.	3 1/4"	1 3/8"			FINISH DATE: 06 May 20	
5/12/2020	1515	3'10"	WELL	WGHT		140#			DRILLER: T McGovern	
				FALL		30"			INSPECTOR: MW	
Depth (ft.)	PID Rdg (ppm)	Sample Number	Blows on Sample Spoon per 6"	IDENTIFICATION					REMARKS	
1		S-1	10	Asphalt 0'2"					Rec = 8" moist	
2	1.1		6	FILL (Br, bk cf S, s \$, l mf G, w/asphalt)						
3			5							
4	3.5	S-2	3	FILL (Br w/wood, asphalt)					Rec = 12" moist to wet	
5			2	<u>FILL (Brown, black coarse to fine SAND, some Silt, little medium to fine Gravel, with asphalt, wood)</u>						
6	2.5	S-3	31						wood in tip, spoon bouncing strong unknown odor	
7			4	FILL (same, dk gr w/wood)						
8	3	S-4	3						Rec = 2" wet	
9			4							
10		S-5	1						Rec = 12" wet	
11	0.5		2	FILL (same, dk gr w/wood, organics)						
12		Run #1	6						Rec = 3" wet	
13			10	FILL (same, br) 10'6"						
14		Run #1	5	FILL (same, br) 10'6"					Rec = 3" wet	
15			50/3"	<u>Brown, gray completely weathered rock</u> 11'6"						
16		Run #1							weathered rock in tip Auger refusal @ 11'6"	
17										
18		Run #1		<u>Dark gray Schist, shattered very blocky and seamy, slightly weathered</u>					Run #1 11'6"-15'6" Run = 48" Rec = 38/48 =79% RQD = 14/48 = 29%	
19										
20		Run #1							15'6"	
21										
22		Run #1		<u>End of Boring @ 15'6"</u>					Core barrel jammed	
		Run #1							Installed well W108 Screen interval is 5'-10'	
		Run #1								
		Run #1								
		Run #1								
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CARLIN - SIMPSON & ASSOCIATES Sayreville, N.J.				TEST BORING LOG					BORING NUMBER B-109	
Project: Proposed Development, Guion Place & Lincoln Avenue, New Rochelle NY				SHEET NO.:					1 of 1	
Client: The NRP Group				JOB NUMBER:					20-30	
Drilling Contractor: General Borings Inc.				ELEVATION:					+62.5	
GROUNDWATER					CASING	SAMPLE	CORE	TUBE	DATUM: Topo	
DATE	TIME	DEPTH	CASING	TYPE	HSA	SS			START DATE: 06 May 20	
No Groundwater Reading				DIA.	3 1/4"	1 3/8"			FINISH DATE: 06 May 20	
				WGHT		140#			DRILLER: T McGovern	
				FALL		30"			INSPECTOR: MW	
Depth (ft.)	PID Rdg (ppm)	Sample Number	Blows on Sample Spoon per 6"	IDENTIFICATION					REMARKS	
1		S-1		Asphalt					0'2"	
2	0.1		4	FILL (Br cf S, s \$, l (-) mf G, w/asphalt)					Rec = 0	
3			3							
4	0.1	3								
5		S-2	2	FILL (same, br gr w/asphalt)					Rec = 4"	
6	0		1	<u>FILL (Brown coarse to fine SAND, some Silt, little (-) medium to fine Gravel, with asphalt)</u>					moist to wet	
7		1/12"	slight odor							
8		9	FILL (same br, gr)						Rec = 6"	
9	0	S-3	18						wet	
10		S-4	50/2"	7'6"					Rec = 0"	
11									wet	
12		Run #1		<u>Dark grav Schist shattered, very blocky and seamy, fresh to slightly weathered</u>					Auger refusal @ 7'6"	
13										
14										
15										
16										
17				12'6"					Run #1	
18									7'6"-12'6"	
19									Run = 60"	
20									Rec = 60/60 = 100%	
21									RQD = 22/60 = 36%	
22				<u>End of Boring @ 12'6"</u>					Core barrel jammed	

CARLIN-SIMPSON & ASSOCIATES Sayreville, NJ				TEST BORING LOG					BORING NUMBER B-110	
Project: Proposed Development, Guion Place & Lincoln Avenue, New Rochelle NY									SHEET NO.: 1 of 1	
Client: The NRP Group									JOB NUMBER: 20-30	
Drilling Contractor: General Borings Inc.									ELEVATION: +62.5	
GROUNDWATER					CASING	SAMPLE	CORE	TUBE	DATUM: Topo	
DATE		TIME	DEPTH	CASING	TYPE	HSA	SS			START DATE: 6/May/20
No Groundwater Reading					DIA.	3 1/4"	1 3/8"			FINISH DATE: 6/May/20
					WGHT		140#			DRILLER: T McGovern
					FALL		30"			INSPECTOR: MW
Depth (ft.)	PID Rdg (ppm)	Sample Number	Blows on Sample Spoon per 6"	S y m	IDENTIFICATION					REMARKS
1		S-1	9		Asphalt					0'2"
2	0.2		12		FILL (Gr, bk cf S, s \$, l (-) mf G, w/cinder, glass, asphalt)					Rec = 6" moist
3			15							
4	0.1	S-2A	9		FILL (same, dk gr)					Rec = 12" moist to wet
5			8							
6	0.1	S-2B	9		FILL (same, dk gr w/debris)					
7			2		<u>FILL (Gray, black coarse to fine SAND, some Silt, little (-) medium to fine Gravel, with cinder, glass, asphalt)</u>					Rec = 12" wet
8	0.1	S-3	1							
9			1							
10		S-4	1		FILL (same, dk gr w/debris)					Rec = 8" wet
11	0.2		2							
12		S-5	2							
13			17							
14			15		possible FILL (same, dk gr s mf G, no debris)					Rec = 3" wet
15			50/4"		Highly/Completely weathered rock					Dense drilling @ 11'-14'
16					<u>Highly/Completely weathered rock</u>					
17										
18										
19										
20										
21										
22										
										</

CARLIN - SIMPSON & ASSOCIATES Sayreville, N.J.					TEST BORING LOG					BORING NUMBER B-111		
Project: Proposed Development, Guion Place & Lincoln Avenue, New Rochelle NY										SHEET NO.: 1 of 2		
Client: The NRP Group										JOB NUMBER: 20-30		
Drilling Contractor: General Borings Inc.										ELEVATION: +61.0		
GROUNDWATER						CASING	SAMPLE	CORE	TUBE	DATUM: Topo		
DATE	TIME	DEPTH	CASING	TYPE	HSA	SS			START DATE: 7/May/20			
7/May/20	0910	6'6"	Open	DIA.	3 1/4"	1 3/4"			FINISH DATE: 7/May/20			
7/May/20	0930	4'6"	Open	WGHT		140#			DRILLER: T McGovern			
				FALL		30"			INSPECTOR: MW			
Depth (ft.)	PID Rdg (ppm)	Sample Number	Blows on Sample Spoon per 6"	S Y M	IDENTIFICATION					REMARKS		
1	0	S-1	3		Topsoil					0'6"		
			10	FILL (Dk gr, br cf S, l \$, a cf G, w/cinders, concrete)					Rec = 12" moist			
2		14	<u>FILL (Dark gray brown coarse to fine SAND, little Silt, and coarse to fine Gravel, with cinders and concrete)</u>									
		20										
3		13										
		18										
4	0	S-2	24	FILL (same, br, l \$)					Rec = 12" moist			
			50/0"									
5					5'0"					Rec = 12" wet		
6	0	S-3A	1/12"	<u>Dark gray SILT and Clay little, fine Sand</u>								
				Dk gr \$ & C l, f S					6'6"			
7	0	S-3B	8	Gr cf S, s \$, t f G					Rec = 12" wet			
			11									
8	0	S-4	5	same, a \$, w/seams of Cy \$							Rec = 12" wet	
			15									
9			9	<u>Gray coarse to fine SAND, and Silt, trace fine Gravel</u>								
			8									
10										Rec = 0 wet spoon bouncing dense drilling 11' Auger refusal @ 11'0"		
11	0	S-5	12	same								
			19									
12			30/1"		12'0"							
13		Run #1			<u>Dark gray, white Schist, intact rock, slightly weathered</u>					Run #1 12'0"-17'0" Run = 60" Rec = 59/60 = 98% RQD = 57/60 = 95%		
14												
15												
16												
17					17'0"					Run #2 17'0"-22'0" Run = 60" Rec = 59/60 = 98% RQD = 46/60 = 76%		
18	Run #2		<u>Dark gray, white Schist, massive, moderately jointed, slightly weathered</u>									
19												
20												
21												
22									22'0"			

CARLIN - SIMPSON & ASSOCIATES Sayreville, NJ				TEST BORING LOG		BORING NUMBER B-111	
Project: Proposed Development, Guion Place & Lincoln Avenue, New Rochelle NY				SHEET NO.: 2 of 2			
Client: The NRP Group				JOB NUMBER: 20-30			
Depth (ft.)	Casing Blows pre Foot	Sample Number	Blows on Sample Spoon per 6"	S y m	IDENTIFICATION	REMARKS	
23		Run #3			<u>Dark gray Schist, blocky and seamy, slightly weathered</u>	Run #3 22'0"-27'0" Run = 60" Rec = 57/60 = 95% RQD = 38/60 = 63%	
24							
25							
26							
27							
27							
28					<u>End of Boring @ 27'0"</u>		
29							
30							
31							
32							
33							
34							
35							
36							
37							
38							
39							
40							
41							
42							
43							
44							
45							
46							
47							

CARLIN-SIMPSON & ASSOCIATES Sayreville, NJ				TEST BORING LOG					BORING NUMBER B-112		
Project: Proposed Development, Guion Place & Lincoln Avenue, New Rochelle NY									SHEET NO.: 1 of 1		
Client: The NRP Group									JOB NUMBER: 20-30		
Drilling Contractor: General Borings Inc.									ELEVATION: +61.5		
GROUNDWATER					CASING	SAMPLE	CORE	TUBE	DATUM: Topo		
DATE		TIME	DEPTH	CASING	TYPE	HSA	SS			START DATE: 7/May/20	
7/May/20		1205	9'0"	Open	DIA.	3 1/4"	1 3/8"			FINISH DATE: 7/May/20	
7/May/20		1330	4'6"	Open	WGHT		140#			DRILLER: T McGovern	
					FALL		30"			INSPECTOR: MW	
Depth (ft.)	PID Rdg (ppm)	Sample Number	Blows on Sample Spoon per 6"	S y m	IDENTIFICATION					REMARKS	
1	0	S-1	3		<u>Topsoil</u>					0'6"	
			5		FILL (Dk br cf S, s \$, l (+) mf G, w/glass, concrete,brick)					Rec = 14"	
2			9		<u>FILL (Dark brown coarse to fine SAND,</u>					moist	
			10		<u>some Silt, little (+) medium to fine</u>						
3	0	S-2	9		<u>Gravel, with glass, concrete, brick)</u>						
			37		FILL (same)					Rec = 6"	
4			50/3"							moist	
5					<u>Dark gray Clayey SILT little, medium</u>						
					<u>to fine Sand, with trace organics</u>						
6	0	S-3	2								
			4		Dk gr Cy \$ l, mf S, w/t O					Rec = 18"	
7			10							wet	
			11							slight organic odor	
8	0	S-4A	13		<u>Dark gray coarse to fine SAND, little Silt,</u>					Rec = 18"	
			18		<u>trace (-) medium to fine Gravel</u>					wet	
9	0	S-4B	35		Or br, lt gr cf S, l (-) \$, l mf G						
			48								
10											
11	0	S-5	44		<u>Orange brown, light gray coarse to fine</u>						
			50/3"		<u>SAND, little (-) Silt, little medium to</u>					Rec = 6"	
12				same	<u>fine Gravel</u>					wet	
										Auger refusal @ 12'6"	
13					<u>End of Boring @ 12'0"</u>						
14											
15											
16											
17											
18											
19											
20											
21											
22											

TEST BORING REPORT


Boring No. B-3

Project Proposed Multifamily Residential and Boys & Girls Club Development New Rochelle, NY
 Client The NRP Group
 Contractor Craig Geotechnical Drilling Co., Inc.

File No. 133128-002
 Sheet No. 1 of 1
 Start 9 January 2019
 Finish 9 January 2019
 Driller M. Tarter
 H&A Rep. T. Poggiogalle
 Elevation 62.0 (est.)
 Datum NAVD88
 Location See Plan

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	HW	S	--	Rig Make & Model: Track-mounted CME-75
Inside Diameter (in.)	4.0	1 3/8	--	Bit Type: Roller Bit
Hammer Weight (lb)	140	140	-	Drill Mud: Bentonite
Hammer Fall (in.)	30	30	-	Casing: Driven
				Hoist/Hammer: Winch Automatic Hammer
				PID Make & Model: None

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel		Sand			Field Test			
							% Coarse	% Fine	% Coarse	% Medium	% Fine	% Fines	Dilatancy	Toughness	Plasticity
0	2	S1	0.0	61.5 0.5		-TOPSOIL-									
	1	12	2.0		SM	Very loose black to brown silty SAND with gravel (SM), mps 1.0 in., no structure, no odor, moist, contains glass	10	20	20	20	15	15			
	2														
	3														
	1	S2	2.0	58.0 4.0	SP-SM	Very loose black to brown poorly-graded SAND with silt and gravel (SP-SM), mps 1.0 in., no structure, no odor, moist, contains glass fragments	10	20	20	30	10	10			
	2	12	4.0			-FILL-									
	4														
	1	S3	4.0	54.0 8.0	SM	Loose gray to light brown silty SAND (SM), mps 2 mm, no structure, no odor, moist	-	-	-	25	40	35			
5	1	18	6.0												
	7														
	6														
	8	S4	6.0		SM	Medium dense brown silty SAND (SM), mps 0.5 in., no structure, no odor, wet	-	10	25	35	15	15			
	9	16	8.0			-GLACIOFLUVIAL DEPOSITS-									
	10														
	13	S5	8.0	50/3"	SP-SM	Very dense black to gray to brown to white poorly-graded SAND with silt and gravel (SP-SM), mps 1.5 in., no structure, no odor, wet	10	15	15	30	20	10			
	50/3"	8	8.8												
10						Note: Split spoon refusal at 8.8 ft. Advance roller bit to 15.0 ft.									
						-WEATHERED BEDROCK-									
15				47.0 15.0		BOTTOM OF EXPLORATION 15.0 FT									
						Note: Borehole backfilled with soil cuttings. Water estimated to be at approximately 5.0 ft.									

Water Level Data					Sample ID		Well Diagram		Summary	
Date	Time	Elapsed Time (hr.)	Depth (ft) to:			O - Open End Rod T - Thin Wall Tube U - Undisturbed Sample S - Split Spoon Sample			Overburden (ft)	15.0
			Bottom of Casing	Bottom of Hole	Water					
		-NOT MEASURED-							Rock Cored (ft)	-
									Samples	5S
									Boring No. B-3	

Field Tests: Dilatancy: R - Rapid S - Slow N - None Plasticity: N - Nonplastic L - Low M - Medium H - High
 Toughness: L - Low M - Medium H - High Dry Strength: N - None L - Low M - Medium H - High V - Very High

*Note: Maximum particle size is determined by direct observation within the limitations of sampler size.

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich of New York.

TEST BORING REPORT


Boring No. B-4

Project Proposed Multifamily Residential and Boys & Girls Club Development New Rochelle, NY
 Client The NRP Group
 Contractor Craig Geotechnical Drilling Co., Inc.

File No. 133128-002
 Sheet No. 1 of 1
 Start 9 January 2019
 Finish 9 January 2019
 Driller M. Tarter
 H&A Rep. T. Poggiogalle
 Elevation 62.5 (est.)
 Datum NAVD88
 Location See Plan

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	HW	S	--	Rig Make & Model: Track-mounted CME-75
Inside Diameter (in.)	4.0	1 3/8	--	Bit Type: Roller Bit
Hammer Weight (lb)	140	140	-	Drill Mud: Bentonite
Hammer Fall (in.)	30	30	-	Casing: Driven
				Hoist/Hammer: Winch Automatic Hammer
				PID Make & Model: None

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel		Sand				Field Test					
							% Coarse	% Fine	% Coarse	% Medium	% Fine		% Fines	Dilatancy	Toughness	Plasticity	Strength	
0				62.0		-BITUMINOUS CONCRETE-												
				61.5		-FILL-												
	8 8 8 9	S1 14	0.5 2.5	61.0	SM	Medium dense brown to gray silty SAND with gravel (SM), mps 1.5 in., no structure, no odor, moist, contains weathered schist	15	15	15	20	20	15						
	10 11 15 11	S2 8	2.5 4.5		GP- GM	Medium dense gray poorly-graded GRAVEL with silt and sand (GP-GM), mps 1.5 in., no structure, no odor, moist, contains weathered bedrock	20	30	15	15	10	10						
5	18 39 50/2"	S3 10	4.5 5.7		SP- SM	Very dense gray poorly-graded SAND with silt (SP-SM), mps 2 mm, no structure, no odor, moist	-	-	-	35	55	10						
	50/0"	S4 0	6.5 6.5			Very dense, no recovery Note: Split spoon refusal at 6.5 ft. Advance roller bit to 10.0 ft.												
10	50/1"	S5 1	10.0 10.1		SP- SM	Very dense gray to white to black poorly-graded SAND with silt (SP-SM), mps 2 mm, no structure, no odor, moist Note: Split spoon refusal at 10.1 ft. Advance roller bit to 15.0 ft.	-	-	-	30	60	10						
						-WEATHERED BEDROCK-												
15				47.5 15.0		BOTTOM OF EXPLORATION 15.0 FT Note: Borehole backfilled with soil cuttings and surface patched with cold patch. Note: Concrete encountered and split spoon refusal at 6.0 in. at first borehole location. Offset 2.0 ft towards Guion Place.												

Water Level Data				Sample ID		Well Diagram		Summary	
Date	Time	Elapsed Time (hr.)	Depth (ft) to:	O - Open End Rod T - Thin Wall Tube U - Undisturbed Sample S - Split Spoon Sample				Overburden (ft)	15.0
			Bottom of Casing Bottom of Hole Water					Rock Cored (ft)	-
			-NOT ENCOUNTERED-					Samples	5S
								Boring No. B-4	

Field Tests: Dilatancy: R - Rapid S - Slow N - None Plasticity: N - Nonplastic L - Low M - Medium H - High
 Toughness: L - Low M - Medium H - High Dry Strength: N - None L - Low M - Medium H - High V - Very High

*Note: Maximum particle size is determined by direct observation within the limitations of sampler size.

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich of New York.

SECTION 321100

BASE COURSES (PAVEMENT)

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This Section specifies requirements for the preparation of the subgrade for and placement of granular subbase and base materials for pavement areas.
- B. The work includes:
 - 1. Fine grading and compaction of pavement subgrade.
 - 2. Furnishing, placing and compacting of subbase and base materials.

1.2 RELATED SECTIONS

- A. Other specification Sections which directly relate to the work of this Section include:
 - 1. Section 321215 - HOT MIX ASPHALT (HMA) PAVEMENT.
 - 2. Section 321610 - CURBING.
 - 3. Section 033055 - CAST-IN-PLACE CONCRETE (SITE).
 - 4. Geotechnical Report prepared by Carlin Simpson & Associates.

PART 2 - PRODUCTS

- 2.1 Base course to be NYSDOT Type 3 Base. See Geotechnical Engineering Report.
- 2.2 Subbase to be NYSDOT Type 2 Base Course. See Geotechnical Engineering Report.

PART 3 - EXECUTION

3.1 SUBGRADE PREPARATION

- A. All subsurface utility construction shall be completed before fine grading is begun.
- B. The pavement and curb subgrade shall be fine graded to the location, elevations and cross slope shown on the Drawings, using gravel for final adjustments.
- C. Subgrades in in-situ soils in excavation areas and in embankment areas shall be compacted during fine grading to 90 percent of maximum dry density in conformance with the Geotechnical Report and Geotechnical specifications.

3.2 SUBBASE MATERIAL PLACEMENT

- A. Subbase material shall not be placed until the Engineer has approved the fine grading, compaction and, condition of the subgrade.
- B. Subbase material shall be placed and spread on the approved subgrade in layers not exceeding eight inches (8") in thickness by approved self-spreading equipment. Any displacement of the compacted subgrade material by the equipment shall be restored to the required grade and recompact before placement of the subbase material.
- C. Subbase material shall be compacted to 95 percent of maximum dry density in conformance with the Geotechnical Report and Geotechnical specifications.
- D. The surface of the subbase material shall be fine graded to the location, elevations, and cross slope shown on the Drawings during final layer compaction operations.

3.3 BASE MATERIAL PLACEMENT

- A. Base material shall not be placed until the Engineer has approved the fine grading, compaction, and condition of the subbase material.
- B. Base material shall be spread on the approved subbase in layers not exceeding four inches (4") in thickness by approved self-spreading equipment. Any displacement of the subbase material by equipment shall be restored to the required grade and recompact before placement of the base material.
- C. Base material shall be compacted to 95 percent of dry density in conformance with the Geotechnical Report and Geotechnical specifications.
- D. The surface of the base material shall be fine graded to the proposed location, elevations, and cross slope shown on the Drawings during final layer compaction operations.

END OF SECTION

SECTION 321215

ASPHALT PAVING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. General: Work under this Section consists of providing asphalt paving complete, as indicated on the Drawings and as specified herein including:
1. Furnishing hot mix asphalt (HMA) pavement (note – on the Drawings, this is also referred to as ‘bituminous concrete paving’) composed of mineral aggregate, reclaimed asphalt pavement (RAP), asphalt binder material, and an anti-strip additive (if required), that are mixed in a central mixing plant and then placing the mix on a prepared course in accordance with these specifications and conformance to the lines, grades, thicknesses and typical cross sections as shown on the Drawings or as directed by the Owner.
- B. The work includes:
1. Preparation for HMA paving and furnishing and installing HMA.
 2. HMA overlays over existing pavement, including surface preparation, and leveling courses, tack coating and all other associated operations required.
 3. Saw cutting existing pavements.
- C. Acceptance: The acceptance of plant produced material for gradation, asphalt content, and air voids may be determined by the Owner in accordance with the requirements of the section on ACCEPTANCE CRITERIA, herein specified.

1.2 RELATED SECTIONS

- A. Sections that directly relate to the Work of this Section include:
1. Section 321100 - BASE COURSES (PAVEMENTS).
 2. Section 321135 - RECLAIMED PAVEMENT BASE.
 3. Section 321610 – CURBING.
 4. Section 321723 – PAVEMENT MARKINGS.
 5. Geotechnical Report prepared by Carlin Simpson & Associates.

1.3 REFERENCE STANDARDS

- A. References herein are made in accordance with the listed specific standards of the following organizations and work under this Section shall conform to the latest edition, unless modified by these Specifications.
1. American Association of State Highway and Transportation Officials (AASHTO).

2. ASTM International (ASTM).
3. Asphalt Institute (AI).
4. U.S. Department of Transportation Federal Highway Administration (FHWA).
5. New Rochelle Department of Public Works (NRDPW).
6. New York State Department of Transportation (NYSDOT).

1.4 SUBMITTALS

- A. Job Mix Formula (JMF): No HMA shall be produced until a JMF has been submitted by the Contractor and reviewed by the Owner's Representative.
- B. JMF Submittal: The job mix formula shall be submitted in writing by the Contractor at least 30 days prior to the start of paving operations and shall include as a minimum:
 1. Percent passing each sieve size.
 2. Percent of asphalt binder.
 3. Performance graded asphalt binder certified test results and Material Certificate certifying the PG grade, including source and location.
 4. Mixing temperature.
 5. Compaction temperature.
 6. Percent anti-stripping additive.
- C. JMF Types: The JMF shall identify the various types of asphalt paving (i.e., base course, top coat, sidewalk, etc.) required for the work and shall indicate minimum criteria listed above for each type of asphalt.

1.5 WEATHER LIMITATIONS

- A. General: Construct pavement when atmospheric temperature is above 40°F., the base is not frozen, and there is not any film of water (free standing water) on the base to be paved.
- B. Mix Temperature: The required temperature of the HMA mixture, within a tolerance of plus or minus 15°F., when delivered at the site, will be governed by the temperature of the base upon which the mix is placed, as follows:

TABLE 1

Base Temperature in Degrees F	Required Material Temperature in Degrees F. For Course Thickness in Inches			
	<u>1</u>	<u>1-1/2</u>	<u>2</u>	<u>3 and Greater</u>
35 - 40	-	305	295	280
41 - 50	310	300	285	275
51 - 60	300	295	280	270
61 - 70	290	285	275	265
71 - 80	285	280	270	265
81 - 90	275	270	265	260
91 and over	270	265	260	255

- C. Tack Coat: The emulsified asphalt tack coat shall be applied only when the ambient temperature is above 40°F., and when the temperature has been above 35°F. for 12 hours immediately prior to application. Do not apply when base is wet, contains excess moisture, or during rain.

1.6 COORDINATION

- A. The Contractor shall coordinate paving with all other work, especially underground utility construction, to prevent covering up unfinished or uninspected work and loss of time or labor by improper scheduling. Any repaving required shall be done at no cost to Owner.

1.7 PAVEMENT WITHIN PUBLIC RIGHT OF WAY

- A. The construction of all pavements within public rights-of-way shall be in accordance with the rules, regulations and requirements of the public agency having control and ownership of such rights-of-way.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. HMA shall meet all requirements and specifications for NYSDOT Type 7 or 7F Top. See Geotechnical Engineering Report.

PART 3 - EXECUTION

3.1 GENERAL

- A. The Contractor shall install all pavements in the location and to the grades shown on the Drawings, or approved by the Owner. The type and thickness of pavement courses shall be as shown on the Drawings.
- B. Maintain equipment in satisfactory operating condition and correct breakdowns in a manner that will not delay or be detrimental to progress of paving operations.

3.2 PREPARATION

- A. Proof roll prepared base material surface to identify areas requiring removal and recompaction, and to provide a uniform degree of compaction over the entire pavement area.
- B. Do not begin paving work until deficient base material areas have been corrected and are ready to receive paving. The Contractor shall give 48 hours prior notice before placing HMA. The Owner reserves the right to inspect and approve the finished base upon which HMA is to be placed.
- C. Check all frames, covers, grates, water valve boxes, and other miscellaneous castings that are located in the proposed pavement areas to ensure that all have been correctly positioned and set to the proper slope and elevation.
- D. All vertical surfaces of structures and existing concrete surfaces in contact with new hot mix asphalt pavement shall be painted with a uniform coating of an approved tack coat material. Extreme care shall be exercised in the application of this material to prevent splattering or staining of surfaces that will be exposed after the paving is completed. Surfaces that are stained as a result of the Contractor's operations shall be repaired or replaced by the Contractor at no additional cost to the Owner.
- E. All existing paved surfaces to be overlaid shall be thoroughly cleaned by a self-propelled sweeper. Areas inaccessible by power sweeper shall be broom swept until the pavement surface is clean.

3.3 APPLICATION

- A. Tack Coat: An emulsified asphalt tack coat shall be applied to contact surfaces of all cement concrete and other surfaces abutting or projecting into pavement.
 - 1. Apply tack coat to existing pavement surfaces to receive HMA overlay at a rate of 0.03 to 0.06 gallons per square yard of residual asphalt on the surface.
 - 2. When the intermediate (binder) course pavement is exposed to construction and/or local traffic for more than 30 days or when the surface becomes contaminated with silt, a tack coat shall be applied prior to the surface course pavement at a rate of 0.03 to 0.06 gallons per square yard of residual asphalt on the surface.
 - 3. Tack coat shall be allowed to cure from brown to black prior to receiving paving.
- B. Weather Limitations: The hot mix asphalt shall not be placed when weather conditions of fog or rain prevail or when the pavement surface or base shows signs of free moisture (film of water). When the surface temperature of the underlying course is less than 50°F. (10°C.) the Contractor shall determine the time available for compaction, taking into consideration the air temperature, wind speed, sky conditions, mix delivery temperature, and ground or base temperature. Contractor shall not place hot mix asphalt when the time available or required for compaction will allow the temperature of the HMA to drop below specified levels.
 - 1. The Contractor shall not continue work when overtaken by sudden storms until the pavement surface shows no signs of free moisture. The material in transit at the time of shutdown will not be placed until the pavement surface shows no signs of free moisture, provided the mixture is within temperature limits as specified.

3.4 HOT MIX ASPHALT PAVEMENT PRODUCTION AND PLACEMENT

- A. Asphalt Binder Material: The Contractor shall maintain documentation in the form of a Materials Certificate of each shipment. Material shall conform to the specification requirements for the applicable performance grade as specified herein.
- B. Job Mix Formula (JMF): No HMA shall be produced until a JMF has been submitted by the Contractor and approved by the Owner. A separate job mix formula shall be submitted for each mixture and each approved RAP stockpile (the stockpile shall be of a uniform quality throughout).
 - 1. The approved JMF for each mixture shall be in effect until modified in writing by the Contractor. Should a change in sources of materials be made, a new JMF must be developed and approved before the new material is used
- C. Sampling: Sampling and testing may be performed by the Owner to assure conformance with these specifications. Contractor shall make materials available for sampling by Owner.
- D. JMF Tolerances: The job mix formula with the allowable tolerances stated in the Standard Specifications shall govern the production limits. Minimum liquid asphalt contents shall be within the limits stated in TABLE 3.
- E. Hot Mix Asphalt Mixing Plants, Haul Vehicles, Pavers and Compactors: Shall conform to MHD Standard Specifications for Highways and Bridges, latest edition, unless modified herein.
- F. Hand Work: Whenever possible, all pavement shall be spread by a self-propelled finishing machine. At inaccessible or irregular areas, pavement may be placed by hand methods. If hand methods are used, the hot mixture shall be spread uniformly to the required depth with hot shovels and lutes. After spreading, the hot mixture shall be carefully smoothed to remove all segregated coarse aggregate and lute marks. Lutes used for hand spreading shall be of the type designed for this use. Material loads shall not be dumped faster than they can be properly spread. Workers shall not stand on the loose mixture while spreading.
- G. Paving Machine Placement: Upon arrival, the mixture shall be placed to the full width by a hot mix asphalt paver. The mixture shall be struck off in a uniform layer of such depth that, when the work is completed, it shall have the required thickness and conform to the grade and contour indicated. The speed of the paver shall be regulated to eliminate pulling or tearing of the hot mix asphalt mat. Unless otherwise permitted, placement of the mixture shall begin along the centerline of a crowned section or on the low side of areas with a one-way slope. The top course in larger parking areas shall be placed in the direction of surface water flow.
 - 1. No traffic will be permitted over freshly placed surface course material until the material has been compacted, and allowed to cool to a temperature of 140°F. or less.
- H. Joints: Make joints between old and new pavements and between successive days' work, to ensure continuous bond between adjoining work. Construction joints shall have the same texture, density, and smoothness as other sections of paving. Clean contact surfaces and apply tack coat to joint edges.

3.5 ROLLING AND COMPACTION

- A. The number, weight, and types of rollers and sequences of rolling operations shall be such that the required compaction and surface texture are consistently attained while the mixture is in a workable condition.

- B. Compact mixture with hot hand tampers, hand rollers, or vibratory plate compactors in areas inaccessible by self-propelled rollers.
- C. Accomplish breakdown or initial rolling immediately following rolling of joints and outside edge. Check surface after breakdown rolling, and repair displaced areas by loosening and filling, if required, with hot material.
- D. Follow breakdown rolling as soon as possible, while mixture is hot. Continue rolling until mixture has been thoroughly compacted.
- E. Perform finish rolling while mixture is still warm enough for removal of roller marks. Continue rolling until roller marks are eliminated and course has attained specified density.
- F. Remove and replace paved areas mixed with foreign materials and any defective areas with fresh HMA top or intermediate course material, as required. Compact by rolling to specified surface density and smoothness.
- G. After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened. Erect barricades to protect paving from traffic.

3.6 HMA SIDEWALKS

- A. Forms: Where walls, curbing or other suitable permanent supports are not present, satisfactory forms shall be installed to assist in securing alignment and adequate compaction of the courses. All forms shall be removed after paving has been completed and the area backfilled and compacted.
- B. Placing HMA: The HMA walkway surface shall be laid in two courses to a depth after compaction of 2-1/2 inches. The bottom course shall be 1-1/2 inches in thickness after compaction, and its surface after rolling shall be parallel to the proposed grade of the finished surface. The top course shall be 1 inch in thickness after compaction.
 - 1. Unless otherwise directed, the walkway shall have a 1.5% slope to provide for proper drainage and shall conform to handicap accessibility requirements.
 - 2. Spreading Mixture: The mixture shall be dumped, as needed, into a self-propelled sidewalk paver, or into wheelbarrows or an approved steel dump sheets outside the areas on which it is to be placed. Mixture shall then be immediately distributed into place by means of shovels and lutes into a uniformly loose layer to the full width required and of such depth that, when the work is completed, it shall conform to the grade and surface contour required.
 - 3. Rolling: The surface shall be rolled with a self-propelled tandem roller weighing not less than 1-1/2 tons and not more than 5 tons. In places not accessible to a power roller, compaction shall be obtained by means of mechanical rammers or by hand tampers weighing not less than 50 lbs. and having a tamping face not exceeding 100 square inches.
 - 4. Testing Surface: When tested with a 10-foot straightedge placed parallel to the centerline of the courses, there shall be no deviation from a true surface in excess of 1/4 of an inch.

3.7 FIELD AND QUALITY ASSURANCE

- A. Independent Testing Laboratory, selected and paid for by the Owner, may be retained to perform construction testing of in-place HMA courses for compliance with requirements for density, thickness, and surface smoothness.
- B. Thickness: In-place compacted thickness shall not be less than the thickness specified on the Drawings. Areas of deficient paving thickness shall receive a tack coat and a minimum 1-inch compacted thickness overlay; or shall be removed and replaced to the proper thickness, at the discretion of the Owner, until specified thickness of the course is met or exceeded, at no additional cost to the Owner.
- C. Surface Smoothness: Testing may be performed on the finished surface of each course for smoothness, using a 10-foot straightedge applied parallel with, and at right angles to centerline of paved area. Surfaces may not be acceptable if they exceed the following tolerances for smoothness:
 - 1. Intermediate (binder) course: 3/8 inch.
 - 2. Top course: 1/4 inch.
- D. Compaction: The in-place compaction of each course shall be compacted to a density of at least ninety-two percent(92%) and no more than ninety-seven percent (97%) of the theoretical maximum specific gravity, AASHTO T 209, Type C, D, or E container.
 - 1. Areas of insufficient compaction shall be delineated, removed, and replaced in compliance with the specifications at no additional cost to the Owner.

3.8 MATERIAL ACCEPTANCE

- A. Acceptance Sampling and Testing: All acceptance sampling and testing necessary to determine conformance with the requirements specified in this Section may be performed by the Owner, or his representative.
 - 1. Plant Produced Material. Plant produced material may be tested for gradation, asphalt content, and air voids on a random basis.
 - 2. Field Placed Material: Material placed in the field may be tested for mat and joint density, and compacted thickness on a random basis, in accordance with ASTM D3665.

3.9 ACCEPTANCE CRITERIA

- A. General: Acceptance will be based on the following characteristics of the hot mix asphalt and completed pavement on a material course:
 - 1. Hot Mix Asphalt Production
 - a. Plant air void
 - b. Gradation
 - c. Asphalt binder content
 - d. Mixture Temperature
 - 2. Hot Mix Asphalt Placement
 - a. Mat density
 - b. Joint density
 - c. Thickness
 - d. Inferior Material

- e. Smoothness
 - f. Grade
3. Material not conforming to specification requirements shall be subject to corrective action, production suspension, rejection, removal, or reduced payment as determined by the Owner.
- B. Inferior Material: The Owner may at any time, notwithstanding previous acceptance, notify the Contractor of inferior material and recommend the rejection of any batch of HMA which is rendered unfit for use due to contamination, segregation, incomplete coating of aggregate, or improper mix temperature. Such recommendation may be based on only visual inspection or temperature measurements.
- C. Smoothness: The finished surfaces of the pavement shall be uniform in appearance, free from irregularities in contour and texture, and shall present a smooth-riding surface.
- 1. Measurements should be made perpendicular and parallel to the paver passes at distances not to exceed 50 feet (15.2 m).
 - 2. When profile corrections are required, the Contractor shall use one or more of the following corrective methods:
 - a. Removing and replacing the entire pavement thickness;
 - b. Diamond grinding or micro milling;
 - c. Overlaying (not patching) with the specified surface course;
 - d. Removing the surface by milling and applying lift(s) of the specified course(s);
 - e. Use of other methods that will provide the desired results.
- D. Grade: The finished surface of the pavement shall not vary from the gradeline elevations and cross sections shown on the Drawings by more than 1/2 inch (12.70 mm). The Contractor shall remove deficient areas and replace with new material. Sufficient material shall be removed to allow at least 1.5 inches (37.5 mm) of hot mix asphalt to be placed. Skin patching for correcting low areas will not be permitted. High points may be ground off. The Contractor shall make tests for conformity with the specified crown and grade immediately after initial compaction. Any variation shall be corrected by the removal or addition of materials and by continuous rolling.
- E. Shaping Edges: While the surface is being compacted and finished, the Contractor shall carefully trim the unsupported outside edges of the pavement not receiving curbing. Edges so formed shall be beveled while still hot with the back of a lute or smoothing iron and thoroughly compacted by tampers or by other satisfactory methods.
- F. Corrective Methods: The corrective method(s) chosen by the Contractor shall be performed at the Contractor's expense, including all necessary equipment and traffic control.
- 1. Areas of removal and replacement shall be removed the full width of the paver pass. The removal areas shall be reconstructed with a transverse butt joint, using a transverse saw cut perpendicular to the paver pass.
 - 2. Replacement materials shall be placed in sufficient quantity so the finished surface will conform to grade and smoothness requirements. The corrective area shall conform to all material and compaction specification requirements.

3. When the corrective work consists of an overlay, the overlay shall cover those paver passes sufficient to correct the defects. The area overlaid shall be placed with a transverse butt joint using a transverse saw cut and asphalt removal.
4. All materials shall meet contract requirements. The overlay shall be placed so the finished surface will conform to grade and smoothness requirements. The overlay area shall be compacted to the specified density.
5. The Owner may retest any sections where corrections were made to verify that the corrections produced a surface that conforms to the grade and smoothness requirements.

3.10 MEETING EXISTING PAVEMENTS

- A. General: Where new pavements will abut existing pavements, the Contractor shall saw cut the existing pavements to produce a uniform, smooth joint surface. Saw cutting of existing pavements shall be neat, straight and even lines, and done in a manner that prevents damage to the pavement to remain.
- B. Full-Depth Pavement: Saw cut by approved method to the full depth of the pavement prior to placement of any new pavement. The saw cut surface shall be a neat true line with straight vertical edges free from irregularities. The saw cut surface shall be tack coated immediately prior to the installation of the new abutting HMA material to provide a bond between the old and new pavements. The new compacted pavement surface shall be finished flush with the abutting pavement.
- C. HMA Overlays: The existing hot mix asphalt pavement shall be saw cut to a neat true line with straight vertical edges free of irregularities for a minimum depth of 1-1/2 inches. Prior to completing overlays, existing pavements shall be tapered by grinding. The taper, along the entire length of the joint, shall be 1-1/2 inch deep at the saw cut face and shall taper to zero inches deep toward the overlay at a distance of 6 feet for driveways and parking areas, and 12 feet in roadways and streets. The taper shall be cleaned and shall receive an asphalt emulsion tack coat immediately prior to placement of the overlay to bond the new pavement to the old pavement. The new compacted surface at the joint shall be flush with the abutting existing pavement.
 1. The surface seam of the pavement joint shall be sealed with tack coat and back sanded.

END OF SECTION

SECTION 321610

CURBING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This Section specifies requirements for furnishing and installing all types of curbing including the following: granite curb, concrete and bituminous concrete curbs, granite edging and bituminous concrete berms.
- B. The work includes:
 - 1. Furnishing and installing granite curb, granite edging, curb inlets, and curb corners, precast concrete curb, cast-in-place concrete curb, and bituminous concrete curb and berms.
 - 2. All associated items and operations required to complete the installations, including surface preparation, concrete support, jointing, and finishing.

1.2 RELATED SECTIONS

- A. Sections which directly relate to the work of this Section include:
 - 1. Section 033055 – CAST-IN-PLACE CONCRETE (SITE).
 - 2. Section 311000 – SITE CLEARING.
 - 3. Section 321100 - BASE COURSES (PAVEMENT).
 - 4. Section 321215 – ASPHALT PAVING.
 - 5. Geotechnical Report prepared by Carlin Simpson & Associates.

1.3 REFERENCE STANDARDS

- A. References herein are made in accordance with the following abbreviations and, all work under this Section shall conform to the latest editions as applicable.
- B. ACI 304 - Guide for Measuring, Mixing, Transporting and Placing Concrete.
- C. ANSI/ASTM D1751 – Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
- D. ANSI/ASTM D1752 – Standard Specification for Preformed Sponge Rubber, Cork, and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction.
- E. ASTM C33 – Standard Specification for Concrete Aggregates.
- F. ASTM C94 – Specification for Ready-Mixed Concrete.
- G. ASTM C150 – Standard Specification for Portland Cement.

- H. ASTM C260 – Standard Specification for Air-Entraining Admixtures for Concrete.
- I. ASTM C309 – Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
- J. ASTM C494 – Standard Specification for Chemical Admixtures for Concrete.

1.4 SUBMITTALS

- A. Submit shop drawings and manufacturer's literature for granite and precast curb, edging, corners and inlets indicating size, shape and dimensions, finish, and setting method for Engineer's approval.
- B. Submit copies of tests on representative samples of the concrete used in the manufacture of precast units showing a compressive strength of 5,000 psi to the Engineer prior to shipping any units.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Granite and precast curb units shall be adequately protected from damage during transit to the site.
- B. Curbing shall be protected against staining, chipping, and other damage. Cracked, badly chipped, or stained units will be rejected and shall not be employed in the work.

1.6 SAMPLES

- A. The Contractor shall supply to the site three (3) samples of all curb types for approval prior to ordering materials. Approved sample material may be used in the work upon approval by the Engineer.

PART 2 - PRODUCTS

2.1 GRANITE CURB

- A. Granite curb shall be light gray in color, free from seams and other structural imperfections or flaws which would impair its structural integrity, and of a smooth splitting appearance. Natural color variation characteristic of the deposit from which the curb is obtained will be permitted.
- B. Whenever curbing is sawed, all surfaces that are to be exposed shall be thoroughly cleaned and any iron rust or iron particles removed by sandblasting or other methods approved by the Engineer and any saw mark in excess of 1/8 inch shall be removed.
- C. Dimensions
 - 1. The stones for the several types of granite curb shall be cut to the dimensions and curvature hereinafter needed:

<u>Type</u>	<u>Minimum Length</u>	<u>Width at Top</u>	<u>Depth</u>	<u>Minimum Width at Bottom</u>
Highway	6 feet	6 inches	17 to 19 inches	4 inches (for 2/3 length)
Site	3 feet	5 inches	15-17 inches	3-1/2 inches (for 2/3 length)

2. Stones to be set on a radius of 100 feet or less shall be cut to the required curvature, unless otherwise approved and, except for making closures, shall be of the following minimum lengths:

<u>Radius</u>	<u>Minimum Length</u>
50 feet to 100 feet	6 feet
25 feet to less than 50 feet	4 feet-6 inches
10 feet to less than 25 feet	3 feet

D. Finish

1. Granite curb shall have a top surface free from wind, and shall be peen hammered or sawed to an approximately true plane, and shall have no projections or depressions greater than 1/8 inch. The front and back arris lines shall be pitched straight and true and there shall be no projection on the back surface for 3 inches down from the top which would exceed a batter of 4 inches to 1 foot.
 - a. The front face shall be at right angles to the planes of the top and ends of the curb unit and shall be smooth quarry split, free from drill holes and with no projection of more than 1 inch and no depression of more than 1/2 inch measured from the vertical plane of the face through the arris or pitch line for a distance down from the top of 8 inches. For the remaining distance, there shall be no projection or depression greater than 1 inch measured in the same manner.
 - b. The ends of all stones shall be square with the planes of the top and face of the curb so that when the stones are placed end to end as closely as possible, no space shall show in the joint at the top and face of more than 1/2 inch for the full width of the top and for 8 inches down on the face; after which the end may break back not over 8 inches from the plane of the joint. The arris formed by the intersection of the plane of the joint with the planes of the top and exposed faces shall have no variation from the plane of the top and exposed faces greater than 1/8 inch.

2.2 GRANITE EDGING

- A. Granite shall conform to ASTM C615. Stone shall be hard and durable granite of a uniformly light grayish white color free from seams that would impair the structural integrity.
- B. The stones for the granite edging shall be cut to the following dimensions:

<u>Top Width</u>	<u>Nominal Depth</u>	<u>Minimum Length</u>
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4 inches

12 inches

3 feet

- C. The exposed face shall be smooth quarry split to an approximate true plane and still have no projections of more than 1-1/2 inches and no depression greater than 1 inch. The top shall be sawed and shall have no projection or depression greater than 1/4 inch. Any projection not meeting the above shall be dressed off. The top and bottom lines of the face shall be pitched off to a straight line and shall not show over 1 inch between stone and straight edge when a straightedge is placed along the top and bottom lines.
- D. The top and bottom lines of the face shall be pitched off to a straight line and shall not show over 1 inch between stone and straight edge when a straightedge is placed along the top and bottom lines.
- E. The ends shall be square to the plane of the face so when placed end to end no space more than 1-1/2 inches shall show except on a radius of 10 feet or less where the finish joint shall be no more than 3/4 inch.
- F. Drill holes not more than 3-1/2 inches or 1/2 inch in depth shall be permitted.
- G. The sides shall not be under the square more than 4 inches or over the square at the back more than 1 inch.
- H. The arris formed by the intersection of the plane of the face with the plane of the end joint shall not vary from the plane of the face more than 1/4 inch.

2.3 CAST-IN-PLACE SLIP FORM (EXTRUDED) CONCRETE CURB

- A. Concrete
 - 1. Concrete shall include approximately 75 percent State-approved concrete sand and 25 percent 3/8-inch crushed stone. The concrete shall contain a minimum of 564 pounds of cement (6 sacks) per cubic yard yielding a concrete that will exceed 3,500 psi in 28 days. The concrete shall be produced according to ASTM C94 – Specification for Ready-Mixed Concrete or ASTM C685 – Standard Specification for Concrete Made by Volume Batching and Continuous Mixing.
 - 2. The concrete shall be of such consistency that after extrusion it will maintain the shape of the curb section without support or slumping. Concrete mix shall contain the maximum amount of water that will permit this result.
 - 3. The concrete shall contain a minimum of 1 pound of fiber reinforcement per cubic yard.
- B. Grading limits shall be modified, as necessary, to produce a concrete curb that after extrusion has well defined web marks of water on the surface and is free of surface pits larger than 3/16 inch diameter.
- C. A two component epoxy or suitable cementitious adhesive designed to bond fresh cement concrete to existing bituminous pavement shall be used. Apply adhesive in accordance with manufacturer's recommendations. The adhesive shall be Surebond as manufactured by Kaufman Products, Inc. or approved equal.
- D. Cast-in-Place Slip Form (Extruded) Concrete Curb shall be as manufactured by Concrete Crafters Inc., Naugatuck, CT; or approved equal.

2.4 PRECAST CONCRETE CURB

- A. The concrete shall have a minimum compressive strength of 5,000 psi at 28 days, and shall contain 5 to 7 percent entrained air. The material shall conform to Section 033055 – CAST-IN-PLACE CONCRETE (SITE).
- B. All precast curb with radius of 100 foot or less shall be formed to the radius shown on the Drawings.
- C. Precast concrete curb units shall be rubbed finished, as follows:
 - 1. After the concrete has properly hardened, the exposed surfaces shall be rubbed with a #16 carborundum stone or an approved abrasive to fully remove laitance and sand grain finish. No cement shall be used in the rubbing process.
 - 2. The finish of the units shall be uniform and shall conform to those of adjacent work in their final position.
- D. Precast concrete curb sections shall be furnished with sockets in each end to receive dowels to maintain the horizontal and vertical alignment of the curb. The dowel socket shall be 11/16 inch by 2-1/2 inches. Provide 5/8 inch by 4 inch dowels.

2.5 CAST-IN-PLACE CONCRETE CURB (FORMED)

- A. Concrete and reinforcement for cast-in-place concrete curbs shall be as specified in Section 033055 – CAST-IN-PLACE CONCRETE (SITE).

2.6 BITUMINOUS CONCRETE CURBING

- A. Bituminous concrete curb shall conform to the requirements for Dense Mix as specified in Section 321215 – ASPHALT PAVING.

2.7 CEMENT MORTAR

- A. Cement mortar shall be composed of one part Portland cement and two parts of sand by volume with sufficient water to form a workable mix. Cement shall be Portland cement ASTM C150, Type II.

2.8 TRANSITION SECTIONS

- A. Horizontal transition sections shall be provided at all locations where curb sections change (i.e., vertical to sloped). Vertical transition sections shall also be provided for precast curb sections at wheelchair ramps. Vertical transition sections for granite curb shall be made as shown on the Drawings.

PART 3 - EXECUTION

3.1 GENERAL

- A. Trenching, excavation, backfilling, and compaction shall be completed in accordance with the Geotechnical Report and geotechnical specifications, except as modified within this Section.
- B. Cement mortar bedding, if required, shall be placed as shown on the Drawings and in accordance with Section 033055 – CAST-IN-PLACE CONCRETE (SITE).

3.2 GRANITE CURB AND EDGING INSTALLATION

- A. Excavation shall extend 6 inches below and behind curb, as shown on the Drawings.
 - 1. The gravel base shall be placed in the excavated area, graded and compacted to above the proposed curb subgrade.
- B. Curbing and curb corners shall be set on additional gravel spread upon the foundation. All spaces under the curb and curb corners shall be filled with gravel thoroughly compacted so that the curb and curb corners will be completely supported throughout their length. The curb shall be set at the line and grade required as shown on the plans unless otherwise directed.
- C. Edging shall be set on a thoroughly compacted base so that the edging will be completely supported throughout their length. Concrete shall be placed to support the edging base as shown on the plans.
- D. Curb, curb corners or edging shall be fitted together as closely as possible.
- E. Immediately after the curb, curb corners, curb inlets, and edging is set, the space between it and the wall of the trench shall be filled with gravel thoroughly tamped to a depth of 6 inches, care being taken not to affect the line or grade of the curb, curb corners, curb inlets and edging. The trench shall continue to be filled with gravel and compacted in 6 inch lifts until grade is achieved. If the curb materials and trench are part of reconstruction work and existing bituminous concrete surface is to remain, then the use of concrete backfill is acceptable, to an elevation suitable to support the pavement patch or section.
- F. The joints between curbstones (both front and back) or edging shall be carefully filled with cement mortar and neatly pointed on the top and front exposed portions. After pointing, the curbstones or edging shall be satisfactorily cleaned of all excess mortar that may have been forced out of the joints.
- G. Transitions from normal curb settings to wheelchair ramps shall be accomplished with transition curb as shown on the drawings. Transitions shall be of the same type curb and similar to that abutting the transition piece and, if on a curve, of the same radius.
- H. The ends of the stone curb at driveways and intersections shall be cut at a bevel or rounded, as shown on the Drawings.
- I. If curb, curb corners, curb inlets, or edging of different quarries is used on the same project, curbing of each particular quarry shall be segregated and set to give uniform appearance.
- J. Procedures for removal and resetting of existing granite curb, and new granite curb, in existing pavements shall include the following:
 - 1. Prior to excavation for existing granite curb removal, the pavement surface shall be saw cut a minimum of one foot from the face of curb.
 - 2. Existing curb shall be carefully excavated, and removed in a manner that protects the curb and existing pavement to remain from damage.
 - 3. Existing granite curb shall be cleaned by sandblasting as required to remove bituminous material, paint and concrete from exposed surfaces prior to resetting in the proposed work.

4. New granite curb shall be set to match the top of existing granite curb remaining in place at abutting sections and, if required, transitioned to the typical section shown on Drawings within the first section of curb. Cement concrete shall be placed along the front face of the curb as shown on the Drawings.

3.3 PRECAST CONCRETE CURB

- A. Precast units delivered to the site shall be inspected for damage, unloaded and placed along the prepared curb trench, or other designated location, with the minimum amount of handling.
 1. Materials shall be handled in a manner that prevents damage to the curb units.
 2. All individual pieces of curved curbing shall be marked to correspond to the radius and location where curbing is to be set.
- B. Excavation shall extend 6 inches below and behind finished curb, as shown on the Drawings.
 1. The gravel base shall be placed in the excavated area, compacted and graded to the proposed curb subgrade.
- C. Precast concrete curb units shall be doweled together continuously to the line and grade shown on the Drawings. Any units damaged during setting operations shall be removed and replaced.
- D. After the curb is set, the trench shall be backfilled immediately with approved material. The first layer shall be 4 inches in depth and compacted. The other layers shall be not more than 6 inches in depth and compacted until the trench is filled. Care shall be taken to prevent disturbing the line or grade of the curb during this procedure.

3.4 BITUMINOUS CONCRETE CURB AND BERM

- A. General Requirements
 1. Bituminous curb shall be constructed by the use of an approved self-propelled extruding curb machine equipped with a material hopper, distributing screw and curb forming device capable of placing the bituminous mixture to the required lines, grades and proper curb cross-section. Prior to the placement of any curb, the Contractor shall submit a detail of the cross-section of the curb mold to the Engineer for approval.
- B. Surface Preparation
 1. Before curbing is to be placed on pavement, the pavement surface shall be thoroughly swept and cleaned by mechanical sweepers and allowed to dry. If the curb is to be placed on cement concrete pavement, the concrete shall receive a coating of tack coat material prior to placement of the curb.
- C. Placing and Compaction
 1. The hot bituminous mixture shall be placed in the hopper of the curb paver without segregation and extruded through the mold form to provide the proper compaction and surface texture.
 2. The curb paver shall be properly supported and weighted during operation along the edge of the pavement and shall be guided along string or chalk lines to maintain the proper alignment and level of the completed curb.

3. Any portions of the completed curb, which are not satisfactorily compacted, show signs of sagging, cracking, and distortion, do not conform to the required lines, grades or cross section, and which cannot be satisfactorily repaired, shall be removed and replaced at no additional cost to the Owner.
- D. Joints: Bituminous curb construction shall be a continuous operation in one direction only without joints. When placing of the curb is discontinued for a length of time that permits the mixture to cool, the curb shall be cut in a true vertical plane and the exposed end painted with tack coat material just prior to placing the fresh curb mixture against the previously constructed curb to achieve a continuous bond.
- E. Curing: The newly completed curb shall be protected from traffic or other disturbance by barricades or other suitable methods until adequate stability has been obtained, but in no case less than twelve hours.

3.5 CAST-IN-PLACE CONCRETE CURB

- A. General: Concrete curb shall be cast in place to the size, shape, line and grade shown on the Drawings. The curbing shall be constructed using clean, undamaged forms and in segments separated by construction joints and expansion joints.
- B. Preparation: The curb trench shall be excavated, and the gravel base placed to the dimensions shown on the Drawings. The gravel base shall be compacted and graded to the proposed curb subgrade.
- C. Forms: Forms shall be metal or acceptable planed and matched lumber, straight and free from warp or other irregularities that will adversely affect the installation. Forms shall conform to the curb cross-sections shown on the drawings and shall be carefully set to line and grade, thoroughly braced and secured in place so that there will be no displacement during placing of the concrete. All forms shall be thoroughly cleaned prior to reuse.
- D. Placing of Concrete: Prior to placing the concrete, the subgrade shall be moistened and the contact surfaces of the forms given a light coating of oil that will not discolor the concrete. Concrete shall be placed in the form, struck off with a template and spaded or otherwise compacted to eliminate voids and finished to a smooth even surface. The concrete may be compacted by mechanical vibrators if approved by the Engineer. Placing by slip form methods shall be approved by the Engineer.
- E. Expansion Joints: Vertical expansion joints shall be located approximately every 75 linear feet and shall match the location of points of curb curvature and tangency and expansion joints in any adjacent concrete pavements and sidewalks. Expansion joints shall be constructed vertical, plumb, and at right angles to the face of the curb. Expansion joints shall be 1/2 inch in width and formed with premolded bituminous joint filler cut to conform to the curb cross-section.
- F. Construction Joints: Vertical construction joints shall be located approximately every 15 feet equally spaced between expansion joints. The length of the curb segments may be varied slightly for closures, but in no case shall they be less than 8 feet. Construction joints shall be vertical, plumb and at right angles to the face of the curb and shall be formed by approved method that will provide complete separation of the curb segments during the placing of the concrete. If curb is formed by slip form methods, the joints shall be sawed as soon as practicable after the concrete has set to prevent ravelling during the sawing and before any shrinkage cracking occurs in the concrete.

- G. Finishing: Forms shall be left in place for 24 hours or until the concrete has sufficiently cured to permit removal without injury to the curb. Upon removal of the forms, the exposed faces of the curb shall be immediately rubbed to a uniform surface. Rubbing shall be performed by an experienced concrete finisher. Plastering with cement mortar to fill defects will not be permitted.

3.6 CAST-IN-PLACE SLIP FORM (EXTRUDED) CONCRETE CURB

- A. The extruded curb shall be bonded to the existing pavement by using an adhesive. In advance of placing the curbs on the pavement the surface of the pavement shall be thoroughly cleaned and the adhesive shall be applied. The pavement shall be cleaned if necessary by abrading and or high pressure water washing so as to assure removal of all dust, loose materials, and/or oil.
1. The top of the finished curb shall be true to line. The Contractor shall carefully control the placement thickness of the top course of bituminous concrete to achieve a uniform reveal as indicated on the Drawings. The curb shall follow the contour of the pavement. The curb shall be free of humps and sags. Control joints shall be cut as soon as possible through one-third of the cross section of the fresh concrete. Joints shall be tooled and finished to a neat and uniform appearance. The control joints shall be installed at 9 foot intervals and more often on curves so as to minimize shrinkage cracking.
 2. The finished curb shall be coated with a curing compound which has been designed to seal the surface and form a waterproofing membrane to retard the loss of water from the fresh concrete. The manufacturer's instructions shall be followed.

END OF SECTION

SECTION 321723

PAVEMENT MARKINGS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This Section specifies requirements for removal of existing pavement markings and construction of new pavement markings.
- B. The work includes:
 - 1. Removal of existing markings by approved methods.
 - 2. Pavement surface preparation.
 - 3. Furnishing and installing new pavement markings.

1.2 RELATED SECTIONS

- A. Sections which directly relate to the work of this Section include:
 - 1. Section 321100 – BASE COURSES (PAVEMENT).
 - 2. Section 321610 - CURBING.
 - 3. Section 321215 - ASPHALT PAVING.
 - 4. Geotechnical Report prepared by Carlin Simpson & Associates.

1.3 SITE CONDITIONS

- A. The Contractor shall cordon off areas where markings are being applied, but maintain access for vehicular and pedestrian traffic as required for other construction activities. Flagmen, barricades, drums, warning signs, warning lights, and similar devices shall be used as required.

1.4 SUBMITTALS

- A. Submit material certificate to the Engineer, signed by the material producer and Contractor, certifying that materials comply with these specifications and have been approved for use by New Rochelle Department of Public Works.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Pavement markings shall conform to latest edition of the NYSDOT Standard Specifications for Highways and Bridges and Manual of Uniform Traffic Control Devices.

- B. Traffic markings shall be white, unless otherwise noted, Traffic Marking Paint as manufactured by Sherwin-Williams (S-W) equal to Sherwin-Williams Paints 'SetFast Acrylic Latex Traffic Marking Paint White' (S-W TM2160), or approved equal.

PART 3 - EXECUTION

3.1 PREPARATION

- A. The Contractor shall clean the pavement of dust, dirt, old pavement markings, concrete curing compounds, and other foreign material which may be detrimental to the adhesion of the pavement marking materials.

3.2 REMOVAL OF EXISTING PAVEMENT MARKINGS

- A. Existing pavement markings that conflict with the proposed markings, and those shown on the Drawings, shall be removed.
 - 1. Pavement markings shall be removed before any change is made in the traffic pattern.
 - 2. Any excessive damage to the pavement caused by pavement marking removal shall be repaired by the Contractor by methods acceptable to the Engineer at no additional cost to the Owner.
- B. Approved methods of pavement markings removal include:
 - 1. Sandblasting using air or water.
 - 2. High pressure water.
 - 3. Steam or superheated water.
 - 4. Mechanical devices such as grinders, sanders, scrapers, scarifiers and wire brushes.
- C. Painting over a pavement marking line with asphaltic liquids or paints will not be allowed unless approved by the Engineer.
- D. Material deposited on the pavement from removal operations shall be removed as the work progresses. Accumulations of sand or other material which might interfere with drainage or could constitute a hazard to traffic will not be permitted.
- E. Where sandblasting is used for the removal of pavement markings and the removal operation is being performed within 10 feet of a lane occupied by traffic, the residue, including dust, shall be removed immediately as the marking removal progresses by a vacuum attachment operating concurrently with the blast cleaning operation, or by other methods approved by the Engineer.

3.3 PAVEMENT MARKING APPLICATION

- A. The material shall be applied to the pavement by equipment designed and manufactured specifically for the application of pavement markings.
- B. The Contractor shall employ the services of a registered land surveyor to provide control for layout of pavement markings.

- C. Paint markings shall be applied at a minimum thickness of 15± 1 mil. Thermoplastic markings shall be applied at 125 to 188 mils thickness.
- D. Pavement markings shall be applied in accordance with the layout shown on the Drawings. No paint shall be applied to new bituminous pavement until the top course has cured at least one week, and allow two weeks curing for newly installed bituminous concrete curbing.
- E. All parking stalls shall be single stripe and shall be spaced equally. The line indicated on the drawings is on the center line of the stall marking.
- F. Where entire areas are to be cross-hatched, the striping shall conform to the cross-hatching shown on the Drawings.
- G. All parking stall markings shall be straight with sharp corners and clean edges. Directional arrows, cross-hatching, lane divider stripes, stop lines, and lettering shall be painted white to the size, length, and spacing shown on the Drawings.
- H. All markings shall be applied in one coat with brush, spray, or marking machine over clean dry pavement surfaces, when the atmospheric temperature is at or above 40°F., and when the weather is otherwise favorable in the opinion of the Engineer.
- I. Use only skilled workmen who are experienced and normally employed in the work of installing pavement markings. Supply all the necessary equipment and materials required for the work.
- J. The Contractor shall protect the buildings, walks, pavement, curbing, trees, shrubs, mulch, and other site fixtures from over-spray of paint and damage from pavement marking operations.
- K. Traffic shall not be permitted on the pavement until the [paint is thoroughly dry.] [Thermoplastic markings complete cured]

END OF SECTION

SECTION 323113

CHAIN LINK FENCES AND GATES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This Section specifies requirements for furnishing and installing chain link fence and gates.
- B. The work includes:
 - 1. Galvanized steel chain link fabric.
 - 2. Aluminum-coated, steel chain link fabric.
 - 3. Zn-5-Al-MM alloy-coated, steel chain link fabric.
 - 4. PVC-coated, steel chain link fabric.
 - 5. Aluminum chain link fabric.
 - 6. Galvanized steel framework.
 - 7. Polymer-coated steel framework.
 - 8. Aluminum framework
 - 9. Privacy slats.
 - 10. Barbed wire.
 - 11. Barbed tape.
 - 12. Gate operator.
 - 13. Grounding and bonding.

1.2 RELATED SECTIONS

- A. Sections which directly relate to the work of this Section include:
 - 1. Section 033055 – CAST-IN-PLACE CONCRETE (SITE).
 - 2. Geotechnical Report prepared by Carlin Simpson & Associates.

1.3 REFERENCE STANDARDS

- A. References herein are made in accordance with the following abbreviations and all work shall conform to the latest editions, as applicable.
- B. ASTM International (ASTM):

A53	Standard Specification for Pipe, Steel, Black, and Hot-Dipped Zinc-Coated, Welded and Seamless
A116	Standard Specification for Metallic-Coated, Steel Woven Wire Fabric
A121	Standard Specification for Metallic-Coated Steel Barbed Wire
A123	Standard Specification for Zinc (Hot Dip Galvanized) Coatings on Iron and Steel Products
A153	Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
A392	Standard Specification for Zinc-Coated Steel Chain-Link Fence Fabric
A428	Standard Test Method for Weight [Mass] of Coating on Aluminum-Coated Iron or Steel Articles
A491	Standard Specification for Aluminum-Coated Steel Chain-Link Fence Fabric
A653	Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
A817	Standard Specification for Metallic-Coated Steel Wire for Chain-Link Fence Fabric and Marcellled Tension Wire
A824	Standard Specification for Metallic-Coated Steel Marcellled Tension Wire for Use With Chain-Link Fence
A1011	Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength
B211	Standard Specification for Aluminum and Aluminum-Alloy Bar, Rod, and Wire
B221	Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
B429	Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube
C94	Standard Specification for Ready-Mixed Concrete
C1107	Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
F567	Standard Practice Installation of Chain-Link Fence
F626	Standard Specification for Fence Fittings
F668	Standard Specification for Polyvinyl Chloride (PVC) and Other Organic Polymer-Coated Steel Chain Link Fence Fabric.
F900	Standard Specification for Industrial and Commercial Swing Gates

F934	Standard Specification for Standard Colors for Polymer-Coated Chain Link Fence Materials
F969	Standard Practice for Construction of Chain-Link Tennis Court Fence
F1043	Standard Specification for Strength and Protective Coatings on Steel Industrial Chain Link Fence Framework
F1083	Standard Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures
F1183	Standard Specification for Aluminum Alloy Chain Link Fence Fabric
F1184	Standard Specification for Industrial and Commercial Horizontal Slide Gates
F1345	Standard Specification for Zinc-5% Aluminum-Mischmetal Alloy-Coated Steel Chain-Link Fence Fabric

C. Chain Link Fence Manufacturers Institute (CLFMI):

Product Manual Chain Link Fence Manufacturers Institute Product Manual

D. IEEE (formerly Institute of Electrical and Electronics Engineers, Inc.):

81	IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System Part 1: Normal Measurements
C2	National Electrical Safety Code (NESC)

E. InterNational Electrical Testing Association (NETA).

F. National Fire Protection Association (NFPA):

70	National Electrical Code
780	Standard for the Installation of Lightning Protection Systems

G. Occupational Safety & Health Administration (OSHA).

H. Underwriters Laboratories Inc. (UL):

325	UL Standard for Safety Door, Drapery, Gate, Louver, Window Operations and Systems
467	UL Standard for Safety Grounding and Bonding Equipment

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's product data including material descriptions, construction details, dimensions of individual components and profiles, and finishes for the following:

1. Fence and gate posts, rails, and fittings.
 2. Chain-link fabric, reinforcements, and attachments.
 3. Gates and hardware.
 4. Privacy slats.
 5. Barbed wire.
 6. Barbed tape.
 7. Gate operators, including operating instructions.
 8. Motors showing nameplate data, ratings, characteristics, and mounting arrangements.
- B. Shop Drawings: Submit shop drawings showing locations of fence, each gate, posts, rails, and tension wires and details of extended posts, extension arms, gate swing, or other operation, hardware, and accessories. Indicate materials, dimensions, sizes, weights, and finishes of components. Include plans, elevations, sections, gate swing and other required installation and operational clearances, and details of post anchorage and attachment and bracing.
1. Gate Operator: Show locations and details for installing operator components, switches, and controls. Indicate motor size, electrical characteristics, drive arrangement, mounting, and grounding provisions.
 2. Wiring Diagrams: Power and control wiring and communication features and access control features. Differentiate between manufacturer-installed and field-installed wiring and between components provided by gate operator manufacturer and those provided by others.
- C. Samples for Initial Selection: Submit manufacturer's color charts or 6-inch (150-mm) lengths of actual units showing the full range of colors available for components with factory-applied color finishes.
- D. Samples for Verification: Submit samples for verification for the following products, in sizes indicated, showing the full range of color, texture, and pattern variations expected. Prepare samples from the same material to be used for the Work.
1. PVC-coated steel wire fabric in 6-inch lengths.
 2. Polymer coating in 6-inch lengths on shapes for posts, rails, gate framing, and wires.
- E. Product Certificates: Submit manufacturer's product certificates signed by manufacturers of chain-link fences and gates certifying that products furnished comply with requirements.
- F. Qualification Data: Submit qualification data for firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of owners, and other information specified.
- G. Field Test Reports: Submit field test reports which indicate and interpret test results for compliance of chain-link fence and gate grounding and bonding with performance requirements.
- H. Maintenance Data: Submit maintenance data for the following to include in maintenance manuals specified in Division 01 – GENERAL REQUIREMENTS:

1. Polymer finishes.

2. Gate operator.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed chain-link fence and gate installations similar in material, design, and extent to those indicated for this Project and whose work has resulted in a successful record of in-service performance for these installations.

B. Testing Agency Qualifications: Testing agency as defined by OSHA in 29 CFR 1910.7 or a member company of the InterNational Electrical Testing Association (NETA) and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified by the International Electrical Testing Association (NETA) or the National Institute for Certification in Engineering Technologies (NICET), to supervise on-site testing specified in Part 3.

C. Source Limitations for Chain-Link Fences and Gates: Obtain each color, grade, finish, type, and variety of component for chain-link fences and gates from one source with resources to provide chain-link fences and gates of consistent quality in appearance and physical properties.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

E. UL Standard: Provide gate operators that comply with UL 325.

F. Emergency Access Requirements: Comply with requirements of authorities having jurisdiction for automatic gate operators serving as a required means of access.

1.6 PROJECT CONDITIONS

A. Existing Utilities: Do not interrupt utilities serving facilities occupied by the Owner or others.

B. Field Measurements: Verify layout information for chain-link fences and gates shown on Drawings in relation to property survey and existing structures. Verify dimensions by field measurements.

PART 2 - PRODUCTS

2.1 MANUFACTURERES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:

1. Merchants Metals, Statesville, NC.

2. Master-HALCO, Lahabra, CA.

3. Gregory Industries, Canton, OH.

2.2 CHAIN-LINK FENCE FABRIC

- A. Steel Chain-Link Fence Fabric: Height indicated on Drawings. Provide fabric fabricated in one-piece widths for fencing in height of 12 feet and less. Comply with CLFMI "Product Manual" and with requirements indicated below:
1. Mesh and Wire Size: 2-inch mesh, 0.148-inch diameter (9 gage).
 2. Zinc-Coated Fabric: ASTM A392, with zinc coating applied to steel wire before weaving according to ASTM A817, Type II, zinc coated (galvanized) with coating weight of Class 2, not less than 2 oz./sq. ft. of uncoated wire surface.
 3. Aluminum-Coated (Aluminized) Fabric: ASTM A491, with metallic coating Type I, 0.40 oz/square foot of uncoated wire surface, aluminum coated (aluminized), applied to steel wire according to ASTM A817.
 4. Zn-5-Al-MM Alloy-Coated Fabric: ASTM F1345, with metallic coating Type III, Zn-5-Al-MM alloy coated, applied to steel wire according to ASTM A817 with a weight of not less than 1 oz./sq. ft. of uncoated wire surface.
 5. PVC-Coated Fabric: ASTM F668, Class 2b over zinc-coated steel wire with a minimum PVC thickness of .007 inches. Color: as indicated on the plans or, as selected by Owner from manufacturer's full range complying with ASTM F934.
 6. Coat selvage ends of fabric that is metallic coated during the weaving process with manufacturer's standard clear protective coating.
- B. Aluminum-Alloy Chain-Link Fence Fabric: ASTM F1183, with mill finish.
1. Mesh and Wire Size: 2-inch mesh, 0.148-inch diameter (9-gauge).
- C. Selvage: Knuckled at both selvages.

2.3 INDUSTRIAL FENCE FRAMING

- A. Round Steel Pipe: Standard weight, Schedule 40, galvanized steel pipe complying with ASTM F1083. Comply with ASTM F1043, Material Design Group IA, external and internal coating Type A, consisting of not less than 1.8 oz./sq. ft. zinc; and the following strength and stiffness requirements:
1. Line, End, Corner, and Pull Posts and Top Rail: Per CLFMI requirements for Standard Industrial Fence.
- B. Round Aluminum Pipe: Standard weight, Schedule 40, extruded structural aluminum pipe, alloy 6063-T6, mill finish, complying with ASTM B 429. Comply with ASTM F 1043, Material Design Group IB, and the following strength and stiffness requirements:
1. Line, End, Corner, and Pull Posts and Top Rail: Per CLFMI requirements for Standard Industrial Fence.
- C. Round Steel Pipe: Cold-formed, electric-resistance-welded steel pipe. Comply with ASTM F1043, Material Design Group IC, with minimum yield strength of 50,000 psi; and the following external and internal coatings and strength and stiffness requirements:
1. Coatings: External, Type B, zinc with overcoat consisting of a minimum of 0.9 oz./sq. ft. (0.27 kg/sq. m) of zinc after welding, a chromate conversion coating, and a clear,

verifiable polymer film. Internal, Type D, consisting of 81 percent, not less than 0.3-mil- (0.0076-mm) thick, zinc pigmented coating.

2. Coatings: Type C, Zn-5-Al-MM alloy, consisting of not less than 1.8 oz./sq. ft. (0.55-kg/sq. m.) coating.
 3. Line, End, Corner, and Pull Posts and Top Rail: Per CLFMI requirements for Standard Industrial Fence.
- D. Roll-Formed Steel Shapes: C-sections or other shape, produced from structural steel. Comply with ASTM F1043, Material Design Group II, with minimum yield strength of 45,000 psi; and the following coating and strength and stiffness requirements:
1. Coating: Type A, consisting of not less than minimum 2.0 oz./sq. ft. average zinc coating per ASTM A123.
 2. Coating: Type C, Zn-5-Al-MM alloy, consisting of not less than 1.8 oz./sq. ft. (0.55-kg/sq. m) coating.
 3. Line, End, Corner, and Pull Posts and Top Rail: Per CLFMI requirements for Standard Industrial Fence.
- E. Roll-Formed Steel Shapes: Hot-rolled H-beams or other shape, produced from structural steel. Comply with ASTM F1043, Material Design Group III, with minimum yield strength of 45,000 psi; Standard Industrial Fence strength and stiffness for line posts, and external and internal coating Type A, consisting of not less than minimum 2.0 oz./sq. ft. (0.61-kg/sq. m) average zinc coating per ASTM A123.
- F. Square Steel Tubing: Galvanized steel-tubing end, corner, and pull posts and top rail with coating Type A, consisting of not less than 1.8-oz./sq. ft. zinc according to ASTM F1043, and complying with CLFMI "Product Manual", Type I for the components and fence fabric height.
- G. Post Brace Rails: Match top rail for coating and strength and stiffness requirements. Provide brace rail with truss rod assembly for each gate, end, and pull post. Provide two brace rails extending in opposing directions, each with truss rod assembly, for each corner post and for pull posts. Provide rail ends and clamps for attaching rails to posts.
- H. Top Rails: Fabricate top rail from lengths 21 feet (6.4 m) or longer, with swaged-end or fabricated for expansion type coupling, forming a continuous rail along top of chain-link fabric.
- I. Intermediate and Bottom Rails: Match top rail for coating and strength and stiffness requirements.
- J. Extended Members: Extend end, corner and pull posts above top of chain-link fabric as required to attach barbed wire assemblies.
- 2.4 TENSION WIRE
- A. General: Provide horizontal tension wire at the following locations:
1. Location: Extended along bottom of fence fabric, when bottom rail is not shown on the Drawings.
- B. Metallic-Coated Steel Wire: 0.177-inch diameter, marcelled tension wire complying with ASTM A824 and the following:

1. Coating: Type I, aluminum coated (aluminized).
 2. Coating: Type II, zinc coated (galvanized) by the hot-dip process, with the following minimum coating weight: Class 2: Not less than 1.2 oz./sq. ft. (366 g/sq.m) of uncoated wire surface.
 3. Coating: Type III, Zn-5-Al-MM alloy with the following minimum coating weight: Class 2: Not less than 1 oz./sq. ft. of uncoated wire surface.
- C. Aluminum Wire: 0.192-inch diameter tension wire, mill finished, complying with ASTM B211, alloy 6061-T94 with 50,000-psi minimum tensile strength.

2.5 INDUSTRIAL SWING GATES

- A. General: Comply with ASTM F900 for the single and double swing-gate types.
- B. Metal Pipe and Tubing: Galvanized steel. Comply with ASTM F1083 and ASTM F1043 for materials and protective coatings.
- C. Frames and Bracing: Fabricate members from round galvanized steel tubing with outside dimension and weight according to ASTM F900 for the appropriate gate fabric height:
- D. Frame Corner Construction: As follows:
1. Welded or assembled with corner fittings and 5/16-inch diameter, adjustable truss rods for panels 5 feet wide or wider.
- E. Gate Posts: Fabricate members from round galvanized steel pipe with outside dimension and minimum weight according to ASTM F900.
- F. Hardware: Latches permitting operation from both sides of gate, hinges, center gate stops, and (for each gate leaf more than 5 feet wide) keepers.

2.6 INDUSTRIAL HORIZONTAL SLIDE GATES

- A. General: Comply with ASTM F1184 for single and double slide-gate types.
- B. Metal Pipe and Tubing: Galvanized steel. Comply with ASTM F1083 and ASTM F1043 for materials and protective coatings.
- C. Frames and Bracing: Fabricate from round galvanized steel tubing with outside dimension and weight according to ASTM F1184.
- D. Frame Corner Construction: As follows:
1. Type I Overhead Slide Gates: Welded or assembled with corner fittings including 5/16-inch diameter, adjustable truss rods for panels 5 feet wide or wider.
- E. Gate Posts: Fabricate members from round galvanized steel pipe with outside dimension and minimum weight according to ASTM F1184.
- F. Extended Gate Posts and Frame Members: Extend gate posts and frame end members above top of chain-link fabric at both ends of gate frame as required to attach barbed wire assemblies.

- G. Overhead Track Assembly: Manufacturer's standard track, with overhead framing supports, bracing, and accessories engineered to support size, weight, width, operation, and design of gate and roller assemblies.
- H. Guide Posts and Roller Guards: As required per ASTM F1184 for Type II, Class 1 gates.
- I. Hardware: Latches permitting operation from both sides of gate, and stops fabricated from galvanized steel.

2.7 FITTINGS

- A. General: Provide fittings for a complete fence installation, including special fittings for corners. Comply with ASTM F626.
- B. Post and Line Caps: Provide weathertight closure cap for each post. Material shall match post material.
 - 1. Provide line post caps with loop to receive top rail.
- C. Rail and Brace Ends: Provide rail ends or other means for attaching rails securely to each gate, corner, pull, and end post. Material shall match rails.
- D. Rail Fittings: Provide the following:
 - 1. Rail Sleeves: Not less than 6 inches (153 mm) long. Material shall match rails.
 - 2. Rail Clamps: Provide line and corner boulevard clamps for connecting rails in the fence line to line posts. Materials shall match rails.
- E. Tension Bars: Length not less than 2 inches shorter than full height of chain-link fabric. Provide one bar for each gate and end post, and two bars for each corner and pull post. Material shall match fence fabric.
- F. Truss Rod Assemblies: Rod and turnbuckle or other means of adjustment. Material shall match rails.
- G. Barbed Wire Arms: Hot-dip galvanized pressed steel. Provide the Type I, single slanted arm according to ASTM F626, with clips, slots, or other means for attaching strands of barbed wire. Type I, single slanted arm. Use only where specifically indicated on the drawings.
- H. Tie Wires, Clips, and Fasteners: Provide the following types according to ASTM F626:
 - 1. Standard Round Wire Ties: For attaching chain-link fabric to posts, rails, and frames, complying with the following:
 - a. Hot-Dip Galvanized Steel: 0.148-inch diameter wire, galvanized coating thickness matching coating thickness of chain-link fence fabric.
 - b. Aluminum: ASTM B211; alloy 1350-H19; 0.148-inch diameter, mill-finished wire.
 - 2. Power-driven fasteners.
 - 3. Round Wire Clips: Hot-dip galvanized steel or aluminum for attaching chain-link fabric to H-beam posts.

4. Round Wire Hog Rings: Hot-dip galvanized steel or aluminum for attaching chain-link fabric to horizontal tension wires.

- I. Pipe Sleeves: For posts set into concrete, provide preset hot-dip galvanized steel pipe sleeves complying with ASTM A53, not less than 6 inches long with inside dimensions not less than 1/2 inch more than outside dimension of post, and flat steel plate forming bottom closure.

2.8 PRIVACY SLATS

- A. Material: PVC, UV-light stabilized, not less than 0.023 inch thick, sized to fit mesh specified for direction indicated.
- B. Color: As selected by Owner from manufacturer's full range.

2.9 BARBED WIRE

- A. Zinc-Coated Steel Barbed Wire: Comply with ASTM A121, Chain-Link Fence grade for two-strand barbed wire:

2.10 CAST-IN-PLACE CONCRETE

- A. General: Comply with ACI 301 for cast-in-place concrete and Section 033000, CAST-IN-PLACE CONCRETE or Section 033055, CAST-IN-PLACE CONCRETE (SITE) of these Specifications.

2.11 GROUT AND ANCHORING CEMENT

- A. Nonshrink, Nonmetallic Grout: Premixed, factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107. Provide grout recommended in writing by the manufacturer for exterior applications.
- B. Erosion-Resistant Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with potable water at Project site to create pourable anchoring, patching, and grouting compound. Provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended in writing by manufacturer for exterior applications.

2.12 FENCE AND GROUNDING

- A. Conductors: Bare, solid wire for No. 6 AWG and smaller; stranded wire for No. 4 AWG and larger.
 1. Material Above and Below Finished Grade: Copper.
 2. Bonding Jumpers: Braided copper tape, 1 inch wide, woven of No. 30 AWG bare copper wire, terminated with copper ferrules.
- B. Connectors and Ground Rods: Listed in UL 467.
 1. Connectors for Below-Grade Use: Exothermic welded type.
 2. Ground Rods: Copper-clad steel. Size: 5/8 inch by 96 inches.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for site clearing, earthwork, pavement work, and other conditions affecting performance.
 - 1. Do not begin installation before final grading is completed, unless otherwise permitted by Owner's Representative.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Stake locations of fence lines, gates, and terminal posts. Do not exceed intervals of 500 feet (152.5 m) or line of sight between stakes. Indicate locations of utilities, lawn sprinkler (irrigation) system, underground structures, benchmarks, property monuments, and other features which may affect the Work.

3.3 INSTALLATION, GENERAL

- A. General: Install chain-link fencing to comply with ASTM F567 and more stringent requirements specified.
- B. Post Excavation: Drill or hand-excavate holes for posts to diameters and spacings indicated, in firm, undisturbed, or compacted soil.
- C. Post Setting: Hand-excavate holes for post foundations in firm, undisturbed or compacted soil. Set posts in concrete footing. Protect portion of posts aboveground from concrete splatter. Place concrete around posts and vibrate or tamp for consolidation. Verify that posts are set plumb, aligned, and are at the correct height and spacing, and hold in position during placement and finishing operations until concrete has sufficiently cured.
 - 1. Dimensions and Profile: As indicated on Drawings.
 - 2. Exposed Concrete Footings: Extend concrete 2 inches (50 mm) above grade, smooth, and shape to shed water.
 - 3. Concealed Concrete Footings: Stop footings below grade as indicated on Drawings to allow covering with surface material.
 - 4. Posts Set into Concrete in Sleeves: Use steel pipe sleeves preset and anchored into concrete for installing posts. After posts have been inserted into sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions, and finished sloped to drain water away from post.
 - 5. Posts Set into Concrete in Voids: Form or core drill holes not less than 5 inches (125 mm) deep and 3/4 inch (20 mm) larger than outside diameter (OD) of post. Clean holes of loose material, insert posts, and fill annular space between post and concrete with nonshrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions, and finished sloped to drain water away from post.

3.4 CHAIN-LINK FENCE INSTALLATION

- A. Terminal Posts: Locate terminal end, corner, and gate posts per ASTM F567 and terminal pull posts at changes in horizontal or vertical alignment of 15 degrees or more as indicated on Drawings.
- B. Line Posts: Space line posts uniformly at 8 feet o.c.
- C. Post Bracing Assemblies: Install according to ASTM F567, maintaining plumb position and alignment of fencing. Install braces at end and gate posts and at both sides of corner and pull posts. Locate horizontal braces at midheight of fabric on fences with top rail and at two-thirds fabric height on fences without top rail. Install so posts are plumb when diagonal rod is under proper tension.
- D. Tension Wire: Install according to ASTM F567, maintaining plumb position and alignment of fencing. Pull wire taut, without sags. Fasten fabric to tension wire with 0.120-inch diameter hog rings of same material and finish as fabric wire, spaced a maximum of 24 inches o.c. Install tension wire in locations indicated before stretching fabric.
 - 1. Bottom Tension Wire: Install tension wire within 6 inches of bottom of fabric and tie to each post with not less than same gage and type of wire.
- E. Top Rail: Install according to ASTM F567, maintaining plumb position and alignment of fencing. Run rail continuously through line post caps, bending to radius for curved runs and terminating into rail end attached to posts or post caps fabricated to receive rail at terminal posts. Provide expansion couplings as recommended by fencing manufacturer.
- F. Intermediate Rails: Install in one piece at post-height center span as indicated on Drawings, spanning between posts, using fittings, special offset fittings, and accessories.
- G. Bottom Rails: Install spanning between posts using fittings and accessories.
- H. Chain-Link Fabric: Apply fabric to outside of enclosing framework. Leave 2 inches between finish grade or surface and bottom selvage, unless otherwise indicated. Pull fabric taut and tie to posts, rails, and tension wires. Anchor to framework so fabric remains under tension after pulling force is released.
- I. Tension or Stretcher Bars: Thread through fabric and secure to end, corner, pull, and gate posts with tension bands spaced not more than 15 inches o.c.
- J. Tie Wires: Use wire of proper length to firmly secure fabric to line posts and rails. Attach wire at one end to chain-link fabric, wrap wire around post a minimum of 180 degrees, and attach other end to chain-link fabric per ASTM F626. Bend ends of wire to minimize hazard to individuals and clothing.
 - 1. Maximum Spacing: Tie fabric to line posts 12 inches o.c. and to braces 24 inches o.c.
- K. Fasteners: Install nuts for tension bands and carriage bolts on the side of the fence opposite the fabric side.
- L. Privacy Slats: Install slats in vertical direction as indicated, securely locked in place, for privacy factor of 70.

- M. Barbed Wire: Install barbed wire uniformly spaced angled toward security side of fence as indicated on Drawings. Pull wire taut and install securely to extension arms and secure to end post or terminal arms.
- N. Tennis Court Fencing: Construct tennis court fence according to ASTM F969.

3.5 GATE INSTALLATION

- A. General: Install gates according to manufacturer's written instructions, level, plumb, and secure for full opening without interference. Attach fabric as for fencing. Attach hardware using tamper-resistant or concealed means. Install ground-set items in concrete for anchorage. Adjust hardware for smooth operation and lubricate where necessary.

3.6 GROUNDING AND BONDING

- A. Fence Grounding: Install at maximum intervals of 1,500 feet except as follows:
 - 1. Fences within 100 Feet (30 m) of Buildings, Structures, Walkways, and Roadways: Ground at maximum intervals of 750 feet.
 - 2. Gates and Other Fence Openings: Ground fence on each side of opening.
 - a. Bond metal gates to gate posts.
 - b. Bond across openings, with and without gates, except openings indicated as 'intentional fence discontinuities'. Use No. 2 AWG wire and bury it at least 18 inches (460 mm) below finished grade.
- B. Protection at Crossings of Overhead Electrical Power Lines: Ground fence at location of crossing and at a maximum distance of 150 feet on each side of crossing.
- C. Fences Enclosing Electrical Power Distribution Equipment: Ground as required by IEEE C2, unless otherwise indicated.
- D. Grounding Method: At each grounding location, drive a ground rod vertically until the top is 6 inches (150 mm) below finished grade. Connect rod to fence with No. 6 AWG conductor. Connect conductor to each fence component at the grounding location, including the following:
 - 1. Each Barbed Wire Strand. Make grounding connections to barbed wire with wire-to-wire connectors designed for this purpose.
 - 2. Each Barbed Tape Coil: Make grounding connections to barbed tape with connectors designed for this purpose.
- E. Bonding Method for Gates: Connect bonding jumper between gate post and gate frame.
- F. Connections: Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.
 - 1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer in order of galvanic series.
 - 2. Make connections with clean, bare metal at points of contact.

3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
 4. Make aluminum-to-galvanized-steel connections with tin-plated copper jumpers and mechanical clamps.
 5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.
- G. Bonding to Lightning Protection System: If fence terminates at lightning-protected building or structure, ground the fence and bond the fence grounding conductor to lightning protection down conductor or lightning protection grounding conductor complying with NFPA 780.

3.7 FIELD QUALITY CONTROL

- A. Ground-Resistance Testing Agency: Engage a qualified independent testing agency to perform field quality control testing.
- B. Ground-Resistance Tests: Subject completed grounding system to a megger test at each grounding location. Measure ground resistance not less than two full days after last trace of precipitation, without soil having been moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance. Perform tests by two-point method according to IEEE 81.
- C. Desired Maximum Grounding Resistance Value: 25 ohms.
- D. Excessive Ground Resistance: If resistance to ground exceeds desired value, notify Owner's Representative promptly. Include recommendations to reduce ground resistance and proposal to accomplish recommended work.
- E. Report: Prepare test reports, certified by testing agency, of ground resistance at each test location. Include observations of weather and other phenomena that may affect test results.

3.8 ADJUSTING

- A. Gate: Adjust gate to operate smoothly, easily, and quietly, free from binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.
- B. Lubricate hardware and other moving parts.

3.9 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's personnel to adjust, operate, and maintain gates. Allow one day within Contract amount.
1. Test and adjust hardware, and other operable components. Replace damaged or malfunctioning operable components.
 2. Train Owner's personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining equipment and schedules.
 3. Review data in maintenance manuals.

4. Schedule training with Owner with at least seven (7) days advance notice.

END OF SECTION

SECTION 328400
PLANTING IRRIGATION

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This Section specifies requirements for the irrigation systems for site landscaping areas.
- B. The work includes the furnishing and installation of an automatic irrigation system for watering of landscaped areas including the following:
 - 1. Automatic controller.
 - 2. System connection to water supply and controls located in the mechanical room of the building.
 - 3. Provision for drainage/winterization of the system.
 - 4. System design conforming to all industry standards for materials, installation and performance established by the Irrigation Association, Silver Springs, MD.
 - 5. Sprinkler overlap of 55% of spray coverage diameter for triangular head layouts and 50% of spray coverage diameter for square head layouts. Spray coverage overlap shall be sufficient to compensate for 4 mph wind distortion.
 - 6. A precast concrete meter pit of sufficient size to house the water meter and with an access frame and cover, if separate meter pit is required.
 - 7. Backflow prevention device, as required, to meet the local water authority regulations

1.2 RELATED SECTIONS

- A. Sections which directly relate to the work of this section include:
 - 1. Section 331000 – WATER UTILITIES.
 - 2. Section 329220 – SEEDING AND SODDING.
 - 3. Section 329000 – PLANTING.
 - 4. Geotechnical Report prepared by Carlin Simpson & Associates.

1.3 SUBMITTALS

- A. The Contractor shall submit the following information to the Landscape Architect:
 - 1. Prior to construction:
 - a. Materials - complete list of materials of all items to be furnished and installed.

- b. System Layout - drawing of the system layout to be provided showing locations, connections, details, and sprinkler coverages.
- c. Calculations - calculations and back-up data of the system design.

2. Post Construction:

- a. Operation and maintenance manual - operation and maintenance instructions.
- b. As-Built Drawings - showing the location of the piping and sprinkler heads, junctions, and controls.

1.4 PROTECTION

- A. The Contractor shall use extreme care in excavating to prevent damage to existing site and building structures, utilities and other facilities. Any damage that occurs shall be corrected by repair or replacement, as required by the Landscape Architect, at no additional cost to the Owner.
- B. The Contractor shall block all open ends of installed water pipes with an inflatable membrane plug or other type of plug, to prevent the introduction into the pipe of ground water, debris, animals and other contaminants when work is stopped for any reason.

1.5 TESTING

- A. The Contractor shall test the entire irrigation system in the presence of the Landscape Architect. The test shall clearly demonstrate that each and every part of the system functions as specified.
- B. Part circle spray patterns shall be adjusted as required to provide complete coverage of the areas to be watered.
- C. Automatic and manual features of the irrigation controller shall be tested for satisfactory operation. The controller shall automatically operate each zone in the irrigation system for not less than one-half hour during which time each remaining zone shall be added to the automatic cycle by means of manual control switches. If unsatisfactory performance of the controller develops, the condition shall be corrected and the testing procedures repeated until satisfactory operation is obtained.
- D. Before any portion of the pipe is backfilled, water shall be turned into that portion of the pipe and maintained at full pressure for a period of not less than one hour after all air has been expelled. Any leaks that develop shall be repaired and all defective materials shall be replaced. The pipe shall be plugged or capped where sprinklers are to be installed while making this test.

1.6 CLEANING AND ADJUSTING

- A. At the completion of the work, all parts of the installation shall be thoroughly cleaned. All equipment, pipe, valves and fittings shall be cleaned of grease and metal cuttings and sludge which may have accumulated by the operation of the system for testing.

1.7 OPERATION AND MAINTENANCE INSTRUCTIONS

- A. Prior to acceptance of the system, the Contractor shall furnish the services of a competent operator to provide a demonstration of the system operation and maintenance requirements to a representative of the Owner.

- B. The Contractor shall furnish to the Landscape Architect, for approval, two (2) copies of an operations and maintenance manual containing approved shop drawings and details, and typewritten instructions relative to the care and operation of the equipment, all properly indexed, and bound in a three-ring, hard-cover binder. After the Landscape Architect's approval, the manuals shall be delivered to the Owner. Each manual shall contain the following:
1. Table of Contents.
 2. Description of irrigation systems:
 - a. Functional and sequential description of all systems.
 - b. As-built layout plan including sleeve locations.
 - c. Winterization procedure.
 - d. Recommended system operation sequence, frequency, length of operation cycle. These shall be related to site evapotranspiration rates, soil absorption rate, and anticipated gpm flow.
 3. Listing of manufacturers.
 4. Manufacturer's data with multiple model, type, and size listing included, clearly and conspicuously indicating those that are pertinent to the installation:
 - a. Description: Literature, Drawings, illustrations, certified performance charts and technical data.
 - b. Operation.
 - c. Maintenance, including complete troubleshooting charts.
 - d. Parts list.
 - e. Names, addresses and telephone numbers of recommended repair and service companies.
 - f. Guarantee data. Mail warranty information to manufacturer and provide copies to Owner.

1.8 GUARANTEE

- A. The Contractor shall give the Owner a written guarantee to make good any and all faults and defects in the plumbing and irrigation system due to defective or improper materials or workmanship that may appear within one year from the date of final acceptance by the Landscape Architect and shall make all changes within the guarantee period required to return the system to correct condition and operation, without cost to the Owner.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Main Line Plastic Pipe: All main line pipe 3-inch and smaller shall be Schedule 40, ASTM D2241 polyvinyl chloride (PVC) pipe.

- B. Lateral Pipe: Flexible polyethylene (PE) pipe SDR-11.5, PE23, rated at 100 psi, conforming to ASTM D2239.
- C. Sleeves: Minimum diameter of two times larger than the pipe. Sleeves shall be a minimum of 2-inch diameter and shall be Schedule 40 PVC pipe.
- D. Plastic Fittings: Schedule 40, polyvinyl chloride (PVC) standard weight.
- E. Solvent Cement: Compatible with PVC pipe per ASTM D2564 and of proper consistency.
- F. Sprinkler Head Risers: Schedule 80 PVC for risers.
- G. Automatic Controllers: Electric wall-mounted unit with heavy duty vandal-resistant lockable steel cabinet. 0- to 60-minute timing per zone, infinite adjustment with 24-hour program time clock, Modular up to 54 zones, with weather-based Smart Technology, WiFi, and Remote Controlled capability.
- H. Sprinkler Heads: Commerical-rated stainless steel shaft Rainbird, Hunter, Weathermatic, Toro or approved equivalent.
 - 1. Pop-up height for turf: 4 inches.
 - 2. Pop-up height for shrubs and groundcover: 12 inches.
- I. Backflow Preventer: A type suitable for use in a high hazard cross connection to a potable water system which is in conformance with all local and state requirements and codes (to be provided by building contractor).
- J. Wireless ET/Rain/Freeze Sensor: Sensor designed to cancel operation of the irrigation system based Evapotranspiration, Rain, and Frost conditions. Sensor shall be by the same manufacturer as the controller.
 - 1. Acceptable Manufacturers: Rainbird, Hunter, Toro, Weathermatic, or approved equivalent.
- K. Valves: Types manufactured for irrigation systems by Red-White Valve Corp., Clow Valve Corp.; Toro, Hunter, Rainbird, or approved equivalent.
- L. Meter: Shall meet or exceed the requirements of the municipal water department or water utility company.

PART 3 - EXECUTION

3.1 CONSTRUCTION

A. General

- 1. The irrigation system shall be installed in accordance with the manufacturer's instructions.
- 2. Planting beds zones shall be watered separately from lawn zones.
- 3. Loam within the limits of trench excavation shall be carefully removed and stockpiled for subsequent replacement in the upper 6 inches of the trench.

4. For trench excavation in sodded grass areas, the grass sod shall be straight cut, lifted, and stored. The sod shall have at least 1 inch of loam. After pipes are installed and backfilled, loam shall be placed in the trench and sod replaced. Sod shall not be out of the ground for more than three (3) days. Sod shall be watered and protected. All damaged sod shall be replaced at no additional cost to the Owner.
5. Where pipes are installed through paved areas, the Contractor shall saw cut and remove pavement. After pipe installation and backfill, the pavement shall be restored with material of the same type and quality as the existing. Contractor has option of tunneling under pavement.
6. Pipe shall be laid in trenches to lines and grades sufficient to provide minimum one percent (1%) slope to drain the system for winterization. Prior to placing pipe, the trench shall be graded and prepared to provide a firm and uniform bearing throughout the entire length of the pipe barrel. During backfill operations, the pipe shall be rigidly supported to prevent movement or damage to the pipe and joints.
7. All pipe shall be cut straight and true. After cutting, the ends shall be reamed out to the full inside diameter of the pipe.
8. The Contractor shall provide all adapter fittings that may be required for the system.
9. Sleeves shall be installed at all roadway and walkway crossings per plans. Sleeves shall extend 12 inches minimum beyond edge of pavement, PVC-capped, and locations accurately dimensioned on the As-Built Drawings.
10. Sprinkler head connections shall be installed on swing joints as detailed on the manufacturer's drawings.
11. All wire required to connect the solenoid valves to the irrigation controller shall be installed in accordance with local and state requirements.
12. The irrigation controllers shall be permanently installed in the building mechanical equipment room. Contractor shall mount controller on the wall and energize the controller. The Contractor shall install all 24 volt wiring to electrical valves, and conduit from controllers to pipe sleeves inside the building.
13. Manual drain valves shall be installed on the main line pipe. The valves shall be protected by a valve cap. A minimum of one cubic yard of crushed stone shall be placed under each drain valve.
14. Install a combination of drains and quick coupler valves to accommodate forced air system winterization of system.
15. Concrete thrust blocks shall be provided at all bends, tees, and dead ends for pipes greater than 1 inch diameter. Thrust blocks shall bear against soil or ballast of sufficient stability to resist thrusts.
16. Backflow preventer shall be installed by a plumber licensed in the state in which system is being installed.

3.2 EXCAVATION AND BACKFILLING

- A. Trenches shall be excavated to the depth required for the following minimum cover to finish grade.

1. Main line - 18 inches.
2. Laterals - 12 inches.
3. Control Wires - 12 inches.
4. Sleeves - 18 inches under walks; 24 inches under roads and parking areas.

3.3 PIPE LINE ASSEMBLY

- A. Plastic pipe and fittings shall be solvent welded using solvents and methods recommended by manufacturer of the pipe, except where screw connections are required. Pipe and fittings shall be thoroughly cleaned of dirt, dust and moisture before applying solvent with a non-synthetic bristle brush.
- B. Pipe may be assembled and welded on the surface. Snake pipe from side to side of trench to allow for expansion and contraction.
- C. Make all connections between plastic pipe and metal valves or steel with threaded fittings using plastic male adapters.

3.4 SPRINKLER HEADS

- A. Sprinklers: Install plumb to within 1/16 inch, with top collar (not nozzle), installed flush with finish grade.
- B. Provide swing joint with each sprinkler.
 1. Swing joint is not required where entire head is raised above grade and/or where rigid riser piping is required.
- C. Heads adjacent to paving and curbs: Located between 1 inch and 4 inches from edge of paving or back of curb.
- D. Riser pipe shall be cut with a standard pipe cutting tool with sharp cutters. Ream only to full diameter of pipe and clean all rough edges or burrs. Cut all threads accurately with sharp dies. Not more than three full threads shall show beyond fittings when pipe is made up. Assemblies shall conform to manufacturer's recommendations.

3.5 VALVES

- A. Do not locate beneath paved surfaces.
- B. Install plumb to within 1/16 inch.
- C. Located within a valve box with a 6 inch (deep) layer of washed gravel below the bottom of the valve.
 1. Top of quick coupler valves shall be as close to the top of the valve box as possible. Top of gravel layer shall be 3 inches below top of valve.
- D. Install master valve immediately behind backflow preventer and energize through the master valve circuit on the automatic controller.

3.6 ELECTRICAL CONNECTIONS

- A. Install the electrical connection to the system as shown on the Drawings.
- B. Do not run control wiring and power supply wiring in the same conduit.
- C. Provide continuous runs of wire between the controller and valves.
- D. Splices will only be permitted in valve boxes and shall be made with water-tight connectors.
- E. Bury control wire beside pipe in same trench and bundle and tape together at not more than 10 foot intervals.
- F. Construct expansion loops by wrapping wire around a 1/2-inch diameter pipe to create a coil. A 3-foot section of wire shall be used to create a 12-inch coil, and a 6-foot section used to create a 24-inch coil.
 - 1. Provide 12-inch expansion loops at each change of wire direction.
 - 2. Provide 24-inch expansion loops at each control valve and where each valve wire enters the conduit to the automatic controller.

3.7 BACKFLOW AND COMPACTION

- A. Install backflow preventer per manufacturer's and municipal water department or water company requirements.
- B. Provide a combination of drains and quick coupler valves to accommodate winterization of the entire system by forced air.
- C. Install backflow preventer in meter pit, or mechanical room, as directed by Landscape Architect.

3.8 BACKFILL AND COMPACTION

- A. After system is operating and required inspections have been made, backfill with clean soil and compact in conformance with the requirements of Section 310000 – EARTHWORK (SITE).

END OF SECTION

SECTION 329000

PLANTING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This Section specifies requirements for the preparation and planting of trees, shrubs, and other plants in landscaped areas.
- B. The work includes:
 - 1. Furnishing and installation of trees, shrubs, and groundcover plants.
 - 2. Fertilizing and backfill soil mix.
 - 3. Maintenance, clean-up, and guarantee.

1.2 RELATED SECTIONS

- A. Sections which directly relate to the work of this Section include:
 - 1. Section 312500 - EROSION AND SEDIMENTATION CONTROLS.
 - 2. Section 328400 – PLANTING IRRIGATION.
 - 3. Section 329220 - SEEDING AND SODDING.
 - 4. Geotechnical Report prepared by Carlin Simpson & Associates.

1.3 SUBMITTALS

- A. Manufacturer's/Supplier Product Data
 - 1. Submit material manufacturer's literature and installation instructions where applicable attesting that the following materials meet the requirements specified
 - a. Fertilizer
 - b. Bio-Stimulant
 - c. Anti-desiccant
 - d. Mulch
 - 1) Current NYSDEC registration for solid waste handling
 - 2) Latest record documents required by NYS 6 CRR-NY 361-4.6
 - e. Compost
 - f. Soil conditioning/amendments
 - g. Topsoil

- h. Stakes/Anchors/Guying materials and manufacturer's installation recommendations by tree size and type

B. Soil Test Reports

1. Prior to ordering the topsoil, submit a recent soil test report, specific to this project, to the Landscape Architect for review and approval. Do not order materials until the Landscape Architect's approval has been obtained. Delivered materials shall closely match the approved samples.
 - a. Topsoil: The Contractor shall employ a certified testing laboratory to test on-site and off-site topsoil materials and submit test reports of each directly to the Landscape Architect. Reports shall include:
 - (1) Tests for nutrients, micronutrients, soluble salts and soil pH in accordance with the current AOAC International "Standards".
 - (2) Submittal at least one month before any topsoil spreading is scheduled.
 - (3) Location of sample source, date of sampling (not older than 3 months), and project name reference.

C. Certificates

1. A Certificate of Compliance to the specifications shall be submitted by the nursery grower with each shipment of each type of plant, certifying that plants meet the genus, species, and cultivator type specified on the Plant List.

D. Maintenance Manual

1. The Contractor shall submit a written manual prepared for the Owner that outlines a schedule for proper maintenance of the plantings. This maintenance schedule shall include timing and methods for watering, fertilization, mulching, pruning, and other maintenance operations.

E. Submittal Schedule

1. Before installation:
 - a. Manufacturer's/Supplier Product Data. See Section 1.07A.
 - b. Soil Test Reports.
 - c. Plant Certification.
2. After installation and before acceptance:
 - a. Maintenance Manual.

1.4 QUALITY ASSURANCE

- A. All planting operations shall be performed by experienced personnel under competent supervision. Education, experience and certification or license by appropriate organization may be reviewed to evaluate competence.

- B. Plant Approval: Plants shall be inspected and approved by the Owner's Representative. Plants shall be inspected at the grower's nursery and upon delivery at the site for conformity to specification requirements. Approval of plants at the source does not replace additional inspection and rejection at the site, or during the progress of the work. Rejected plants shall be removed immediately from the site. A Contractor's representative shall be present at all inspections. All plants on the Plant List shall be pre-selected by the Contractor to ensure that plants of specified size and species are available at the nursery before the plant selection trip is scheduled. The Landscape Architect's cost for inspection trips outside of Long Island and New York Metropolitan area, shall be paid by Contractor.

1.5 TESTING

- A. All topsoil obtained from on-site and from off-site sources used in the work shall be tested prior to being spread or mixed. All testing shall be done by approved independent test laboratory or by the agriculture unit of state university system. Contractor shall provide required representative samples of material for testing to the testing laboratory site.
- B. Test analysis shall include:
1. Classification of soil.
 2. Percent sand, silt and clay particles.
 3. Percent organic content.
 4. Carbon-Nitrogen Ratio
 5. Macro and Micronutrients
 6. Percent soluble salt index.
- C. Test reports shall include specific recommendations as to the exact types, times, and rates of application of soil additives, amendments, and fertilizers based upon the soil test results and type of material to be planted.
- D. Specified soil additive materials and fertilizer types and requirements are approximate, and all soil additives shall be adjusted to comply with test reports.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver plant materials to site in healthy and undamaged condition.
- B. Move plant material with solid balls wrapped in burlap.
- C. Deliver plant materials immediately prior to placement. Keep plant materials moist. As required by temperature or wind conditions, apply anti-desiccant emulsion per manufacturer's recommendation, based on season, to prevent drying out of plant materials.
- D. Reject plants when ball of earth surrounding roots has been cracked or broken preparatory to, or during, process of planting.
- E. Reject plants when burlap, staves, and ropes required for transplanting have been displaced prior to acceptance.

1.7 GURANTEEE

- A. Provide a two-year guarantee from date of plant material acceptance.
- B. Replace plant materials found dead or not in a healthy growing condition. Plants shall exhibit at least 75% healthy branching and foliage, and shall be free of insect or disease damage. Replace plants during normal planting season.
- C. Replacement: Plant materials shall be of same size and species, with a new warranty commencing on date of replacement. The Landscape Architect shall be given a three day notice of installation of replacement plants to allow inspection of plant material.

1.8 INSPECTION FOR ACCEPTANCE

- A. After the minimum thirty (30) day maintenance period, the Contractor shall request from the Landscape Architect, in writing, for an inspection to determine whether the plant material is acceptable. If the plant material and workmanship are acceptable, written notice will be given by the Landscape Architect to the Contractor stating that the guarantee period begins from the date of the Certificate of Acceptance.
- B. If a substantial number of plants are sickly and dead at the time of inspection, acceptance will not be granted, and the Contractor's responsibility for maintenance of all the plants shall be extended until replacements are made. All dead and unsatisfactory plants shall be promptly removed from the site. Replacements shall conform in all respects to the specification for new plants and shall be planted in the same manner.

PART 2 - PRODUCTS

2.1 PLANT MATERIALS

- A. The Contractor shall furnish and plant all plants shown on the Drawings. Plants shall conform to measurements and species designated on plant list and standards as established in American Standard for Nursery Stock ANSI Z60.1, latest edition. No substitutions will be accepted, without prior approval. Such requests shall be made at least five days before planting. Requests shall list at least five major nursery sources contacted for confirmation of unavailability.
- B. All plant material shall be sourced from nurseries/farms within USDA Hardiness Zones 5a to 8a.
- C. All plant material shall be nursery grown and shall be shapely, well-grown, healthy, sound, and free of disease, insect pests, eggs or larvae, and shall have a well developed root system. All plants shall be typical of their species or variety and shall have a normal habit of growth. They shall conform to the trade classification of "heavy specimen".
- D. All trees and shrubs shall be freshly dug; no heeled-in plants and no plants from cold storage will be accepted. Plants shall have been transplanted or root pruned at least once in the last three years. All plants shall be hardy under climatic conditions similar to those in the locality of the work. All plant materials shall be properly identified by name on legible, weatherproof labels securely attached thereto.
- E. Container grown plants shall have sufficient roots to hold planting mix intact after removal from containers without being root-bound.

- F. Plants that meet the measurements specified, but do not possess a normal balance between height and spread will be rejected.
- G. Plants shall not be pruned before delivery. Trees which have a damaged or crooked leader, or multiple leaders, will be rejected. Trees with abrasion of the bark, sunscalds, disfiguring knots or fresh cuts of limbs over 1-1/4 inches which have not completed calloused, will be rejected.
- H. Certificates of inspection shall accompany the invoice for each shipment of plants as may be required by laws for transportation. File certificates with the Construction Manager prior to unloading material at the Project site. Inspection at place of growth does not preclude rejection of the plants at the site.
- I. Plant material which is to be planted after the specified seasons for planting shall be dug during the normal season for digging of the particular plant material and be stored and maintained in good health until planting. The Contractor shall pay all costs for maintaining plant material while it is being stored.
- J. Plant List: If there is any discrepancy between quantities shown on the Plant List and work shown on the Drawings, the Contractor shall supply the plants required to complete the work as shown on the Drawings. Where the size of a plant on the Plant List is a variation between a minimum and maximum dimension, the sizes of the plants furnished shall be equal to the average of the two dimensions. Where a single dimension is given, it shall be the minimum size of the plants to be furnished.

2.2 TOPSOIL

- A. Topsoil shall conform to the requirements specified in Section 310000 - EARTHWORK.

2.3 SOIL CONDITIONING MATERIALS

- A. Apply conditioning materials in accordance with the recommendations of testing laboratory.
- B. Limestone for adjustment of soil pH shall be ground dolomitic limestone containing not less than 85% of total carbonated and shall be ground to such a fineness that 40% will pass through a 100-mesh sieve and 90 percent will pass through a 20-mesh sieve. Coarser material shall be acceptable provided specific rates of application are increased proportionately on the basis of quantities passing the 100-mesh sieve. Limestone shall be uniform in composition, and shall be dry and free flowing. Limestone shall be delivered to the site in original unopened containers, each bearing manufacturer's guaranteed analysis.
- C. Commercial Fertilizer shall conform to state and federal fertilizer laws. Commercial fertilizer shall be uniform in composition, dry and free flowing, and shall be delivered to the site in the original, unopened containers, each bearing the manufacturer's guaranteed analysis. Any fertilizer which becomes caked or otherwise damaged, making it unsuitable for use, will not be accepted. At least 50% by weight of the nitrogen contents of the fertilizer shall be derived from organic sources. A minimum of 50% of the nitrogen shall be water-insoluble. Fertilizer shall contain not less than percentage of weight of ingredients as follows or as recommended by soil analysis. Nutrient analysis shall be determined by the certified soil lab test results/report.
- D. Humus shall be natural humus, reed peat or sedge peat. Humus shall be free from excessive amounts of zinc, low in wood content, free from hard lumps, shall be furnished in a shredded or granular form, and shall pass through a 1/2 inch mesh screen. According to the methods of testing of AOAC International latest edition, the pH range shall be 5.5 to 7.0 and the organic content shall be not less than 60% as determined by drying at 105 degrees C. The minimum water absorbing ability of the humus shall be 200% by weight on an oven-dry basis.

- E. Manure shall be well-rotted, unleached stable manure not less than eight months and not more than two years old, free from sawdust, shavings, or refuse of any kind and shall not contain over 25% straw. The Contractor shall furnish information as to kind of disinfectant or chemicals, if any, that may have been used in storage of the manure.
- F. Bone Meal shall be fine ground, steam-cooked, packing house bone with a minimum analysis of 23% phosphoric acid and 1.0% nitrogen.
- G. Composted Leaf Mold shall be a highly organic dark brown to black spongy residue resulting from the well-aerated composting of deciduous tree parts, free of plants and their roots, debris, and other extraneous matter and shall be uncontaminated by foreign matter and substances harmful to plant growth. The organic matter shall not be less than 85% by weight as determined by the loss on ignition of oven-dried samples. Test samples shall be oven-dried to a constant weight at a temperature of 16 degrees C. The inorganic residue of leaf mold after ignition shall not be finer textured than 4% by weight passing the No. 200 sieve with washing.
- H. Mulch shall be native shredded bark of 100% wood products, having a maximum moisture content of 40%, and shall be free of weed seed, disease, insects, construction waste, and debris materials. Mulch material shall pass a 1 inch square mesh and be retained on a 1/8 inch square mesh. Mulch suppliers shall be registered and approved by NYSDEC.
- I. Biostimulant shall be Roots Tree Saver as manufactured by Lebanon Seaboard Corporation, 1600 E. Cumberland St., Lebanon, PA 17042, (800) 233-0628, www.lebanonturf.com, or approved equivalent, applied regardless of soil lab results, to all plant backfill soils for all plant types per manufacturer's recommendations.

2.4 PLANT BACKFILL MIXTURE

- A. Plant backfill mixture shall consist of 66% in-situ topsoil and 34% fully composted leaf mold, by volume, thoroughly mixed together. In addition, plant backfill mixture shall have biostimulant, fertilizer, cow manure, and other additives added as required by recommendations of the testing laboratory reports.
- B. The plant backfill mixture shall have a pH of 5.6 to 7.4.

2.5 WATER

- A. Water shall be furnished by the Contractor in the quantities required to maintain healthy growth of plant materials and shall be suitable for irrigation and free from ingredients harmful to plant life. The Contractor shall provide all hose and other watering equipment required for the work.

2.6 SUPPORT MATERIALS

- A. ArborTie Nylon webbing as manufactured by DeepRoot Green Infrastructure, LLC, 101 Montgomery Street, Suite 2850, San Francisco, CA 94014, (415) 781-9700, www.deeproot.com, or approved equal.
- B. Stakes shall be hardwood stakes and shall be sharp pointed at one end. Size and length of the stakes shall be as required for staking and guying.
- C. Anchoring and support material for supporting shade, ornamental, and evergreen trees shall be in accordance with Nylon Webbing manufacturer's recommendations and configuration by tree size and type.

2.7 ANTI-DESICCANT

- A. Anti-desiccant emulsion that will provide a protective film over plant surfaces, permeable enough to permit transpiration, delivered in containers with manufacturer's directions. Antidesiccant shall be Wiltpruf, manufactured by Nursery Specialty Products, Inc., Stubbins Road, Groton Falls, New York, or approved equivalent. Apply according to manufacturer's recommendations.

PART 3 - EXECUTION

3.1 PLANTING DATES

- A. Plant within the following dates:
 - 1. Evergreen Trees and Shrubs:
 - a. Spring: April 1 - June 1.
 - b. Fall: September 1 - November 1.
 - 2. Deciduous Trees and Shrubs:
 - a. Spring: April 1 - June 1.
 - b. Fall: September 15 - November 15.
 - 3. Planting shall be prohibited in frozen or muddy ground.
- B. Special conditions may warrant a variance in the above dates. Contractor shall notify the Landscape Architect of the conditions and the proposed variance. Permission will be given if the variance is warranted.
- C. Approximate planting date schedules shall be furnished by Contractor to the Landscape Architect for approval. Material planted out-of-season shall be given extra care and attention by the Contractor. Out-of-season planting shall be performed entirely at the Contractor's risk.

3.2 EXCAVATION OF TREE PITS AND SHRUB BEDS

- A. Stake out on the ground locations for trees and outlines of all planting beds. Obtain approval of the Landscape Architect before excavation.
- B. If rock, utilities, tree roots, or obstructions are encountered in the excavation of shrub beds and tree pits, alternate locations may be selected by the Landscape Architect.
- C. Test drainage of plant beds and pits by filling with water twice in succession. Conditions permitting the retention of water for more than 24 hours shall be brought to attention of the Landscape Architect.
- D. Notify the Landscape Architect in writing of all soil or drainage conditions which the Contractor considers detrimental to the growth of plant material.
- E. Excavate tree pits and shrub beds to depths required. Tree pits shall be circular in outline. Tree pits shall be three times wider than the root ball diameter.

3.3 PLANTING

- A. Place plants in the center of the holes. Use planting mix to backfill plant pits. Place planting mix in layers not to exceed 8 inches thick.
- B. Set the trunk flare of the plant slightly above the finish grade in the same relationship it was to the ground from which it was dug. Set plant plumb, turned to face best side of plant forward, and brace firmly in position until the planting mix has been tamped lightly around the ball and roots. When plant pits have been backfilled approximately two-thirds full, water thoroughly to eliminate air pockets before installing remainder of the planting soil. Cut ropes or wires from top two-thirds of ball after plant has been set. Cut away and remove all visible burlap wrapping from around root balls. Loosen surface soil of root ball and comb out any exposed roots. Remove synthetic wrap and **slowly** biodegradable materials completely.
- C. Form saucers, 3 inch deep, around tree pits and shrub beds.
- D. Water all plants immediately after planting. All plants shall be flooded with water twice within the first 24 hours of planting.
- E. Mulch all pits and beds to the required depth immediately after planting and first watering. Mulch shall be 3" clear horizontally from root flare.

3.4 TREE SUPPORT

- A. Firmly stake or guy all trees immediately after planting. Plants shall stand plumb after staking or anchoring and guying. Stakes shall be plumb and neat, and shall be installed in accordance with the details shown on the Drawings.

3.5 PRUNING

- A. Each tree and shrub shall be pruned in accordance with American Nurserymen Association Standards to preserve the natural character of the plant.
- B. Pruning shall include the following:
 - 1. Remove only all dead wood, suckers, and broken or badly bruised branches. Never cut a leader.
 - 2. Use only clean, sharp tools.
- C. Apply antidesiccant to foliage if conditions warrant per manufacturer's recommendations.

3.6 CLEAN-UP

- A. Soil or other material deposited on paved areas shall be promptly removed. Keep paved areas clean at all times.
- B. Upon completion of planting, all excess stones, debris, and soil shall be cleaned up and removed from the site.
- C. Broom and hose clean all pavements.

3.7 MAINTENANCE AND PROTECTION OF PLANTINGS

- A. Maintenance shall begin immediately after each plant is planted and shall continue until acceptance.
- B. Maintenance shall include:
 - 1. Pruning, watering, cultivating, weeding, mulching, tightening and repairing of stakes or guys, resetting plants to proper grades or upright position, restoration of the planting saucer, and furnishing and applying sprays required to keep the planting free of insects and disease.
 - 2. Protect planting areas and plants against trespassing and damage of all kinds for the duration of the maintenance period. If any plants become damaged or injured, they shall be treated or replaced as required.
 - 3. All plantings shall be thoroughly saturated at least twice per week during maintenance period.

3.8 REJECTION AND REPLACEMENT

- A. Promptly remove rejected plant material from site.
- B. Replace as soon as planting conditions permit with plants of same species and of the required quality.

3.9 TWO YEAR GURANTEE INSPECTION

- A. Two years after the date of acceptance, the Contractor shall, at the request of the Owner, conduct an inspection of the condition of the plantings. The Landscape Architect will provide a written report on the results of the inspection. The Contractor shall replace any dead or unhealthy plants at this time.
- B. The Contractor shall remove tree wraps and tree support systems on nursery-grown plants after one year.

END OF SECTION

SECTION 329220

SEEDING AND SODDING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This Section specifies requirements for topsoil, seeding, and sodding for site landscape areas.
- B. The work includes:
 - 1. Furnishing, spreading, and fine grading of topsoil and loam borrow
 - 2. Application of lime and fertilizers.
 - 3. Seeding, sodding, and mulching
 - 4. Maintenance of seeded and sodded areas.

1.2 RELATED SECTIONS

- A. Sections which directly relate to the work of this Section include:
 - 1. Section 312500 - EROSION AND SEDIMENTATION CONTROLS.
 - 2. Section 328400 – PLANTING IRRIGATION.
 - 3. Section 329000 – PLANTING.
 - 4. Geotechnical Report by Carlin Simpson & Associates.

1.3 SUBMITTALS

- A. Manufacturers Product Data
 - 1. Submit material specifications and installation instructions where applicable attesting that the following materials meet the requirements specified:
 - a. Fertilizer
 - b. Seed
 - c. Lime
 - d. Topsoil
 - e. Hydromulch
- B. Soil Test Reports

1. Prior to ordering the topsoil, submit soil test report to the Engineer for review and approval. Do not order materials until approval has been obtained. Delivered materials shall closely match the approved samples.

C. Certificates

1. A manufacturer's Certificate of Compliance to the specifications shall be submitted by the manufacturer's with each shipment of each type of seed. These certificates shall include the guaranteed percentages of purity, weed content, and germination of the seed; the net weight of seed; and date of shipment. No seed shall be sown until the Contractor has submitted these certificates.

D. Maintenance Manual

1. The Contractor shall submit a written manual prepared for the Owner that outlines a schedule for proper maintenance of the seeded and/or sodded lawns. This maintenance schedule should include timing and methods for mowing, watering, aeration, fertilization, liming, and other lawn maintenance operations.

E. Submittal Schedule

1. Before installation:
 - a. Manufacturer's product data for seed
 - b. Soil test reports
 - c. Seed certification
 - d. Seed mix
 - e. Engineered Wood Fiber Hydromulch
2. After installation and before acceptance
 - a. Maintenance Manual.

1.4 QUALITY ASSURANCE

- A. All work shall be performed by personnel experienced in lawn installation under the full-time supervision of a qualified foreman.
- B. Work shall be coordinated with all other trades on site.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver material to the site in original unopened packages, showing weight, manufacturer's name, and guaranteed analysis made available for site inspections.
- B. Store materials in a manner that their effectiveness and usability will not be diminished or destroyed. Materials shall be uniform in composition, dry, unfrozen, and free flowing. Any material which has become caked or otherwise damaged or which does not meet specified requirements will be rejected.

1.6 INSPECTION FOR ACCEPTANCE

A. Conditions of Acceptance

1. Acceptance shall be given for the entire portion of the lawn areas. No partial acceptance will be given.
2. Lawns shall exhibit a uniform, thick, well-developed stand of grass. Lawn areas shall have not bare spots in excess of four inches in diameter and bare spots shall comprise no more than 2% of the total area of the lawn.
3. Lawn areas shall not exhibit signs of damage from erosion, washouts, gullies, or other causes.
4. Pavement surfaces and site improvements adjacent to lawn areas shall be clean and shall be free of spills or overspray from placing or handling of topsoil and seeding operations.

B. Inspection and Acceptance

1. Upon written request of the Contractor, the Engineer will inspect all lawn areas to determine completion of work. This request must be submitted at least five days prior to the anticipated inspection date.
2. If the lawn areas are not acceptable, the Engineer will indicate corrective measures to be taken, and shall extend the maintenance period as necessary for the completion of the work. The Contractor shall request a second inspection of the lawns after corrective measures have been accomplished. This process shall be repeated until the total lawn area being inspected is acceptable.
3. When the lawn areas are acceptable, a meeting of the Contractor and Owner's Representative will be arranged to accept the lawn work. A final inspection will be a part of this meeting. At this meeting, the Contractor shall be furnished with a written acceptance of the lawn section being approved. The Contractor shall turn over maintenance of the lawn areas to the Owner at this meeting.
4. Following the acceptance of lawns, the Contractor shall provide the Owner with access to all lawn areas as required for the Owner's maintenance work.

C. Site Cleanup

1. The Contractor shall leave the site in a clean and neat condition. Final acceptance will not be granted until this condition is met.

PART 2 - PRODUCTS

2.1 SOILS

- A. Topsoil shall conform to the requirements of Section 310000 - EARTHWORK.
- B. Testing shall confirm that the topsoil, obtained from the site or loam from off-site, contains not less than 4% nor more than 20% organic matter as determined by the loss on ignition of oven-dried samples. Test samples shall be oven-dried to a constant weight at a temperature of 230 degrees F. (± 5 degrees F.) and certified test results shall be sent to the Engineer by the laboratory for approval.

2.2 SOIL CONDITIONING MATERIALS

- A. Lime: Lime shall be an approved agricultural dolomitic pelletized limestone containing no less than 50% total carbonates, and 25% total magnesium with a neutralizing value of at least 100%. The material shall be pelletized and not ground or fine-powdered form. The lime shall be uniform in composition, dry and free flowing, and shall be delivered to the site in the original, unopened containers, each bearing the manufacturer's guaranteed analysis. Any lime that becomes caked or otherwise damaged (making it unsuitable for use) will be rejected.
- B. Fertilizer: Fertilizer shall be a complete, standard product complying with state and federal fertilizer laws. The fertilizer shall be uniform in composition, dry and free flowing, and shall be delivered to the site in the original, unopened containers, each bearing the manufacturer's guaranteed analysis, and submitted to the Engineer for approval.
1. Fertilizer nutrient analysis, quantity, and application rate shall be determined by the soil lab test/analysis report, in which 50% of the nitrogenous elements shall be derived from water-insoluble organic nitrogen.
 2. Any fertilizer that becomes caked or otherwise damaged (making it unsuitable for use) will be rejected.
- C. Starter Fertilizer: Fertilizer nutrient analysis shall be in the ratio of 3:4:1, quantity and application rate per the soil lab recommendations. Application shall be for newly seeded lawns.
- D. Superphosphate: Superphosphate shall be composed of finely ground phosphate rock, as commonly used for agricultural purposes, and containing not less than 20% available phosphoric acid. Superphosphate shall be delivered to the site in the original, unopened containers, each bearing the manufacturer's guaranteed analysis and submitted to the Engineer for approval. Any superphosphate that becomes caked or otherwise damaged (making it unsuitable for use) will be rejected.

2.3 WATER

- A. Water shall be furnished by the Contractor, suitable for irrigation, and free from ingredients harmful to plant life. Hoses and other watering equipment required for the work shall be furnished by the Contractor.

2.4 SEED

- A. Lawn Seed: Seed shall be: fresh, clean, and selected from the previous year's crop; shall have a maximum weed seed content of 1%; shall comply with applicable federal and state seed laws; and shall be furnished and delivered premixed in unopened containers applied per the specified rate in the Planting Plans and in the following proportions:

	Percent Proportion	Percent Germination Minimum	Percent Purity Minimum
1. For Lawns: Turf-Type Tall Fescue (improved varieties)	100	90	99
2. For Field Grass:			
Creeping Red Fescue	60	90	95
Perennial Rye	25	90	95
Birdsfoot Trefoil	15	90	95
3. For Temporary Lawns:			
Annual Rye	60	90	95
Perennial Rye	40	90	95

B. Wild Flower Seed (if specified)

- Wild flower seed shall contain: Bachelor's Button, Chicory, Lance Leaved Coreopsis, Baby's Breath, Baby Snapdragon, Scarlet Flax, Lewis Flax, Evening Primrose, Corn Poppy and Catchfly, or other varieties as approved by the Engineer.
- Wild flower seed mix shall be as follows: 4 lbs. of wild flower seed shall be thoroughly mixed with 26 lbs. of Sheep Fescue (*Festuca ovina*) seed.
- Submit a certificate from the supplier outlining the type and percentage of wild flower plants in the mix.

2.5 SOD

- A.
- Composition
- : Nursery grown sod composed of grasses grown from the following seed mixture:

Grass Species	Proportion of Seed by Weight
Turf Type Tall Fescue Varieties	100%

- B.
- Characteristics
- : Sod shall be well-rooted turf, free from weeds, insect pests, and disease. Sod shall be machine-cut to a uniform soil thickness of 3/4 inch plus or minus, and to industry standard length and widths. Sod shall be harvested and replanted within 36 hours. Soil on sod pads shall be kept moist at all times.

2.6 MULCH

- A. Engineered Wood Fiber Hydromulch

- Mulch to cover hydroseeded areas shall be fiber-processed from engineered whole wood chips manufactured specifically for standard hydraulic mulching equipment. Fiber shall not be produced from recycled material such as sawdust, paper, or cardboard.

2. Moisture content shall not exceed 10%, plus or minus 3%, as defined by the pulp and paper industry standards. Fiber shall have a water holding capacity of not less than 900 grams of water per 100 grams fiber.
3. Mulch shall disperse into a uniform slurry when mixed with water. Mulch shall be nontoxic to plant life or animal life.
4. Mulch shall contain a non-petroleum based tackifier and a green dye for visual monitoring during application, but non-injurious to plant growth.
5. Mulch to be applied per manufacturer's application rate based on soil slope/gradient.

2.7 EROSION CONTROL MATTING FOR SLOPED AREAS

- A. Matting for erosion control shall be provided on all slopes of 1 foot rise to 2 feet and steeper and shall consist of undyed and unbleached smolder resistant jute yarn woven into a uniform, open, plain weave mesh. Jute matting shall be furnished in rolled strips and shall conform to the following:
 1. Width: 48 inches, plus or minus one inch.
 2. 78 warp ends per width of cloth.
 3. 41 weft ends per yard.
 4. Weight: To average between 1.22 lbs. and 1.80 lbs. per linear yard.
 5. Tolerance: plus or minus 5%
- B. Stakes for pegging erosion control matting shall be sound hardwood approximately 1 inch by 3 inches. Stakes shall be free from insects and fungi and capable of remaining intact in the ground for at least two years.

2.8 HYDROSEED MIX

- A. The Contractor shall submit a certified statement as to number of lbs. of fertilizer, amounts and types of grass seed, and hydromulch, per 100 gallons of water.

PART 3 - EXECUTION

3.1 SEED AND SOD BED PREPARATION

- A. Grade all lawn areas to finish grades as indicated on the Drawings. When no grades are shown, areas shall have a smooth and continual grade between existing or fixed controls and elevations shown on Drawings. Roll, scarify, and rake as required to obtain uniform, even lawn surfaces. All lawn areas shall slope to drain. Finish grades shall be approved by the Engineer.
- B. If no new topsoil is required, thoroughly loosen soil in areas to be seeded or sodded to a minimum depth of 6 inches with approved power or hand equipment. Remove rocks, debris, clods and other undesirable substances, and maintain grading and drainage patterns.
- C. When topsoil is required, place topsoil on previously scarified subsoil to a minimum depth of 6 inches. Subsoil shall be cleaned of debris and stones larger than 2 inches prior to topsoil spreading.

- D. Apply soil amendments: fertilizer, superphosphate, and/or lime, at rates recommended by the testing agency and approved by the Engineer. Thoroughly and evenly incorporate soil amendments into the soil to a depth of 3 inches by discing or other approved methods. In areas inaccessible to power equipment, fertilizer and lime shall be incorporated into the soil by manual methods. At existing trees, the depth shall be adjusted to avoid disturbance of the tree roots.
- E. Seeding and sodding shall be done immediately after final grading, provided the bed has remained in a good, friable condition, and has not become muddy or compacted. Any undulations or irregularities in the surface resulting from fertilizing, liming, tilling, or other causes, shall be regraded prior to seeding and sodding. The surface shall be free of stones, cleared of all trash, debris, roots, brush, wire, grade stakes, and other objects that would interfere with establishment of lawn and lawn maintenance operations.

3.2 HYDROSEED BED PREPARATION

- A. Prepare seed bed for hydroseeding the same as for seeding and sodding, but do not incorporate fertilizer into the top 3 inches of topsoil.
- B. Hydroseeding shall be applied with a spray machine designed for this purpose and approved by the Engineer.

3.3 SEEDING

- A. Seeding shall be done between April 1 to May 15, or between August 15 to October 15, except as otherwise authorized in writing by the Engineer.
- B. All disturbed areas not covered by buildings, paving, or otherwise developed, shall be seeded.
- C. Seeding shall not be done during windy or inclement weather.

3.4 MANUAL SEEDING

- A. Sow lawn seed uniformly with an approved mechanical seeder at the specified rate per planting plans. Culti-packer or approved similar equipment may be used to cover the seed and to form the seed bed in one operation. In areas inaccessible to the Culti-packer, the seeded ground shall be lightly raked with flexible rakes and rolled with a water ballast roller. Seeding shall be done in two directions at right angles to each other.
- B. In areas having slopes 3:1 or steeper, and in drainage swales, the Contractor shall carry out a separate overseeding operation immediately after sowing the specified seed mix. The overseeding shall be sown at the rate of 6 lbs. per 1,000 square feet. Seeded areas requiring additional erosion control, shall be covered with an approved, biodegradable erosion control fabric and the fabric firmly anchored in place.
- C. The wild flower seed mix, if specified, shall be applied uniformly over the designated area at a rate of 30 lbs. pure live seeds per acre. The seed shall be lightly raked to ensure proper soil-seed contact and kept damp until the plants have become established.

3.5 HYDROSEEDING

- A. Designated areas shall be hydroseeded only after written approval of the finished grading by the Engineer.
- B. Fertilizer shall be added to the hydroseeding slurry at the rate determined by the soil lab test analysis/report recommendations.

- C. Seed shall be added to the hydroseeding slurry at the rate consistent with the specified rate on the planting plans.
- D. Wood cellulose fiber mulch shall be added to the hydroseeding slurry at the rate per the manufacturer's recommendations for the soil type, slope, and application.
- E. A mobile tank with a capacity of at least 500 gallons shall be filled with water, and the required amounts of seed, wood cellulose mulch, and fertilizer. The slurry shall be thoroughly mixed by means of positive agitation in the tank. The slurry shall be applied by means of a centrifugal pump using the turret or hose application technique from the mobile tank. The hose or turret shall be equipped with a seeding nozzle of a proper design to ensure even distribution of the solution over the area to be seeded and shall be operated by a person thoroughly familiar with this type of seeding operation.

3.6 SODDING

- A. Before sod is laid, and after all grading is complete, the loam bed shall be lightly raked with a fine toothed harrow or hand rake. The loam bed shall be moist, but not wet, prior to laying the sod. Sod shall not be laid on soil that is dry and powdery.
- B. The first row of sod shall be laid in a straight line with subsequent rows placed parallel to, and tightly against, each other. Lateral joints shall be staggered to promote more uniform growth and strength. Care shall be exercised to ensure that the sod is not stretched or overlapped, and that all joints are butted tight to prevent voids. The Contractor shall rake sufficient screened loam into the sod to fill all small voids. All large voids shall be filled with sod plugs.
- C. Sod shall be laid with staggered joints and secured by bio-degradable pegs on slopes greater than 25%.
- D. Sod shall be placed from April 1 to June 1 and August 1 to October 31, provided that irrigation is provided in summer months and the ground is not frozen.
- E. Sod shall be harvested, delivered, and transplanted onto the site within a period of 36 hours.
- F. Sod shall be watered immediately, during and after installation, to a sufficient depth to thoroughly wet the underside of the new sod and the soil immediately below. The Contractor shall have adequate water available on the site prior to and during installation of sod.

3.7 MAINTENANCE AND PROTECTION

- A. Maintenance of seeded and sodded areas shall begin immediately after installation. Maintenance includes watering, weeding, mowing and edging, reseeding, replacement of dead sod, disease and insect pest control, repair of all erosion damage, and any other procedures consistent with good horticultural practice, required to ensure normal, vigorous, and healthy growth. Maintenance shall continue until final acceptance of the work.
- B. Maintenance shall also include all temporary protection fences, barriers, signs, and all other work incidental to proper maintenance.
- C. Scattered bare spots will be allowed up to a maximum of 2% of any lawn area, provided none are larger than 72 square inches. After the grass has sprouted, all bare areas shall be re-seeded or re-sodded repeatedly until all areas are covered with a satisfactory growth of grass. At the time of the first cutting, lawn should be mowed not less than 2-1/2 inches high. Sod shall be maintained between 1-3/4 and 2-1/2 inches high. Do not remove more than one-third of the grass blade. All lawns shall receive at least three mowings before acceptance.

- D. The seeded and sodded areas shall be maintained in a continuous moist condition, satisfactory for good germination and growth of grass until acceptance.
- E. Six weeks after the seeded/sodded areas have become established, soils shall be sampled and analyzed by the soil lab for pH and nutrients, and fertilized per soil lab analysis and recommended rates. If necessary, fertilizer shall be applied over the entire area.

END OF SECTION

SECTION 331000

WATER UTILITIES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This Section specifies requirements for the proposed water utilities including water system piping, fittings, appurtenances, and services.
- B. The work includes:
 - 1. Furnishing and installation of water distribution pipe, valves and valve boxes, hydrants, pipe fittings, anchors, thrust restraints, and required accessories and connections to existing water systems.
 - 2. Resetting existing hydrants and valve boxes to grade.
 - 3. Relocation of existing hydrants, valves, and other appurtenances as required.
 - 4. Furnishing and installing meter pit, backflow prevention assembly, pressure-reducing valves, and other related appurtenances.
 - 5. Disinfecting and testing of the water system.

1.2 RELATED SECTIONS

- A. Sections which directly relate to the work of this Section include:
 - 1. Section 033055 – CAST-IN-PLACE CONCRETE (SITE).
 - 2.
 - 3. Geotechnical Report prepared by Carlin Simpson & Associates.

1.3 STANDARDS

- A. AWWA – American Water Works Association.
- B. NFPA – National Fire Protection Association.

1.4 COORDINATION WITH THE MUNICIPALITY

- A. The municipal water department shall be notified prior to starting construction of any portion of the municipal water system.
- B. The closing of valves necessary for making connections with existing municipal system will be done by the local Water Department employees, assisted by the Contractor. Sufficient notice shall be given the Water Department of planned connection. No allowance will be made for any delay in closing of valves. A 48-hour notice shall be given to residents or businesses affected by the shut-down, and shall be done by the Contractor under the direction of the Engineer. The Water Department may require the work to be done at night during the low-water use time period.

- C. Contractor shall be responsible for furnishing and installing water pipes, fittings, valves, hydrants and other necessary equipment in accordance with the requirements of the municipal water and fire departments. Prior to ordering materials, the Contractor to obtain the latest copy of the municipal water department's standards and specifications and shall notify the Engineer immediately if any discrepancies are found between those requirements and the Contract Documents.

1.5 SUBMITTALS

A. Shop Drawings

- 1. Submit Shop Drawings or descriptive literature, or both, showing dimensions, joints, and other details of all materials to be furnished. Shop Drawings shall be submitted to the Engineer for approval prior to ordering materials.

B. As-Built Drawings

- 1. Submit three (3) copies of As-Built Drawings upon completion and acceptance of work.
- 2. As-Built Drawings shall be complete and shall indicate the true measurements and locations, horizontal and vertical of all new construction. As-Built Drawings shall include a minimum of three (3) ties to each gate valve box from fixed permanent objects. As-Built Drawings shall also contain any additional information required by the municipality, and shall be stamped with the seal of a licensed land surveyor and licensed professional engineer.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Storage of pipe, fittings, valves, hydrants and other water line appurtenances on the site shall be in accordance with the manufacturer's recommendations, subject to the approval of the Engineer.
- B. Care shall be taken in loading, transporting, and unloading of the water utilities materials to prevent injury to the pipe, fittings, valves, hydrants, and other water line appurtenances. Pipe, valves, or fittings shall not be dropped. All pipe or fittings shall be examined before laying and no piece shall be installed which is found to be defective. Any damage to pipe and fitting coatings shall be repaired as directed by the Engineer.
- C. Pipe, fittings, valves, hydrants, and other water system appurtenances which are defective from any cause, including damage caused by handling, and determined by the Engineer as unrepairable, shall not be used and shall be replaced at no cost to the Owner.
- D. Pipe and all water system appurtenances that are damaged or disturbed through any cause prior to acceptance of the work shall be repaired, realigned, or replaced as required by the Engineer at no additional cost to the Owner.

1.7 LICENSED FIRE PROTECTION SPRINKLER SYSTEM CONTRACTORS

- A. Fire protection and fire control systems, including both overhead and underground water mains, fire hydrants, and hydrant mains, [standpipes and hose connections to sprinkler systems, sprinkler tank heaters, back flow preventers, air lines and thermal systems, hot water fire protection systems and standpipes connected to sprinkler systems], shall be installed by contractors and personnel appropriately licensed. Shop drawings required for submittals and reviews by the Engineer, or other legally recognized professional (M.G.L. c.112, Par. 81R) by

780 CMR 903.1.2 or by applicable NFPA Standards shall note the name(s), license number(s) and license expiration date(s) of the contractor(s) installing the fire protection system.

PART 2 - PRODUCTS

2.1 GENERAL

- A. The Drawings are diagrammatic only and are intended to indicate the extent, but not all details, of the system which shall be constructed. All materials are not shown; but the Contractor shall furnish and install all materials required for the complete system.

2.2 DUCTILE IRON PIPE

- A. Ductile iron pipe shall be designed in accordance with ANSI A21.50/AWWA C150 and manufactured in accordance with ANSI A21.51/AWWA C151.
- B. Ductile iron pipe shall be Pressure Class 150 furnished in 18-foot or 20-foot nominal lengths.
- C. Pipes shall be cement-mortar lined in accordance with ANSI/AWWA C104/A21.4, except that the cement lining shall be double thickness.
- D. The exterior of all pipe shall be factory coated with a double coat of asphaltic material conforming to ANSI/AWWA C151/A21.51.
- E. Restrained joint assemblies for mechanical fittings shall be EBAA Iron Sales MEGALUG, or approved equivalent.
 - 1. Restrained joint pipe shall be American Ductile Iron Pipe Flex-Ring Restrained Joint Pipe 4 inches – 12 inches, manufactured of ductile iron, all in accordance with ANSI/AWWA C151/A21.51, Pressure Rating 350 psi, or approved equivalent.
 - 2. Restrained joint pipe shall be American Ductile Iron Lok Ring Joint 14 inches – 24 inches manufactured of Ductile Iron, all in accordance with ANSI/AWWA C151/A21.51, Pressure Class 350 for sizes 4 inches through 24 inches or Pressure Class 250 for sizes 30 inches through 54 inches, or:
 - 3. U.S. Pipe TR Flex restrained push-on joint pipe 4 inches – 54 inches, manufactured in accordance with the requirements of ANSI/AWWA C141 A21.51, pressure class 350 for sizes 4 inches through 24 inches and pressure class 250 for sizes 30 inches through 54 inches.
 - 4. U.S. Pipe Field Lok Gasket Instant Joint Restraint 4 inches – 24 inches, manufactured in accordance with the requirements of ANSI/AWWA C151/A21.51 for working pressure of 250 psi, or approved equivalent.

2.3 POLYVINYL CHLORIDE PIPE (PVC) PRESSURE PIPE (AWWA C900)

- A. Pipe and fittings for pressure systems shall be C900 polyvinyl chloride pipe (4-inch to 12-inch) as described in AWWA C900. The pipe shall be plain end or gasket bell end, Pressure Class 150 (DR 18) with cast-iron-pipe-equivalent outside diameter. Fittings shall be gray iron or ductile iron, AWWA C110/A21.10 or AWWA C153/A21.53, and have cement-mortar lining, AWWA C104/A21.4, standard thickness. Fittings with push-on joint ends shall conform to the same requirements as fittings with mechanical-joint ends, except that bell design shall be modified, as approved, for push-on joint suitable for use with PVC pipe.

- B. Joints: Joints for pipe shall be push-on joints conforming to ASTM D3139. Joints between pipe and metal fittings, valves, and other accessories shall be push-on joints ASTM D3139, or compression-type joints/mechanical joints, ASTM D 3139 and AWWA C111/A21.11. Provide each joint connection with an elastomeric gasket suitable for the bell or coupling with which it is to be used. Gaskets for push-on joints for pipe shall conform to ASTM F477. Gaskets for push-on joints and compression-type joints/mechanical joints for joint connections between pipe and metal fittings, valves, and other accessories shall conform to AWWA C111/A21.11 for push-on joints and mechanical joints.

2.4 DUCTILE IRON PIPE FITTINGS

- A. All ductile iron pipe fittings shall conform to ANSI/AWWA C110/A21.10 gray and ductile iron standard fittings or ANSI/AWWA C153/A21.53-84 ductile iron compact fittings 3 inch through 16 inch. The ductile iron compact fittings shall be marked in accordance with Sec. 53-11, which states that the fittings shall have distinctly cast on them the identity of this standard, C153; the pressure rating, 350 psi; nominal diameter of openings; manufacturer's identification; the country where cast; the letters "DI" or word "Ductile"; and the number of degrees or fraction of the circle on all bends.
- B. The type of fittings for pipe and valve connections shall be determined by the Contractor in accordance with the requirements shown on the Drawings prior to ordering the fittings.
- C. All fittings shall be cement-mortar lined and coated as specified for pipe.

2.5 DUCTILE IRON PIPE COUPLINGS

- A. Couplings and accessories shall be pressure rated at least equal to that of the pipe. Couplings shall be Dresser Style 253, Smith Blair 441 Style, or approved equivalent. The couplings shall be provided with corrosion resistant nuts and bolts.
- B. Transition couplings for joining pipe of different diameters shall be Dresser Style 162, or approved equivalent. Coupling shall be provided with corrosion resistant nuts and bolts.
- C. After assembly, all exterior surfaces including the bolts and nuts shall be completely coated with two coats of a heavy-duty protective asphaltic coating. The interior of the coupling shall be epoxy-coated. Epoxy coating shall conform to AWWA C550.

2.6 DUCTILE IRON PIPE JOINTS

- A. Joints shall be either push-on or mechanical joints conforming to ANSI A21.11/AWWA C111. Push-on and mechanical joints shall be provided with required gaskets, lubricants and accessories conforming to ANSI A21.11/AWWA C111.

2.7 POLYETHYLENE ENCASEMENT

- A. Polyethylene encasement shall be Class A polyethylene film, 8 mil thick, conforming to ANSI/AWWA C105/A21.5 for Polyethylene Encasement for Ductile-Iron Piping.
- B. Polyethylene encasement of ductile iron pipe shall be within the limits shown on the Drawings and shall be installed in accordance with ANSI/AWWA C105/A21.5.

2.8 GATE VALVES

- A. Gate valves shall be resilient seated conforming to the requirements of AWWA C509 or AWWA C515, solid wedge type valves conforming to the requirements of AWWA C500, of the type used by the municipal water department.
- B. Gate valves shall be cast iron body, bronze mounted, resilient wedge, non-rising stem with O-ring type stuffing box for valves 3 inches to 16 inches in size.
- C. Gate valves shall have mechanical joint, flanged ends.
- D. Bolts, studs, and nuts shall be made from a corrosion-resistant material such as low-zinc bronze, nickel copper alloy, or stainless steel.
- E. Operating nut shall be 2 inches square at the base, tapering to 1-15/16 inches square at the top.
- F. Post indicator valves, when indicated on the drawings, are used to actuate and indicate the opened or closed status of the installed valve and indicator posts. Post indicator valves shall be listed by Underwriter's Laboratories, Inc. (UL) and approved by Factory Mutual Research (FM) and shall be of a manufacturer approved by the local utility company.

2.9 BUTTERFLY VALVES

- A. Butterfly valves shall be pressure Class 150B mechanical joint end with ductile iron body conforming to ASTM A536, Grade 65-45-R and stainless steel body seat, all in accordance with ANSI/AWWA C504 Rubber-Seated Butterfly Valves.
- B. Valve disk shall be constructed of see Section 3.4.1, AWWA 504 options.
- C. Valve shaft shall be see Section 3.3.3.1, AWWA C504 options and shall be see Section 3.3.4, AWWA C504 for options.
- D. Valve seats shall be see Section 3.5.2.2., AWWA C504 options.
- E. Valve seat mating surfaces shall be see Section 3.5.3.1 and 3.5.3.2, AWWA C504 options.
- F. Valve actuator shall be see Section 3.8.5.5, AWWA C504 options, suitable for burial service.
- G. Butterfly valves shall be as manufactured by Clow, or approved equivalent.

2.10 VALVE BOXES

- A. Each gate valve shall be provided with a valve box and cover.
- B. Valve boxes shall be of the adjustable, telescoping, heavy-pattern type designed and constructed to prevent the direct transmission of traffic loads to the pipe or valve.
- C. Valve boxes shall be cast iron, asphalt coated with cast iron covers. The smallest inside diameter of the shaft shall not be less than 5-1/4 inches. The lower section of the box shall be designed to enclose the operating nut and stuffing box of the valve. Provisions shall be made for adjustment through at least 6-inches vertically while retaining a lap of at least 4 inches between sections.

- D. Covers shall be close fitting and substantially dirt-tight. The top of the cover shall be flush with the top of the box rim. The word WATER or other as required by municipality shall be cast in the top surface of the cover.

2.11 HYDRANTS

- A. Hydrants shall include:
 - 1. Make and Model: As required by the City of New Rochelle.
- B. Hydrant shall conform the requirements of ANSI/AWWA C502, latest issue.
- C. Bolts and nuts shall be made from a corrosion-resistant material see AWWA C502, 3.2.17, for options.
- D. Hydrants shall be given two coats of primer paint before shipment. Contractor shall field paint hydrants the color required by the municipality, after installation.

2.12 TAPPING SLEEVE AND VALVE

- A. Tapping sleeve and valve shall meet the requirements of AWWA and shall be of the bolted-sleeve type with a mechanical joint connection to the existing water pipe and flanged end outlets for connecting the tapping valves. The tapping sleeves shall be suitable for a working water pressure of 200 psi and outlet flanges shall conform to the 125-pound American Standard with Cor-Ten or cadmium plated cast iron nuts and bolts. The tapping sleeve and valve shall be as manufactured by Mueller Company, or approved equivalent.

2.13 THRUST RESTRAINTS

- A. Thrust restraints (cement concrete thrust blocks, clamps and tie rods, and restrained joints) shall be installed in accordance with the details shown on the Drawings and per manufacturer's recommendations.
- B. The Contractor shall discuss with the Engineer the method[s] to be used to restrain thrust prior to installing fittings and hydrant. Test pits may be required in areas of existing utilities to determine the exact location and dimensions of thrust restraints required.
- C. Concrete for thrust blocks shall have a minimum 28-day compressive strength of 3,000 psi.

2.14 CORPORATION STOPS AND CURB STOPS

- A. Corporation stops shall be Mueller 300 ball type corporation valves or equivalent with a compression-type fitting, on the outlet end. The inlet end should be threaded per local water department requirements.
- B. Curb stops shall be Mueller 300 ball valve curb stop or approved equivalent, with compression-type fittings, on both ends.
- C. Stops shall be sized to receive the service tubing without the use of enlargement/reduction fittings.

2.15 SERVICE BOXES

- A. Service boxes shall be cast iron improved extension type with arch pattern base. Covers shall be held in place with bronze bolts and the word WATER shall be cast into the top surface of the

cover. Service box shafts shall have a minimum inside diameter of 2-1/2 inches. Service boxes shall be as manufactured by Mueller Co., or approved equivalent.

2.16 WATER SERVICE

- A. Services two inches or smaller shall be ASTM B88 copper water tubing, Type K, for underground water service and shall be in accordance with ANSI/AWWA C800.
- B. Water service fittings including couplings and adapters, check valves and service saddles shall be in conformance with ANSI/AWWA C800, Underground Service Line Valves and Fittings. Joints in copper tubing shall be made with three part compression couplings or an approved equal.
- C. Services 3 inches and greater shall be ductile iron pipe in accordance with Section 2.02 above.
- D. Services less than 3 inches that are installed with plastic pipe where the utility allows, shall be polyethylene plastic tubing, SDR 9, PE3408 rated for 200 psi at 73.4°F in accordance with ASTM D2737. The outside diameter shall be the same as copper tubing (CTS). Stainless steel inserts shall be used at all connections.

2.17 UNDERGROUND PIPE INSTALLATION

- A. Whenever called for on the Drawings, or required for close clearance on structures, provide factory pre-insulated piping systems.
- B. Casing pipe shall be PVC, ASTM D1784.
- C. Insulation shall be polyurethane closed-cell foam completely encapsulated on each pipe segment by a heat resistant compressed rubber seal.
- D. Manufacturer shall be Thermal Pipe Systems, 'Duc-Tite' for use with ductile iron water pipe.

2.18 METER PITS/VAULTS

- A. As required by local water district.

2.19 BACKFLOW PREVENTERS

- A. As required by Westchester County Department of Health and SUEZ. See MEP plans and specifications.

2.20 PRESSURE REDUCING VALVES AND AIR/VACUUM RELEASE VALVES

- A. Not required.

2.21 METERS

- A. As required by SUEZ, see MEP plans and specifications.

PART 3 - EXECUTION

3.1 GENERAL

- A. All water pipes, fittings, valves, hydrants, and other appurtenances shall be installed at the locations as shown on the Drawings.
 - 1. The proposed location and vertical alignment may be altered to avoid conflicts with existing and proposed utilities, as approved by the Engineer.
- B. Contractor shall verify the location, size, invert and type of existing pipes at all points of connection prior to ordering new utility materials.

3.2 LAYING DUCTILE IRON PIPE AND FITTINGS

- A. Ductile iron pipe and fittings shall be installed in accordance with the requirements of ANSI/AWWA C600.
- B. Each length of pipe shall be laid with firm, full and even bearing throughout its entire length, in a trench prepared and maintained in accordance with Section 310000 – EARTHWORK. The type of materials to be used in bedding and backfilling and method of placement shall conform to the requirements of Section 310000 – EARTHWORK.
- C. All pipe shall be clean before laying. When laying is stopped for any reason, the open ends of the pipe shall be closed by watertight plugs or other approved means. If water is in the trench when work is resumed, the plug shall not be removed until the trench has been dewatered and all danger of water entering the pipe has been eliminated.
- D. Fittings, in addition to those shown on the Drawings, shall be provided if required to avoid utility conflicts.
- E. When cutting of pipe is required, the cutting shall be done by machine, leaving a smooth cut at right angles to the axis of the pipe. Cut ends of pipe to be used with a push-on bell shall be beveled to conform to the manufactured spigot end. Cement lining shall be undamaged.
- F. Maximum allowable deflection for pipe laid without fittings shall not exceed the allowable amount established by the pipe manufacturer and shall not exceed those shown in AWWA C600.
- G. The pipe shall be laid with a minimum cover of 4 feet 6 inches below finished grade.
- H. All piping shall be laid in the dry with the spigot ends pointing in the direction of flow. Installation shall proceed from the downstream to upstream in all cases.

3.3 JOINTING DUCTILE IRON PIPE (PUSH-ON TYPE)

- A. Push-on joints shall be made in strict accordance with the manufacturer's instructions. A rubber gasket shall be inserted in the groove of the bell end of the pipe and the joint surface cleaned and lubricated using the pipe manufacturer's suggested methods and materials. The plain end of the pipe to be laid shall be inserted in alignment with the bell of the pipe to which it is to be jointed and pushed home with a jack or by other means. After joining the pipe, a metal feeler gauge shall be used to make certain that the rubber gasket is correctly located and has not been twisted or otherwise displaced.

3.4 JOINTING MECHANICAL JOINT PIPE AND FITTINGS

- A. Mechanical joints shall be made in strict accordance with the manufacturer's instructions. Mechanical joints shall be made by first cleaning the surfaces against which the gaskets will come in contact with a wire brush. The gasket, bell, and spigot shall be lubricated by washing with soapy water just prior to assembling the joint. After the nuts have been made up finger tight, the bottom nut, then top and then diametrically opposite nuts shall be progressively tightened. Bolts shall be tightened to the torques listed:

Bolt Size [Inches]	Range of Torque [Feet-Pounds]
5/8 inch	45 - 60
3/4 inch	75 - 90
1 inch	85 - 100

- Under no conditions shall extension wrenches or a pipe over the handle of an ordinary ratchet wrench be used to secure greater leverage. After installation, a heavy bitumastic coating shall be applied to all bolts and nuts.
- Restraining device shall be ductile iron and shall have dimensions such that it can be used with the standardized mechanical joint bell and tee-head bolts conforming to ANSI/AWWA A21.11 and ANSI/AWWA C153, latest revision.

3.5 LAYING OF PVC WATER PIPE

- A. Installation of PVC Plastic Water Main Pipe and Associated Fittings: Unless otherwise specified, install pipe and fittings in accordance with Section 3.01 entitled "General"; and with the recommendations for pipe joint assembly and appurtenance installation in AWWA M23, Chapter 7, "Installation."
- B. Jointing: Make push-on joints with the elastomeric gaskets specified for this type joint, using either elastomeric-gasket bell-end pipe or elastomeric-gasket couplings. For pipe-to- pipe push-on joint connections, use only pipe with push-on joint ends having factory-made bevel; for push-on joint connections to metal fittings, valves, and other accessories, cut spigot end of pipe off square and re-bevel pipe end to a bevel approximately the same as that on ductile iron pipe used for the same type of joint. Use an approved lubricant recommended by the pipe manufacturer for push-on joints. Assemble push-on joints for pipe-to-pipe joint connections in accordance with the recommendations in AWWA M23, Chapter 7, "Installation," for pipe joint assembly. Assemble push-on joints for connection to fittings, valves, and other accessories in accordance with the applicable requirements of AWWA C600 for joint assembly. Make compression-type joints/mechanical joints with the gaskets, glands, bolts, nuts, and internal stiffeners previously specified for this type joint; assemble in accordance with the applicable requirements of AWWA C600 for joint assembly, and with the recommendations of Appendix A of AWWA C111/A21.11. Cut off spigot end of pipe for compression-type joint/mechanical-joint connections and do not re-bevel. Assemble joints made with sleeve-type mechanical couplings in accordance with the recommendations of the coupling manufacturer using internal stiffeners as previously specified for compression-type joints.
- C. Pipe Anchorage: Provide concrete thrust blocks for pipe anchorage, except where metal harness is indicated. Use concrete, ASTM C94, having a minimum 28 day compressive strength of 3,000 psi.

3.6 CONCRETE THRUST BLOCKS

- A. Where pipes change horizontal and vertical direction, at hydrants, tees, and other fittings, and wherever abnormal thrust forces may developed, the Contractor shall construct thrust and anchor blocks as detailed on the Drawings. They shall be concrete, of minimum dimensions as detailed on the Drawings, or of adequate additional size to suit actual conditions to withstand pressures anticipated, and shall be founded in undisturbed soil.
- B. Concrete for thrust blocks shall have a minimum 28 day compressive strength of 3,000 psi.
- C. Fittings which do not use thrust blocks resting against natural occurring material with passive resistance pressure of 1,500 psf shall be installed with a restrained joint system as specified in Article 3.07.

3.7 RESTRAINED JOINTS

- A. Pipe with restrained joints shall be installed in all areas where the pipe is within fill materials and also at locations shown on the Drawings. Restrained joints shall be installed at bends, reducers, tees, valves, dead ends, and hydrants. The minimum length of pipe to be restrained on either side of the joint shall be as shown on the table below. The fittings of the new piping shall be for restrained joints, as marked on the Drawings.

1. Number of Joints to Restrain on either Side of Fitting

<u>Fitting</u>	<u>Number of Joints to Restrain on Either Side of Fitting [Based on 18-Foot Pipe Length]</u>
90 degree bend	3
45 degree bend	2
22-1/2 degree bend	2
Tee:	
Branch	3
Run	2

- B. No restraining is required in the direction of the existing pipe if only a short length of it is exposed in the trench for making a connection.
- C. Restrained joint assemblies for push-on pipe and fittings shall be made in strict accordance with the manufacturer's recommended installation procedures.
- D. Restrained joint assemblies for mechanical joint pipe shall be EBAA Iron Sales MEGALUG, or approved equivalent.

3.8 WATER/SEWER SEPERATION

- A. When a sewer pipe crosses above or below a water pipe, the Contractor shall comply with these following procedures:
 - 1. Relation to Water Mains
 - a. *Horizontal Separation:* Whenever possible sewers shall be laid at a minimum at least 10 feet, horizontally, from any existing or proposed water main. Should local conditions prevent a lateral separation of 10 feet, a sewer may be laid closer than 10 feet to a water main if:
 - 1) It is laid in a separate trench, or if;

- 2) It is laid in the same trench with the water mains located at one side on a bench of undisturbed earth, and if;
 - 3) In either case, the elevations of the top (crown) of the sewer is at least 18 inches below the bottom (invert) of the water main.
- b. *Vertical Separation:* Whenever sewers must cross under water mains, the sewer shall be laid at such an elevation that the top of the sewer is at least 18 inches below the bottom of the water main. When the elevation of the sewer cannot be varied to meet the above requirements, the water main shall be relocated to provide this separation or reconstructed with mechanical-joint pipe for a distance of 10 feet on each side of the sewer. One full length of water main should be centered over the sewer so that both joints will be as far from the sewer as possible.
- c. When it is impossible to obtain horizontal and/or vertical separation as stipulated above, both the water main and sewer shall be constructed of mechanical-joint cement lined ductile iron pipe or other equivalent based on watertightness and structural soundness. Both pipes shall be pressure tested by an approved method to assure watertightness or both pipes shall be encased in concrete.

3.9 GATE VALVES AND BOXES

- A. Valves shall be set in firmly compacted and shaped soil. Where the soil in the trench subgrade is found to be soft, loose, freshly filled earth, unstable, or otherwise unsuitable as a base, the unsuitable material shall be excavated to such additional depth and width as required. The excavated area shall be backfilled with gravel or crushed stone, compacted, and shaped.
- B. Valve boxes shall be set centered and plumb over the operating nuts of all valves. The top of each valve box shall be set to finished grade with at least 10 inches of overlap remaining between the upper sections for vertical adjustment. Minimum overlap for lower extension pieces shall be 4 inches.
- C. Boxes shall be adequately supported during backfilling to maintain vertical alignment.

3.10 TAPPING SLEEVES AND GATE VALVES

- A. Installation shall be made under pressure and the flow of water through the existing pipe shall be maintained at all times. The diameter of the tap shall be a minimum of 1/4 inch less than the inside diameter of the branch line.
- B. The entire operation shall be conducted by workmen thoroughly experienced in the installation of tapping sleeves and valves, and under supervision of qualified personnel furnished by the manufacturer. The tapping machine shall be furnished by the Contractor.
- C. The Contractor shall determine the location of the existing pipe to be tapped to confirm that interference will not be encountered from existing utilities or a joint or a fitting. No tap shall be made closer than 3 feet from a pipe joint.
- D. Pipe upon which tapping sleeve is to be installed shall be thoroughly cleaned of all foreign matter with scraping tools and wire brushes to a minimum of six inches beyond each side of the sleeve. The cleaned area shall be washed with a hypochlorite solution. The interior of tapping valve shall also be washed with hypochlorite solution.

- E. Tapping sleeves and valves with boxes shall be set vertically and squarely centered on the pipe to be tapped. Adequate support shall be provided under the sleeve and valve during the tapping operation. Thrust blocks shall be provided behind all tapping sleeves. The supporting earth around and under the valve and sleeve shall be compacted. After completing the tap, the valve shall be flushed to ensure that the valve set is clean.
- F. Before backfilling, all exposed portions of any bolts used to hold the two halves of the sleeve together shall be heavily coated with two coats of bituminous paint equivalent to Bitumastic No. 50, by Koppers Company, Inc.

3.11 HYDRANTS

- A. Hydrants shall be installed at the locations and in conformance with the details shown on the Drawings.
- B. Each hydrant shall be set vertically and be properly braced. Hydrants shall be installed with thrust blocks or restrained joints as specified in Articles 3.05 and 3.06. Care shall be taken to ensure that thrust block concrete does not plug the hydrant's drain ports.

3.12 WATER SERVICES

- A. Service Pipe: Care shall be exercised in placing and laying of services to prevent kinks or sharp bends and to prevent contact with sharp stones or ledge which would damage to the pipe. At least 6 inches of sand shall be placed adjacent to, under, and above the pipe, and no stone larger than 2 inches shall be placed over the pipe until the depth of backfill above the pipe is in excess of 1 foot.
- B. Corporation Stop: Taps to the pipe shall be threaded and shall be made at the horizontal diameter of the main. The tap shall be made by means of a tapping machine manufactured for this purpose and supplied by the Contractor. The tap and drill shall be kept sharp and shall have threads matching those of the stop. Corporation stop threads shall be coated with sealing compound and the stop screwed firmly into the water with the key upward and the inlet end projecting at least 1/8 inch beyond the inside face of the pipe. Corporation stop shall be left in the on open position after installation of the service pipe.
- C. Curb Stop and Curb Boxes: Curb stop and curb boxes shall be of a size equal to the size of the service pipe and shall be installed in the locations shown on the Drawings or as ordered by the Engineer. The boxes shall be set in a vertical position and flush with the proposed finish grade.
- D. Ductile Iron Service Pipe: Ductile iron service pipe connections to the water pipe shall be made with tee fittings or tapping sleeves.

3.13 SEPERATION FROM STRUCTURES

- A. Whenever possible, water pipes shall maintain a minimum distance of three (3) feet from underground adjacent unheated structures, such as manholes, catch basins, retaining walls, bridge abutments, parking garages, etc.
- B. When spacing under 3.13A. above is not possible, Contractor shall provide insulated water pipe for a minimum of three (3) feet beyond the limits of the adjacent structure.

3.14 POLYETHYLENE ENCASEMENT

- A. Installation of polyethylene encasement shall be in accordance with the recommended procedures contained in ANSI/AWWA A21.5/C105.

- B. Care shall be taken during backfilling to prevent damage to polyethylene wrap. Backfilling shall be in accordance with AWWA C600.

3.15 PRESSURE TESTING

- A. Hydrostatic and leakage test shall be conducted in accordance with AWWA Standard C600, and NFPA 24, Standards, except it shall meet the leakage rates stated in 3.15D. below as directed by the Engineer. Testing shall be conducted by a certified independent water testing company.
- B. Conduct pipe tests after concrete thrust blocks have cured to the required minimum 28 day compressive strength of 3,000 psi. Fill pipe 24 hours prior to testing, and apply test pressure to stabilize system. Use only potable water.
- C. Prior to pressure testing, the entire pipe section shall be flushed to remove any rocks or debris which may have inadvertently entered the pipe during construction.
- D. Once the pipe section has been filled at normal pressure and all entrapped air removed, the Contractor shall raise the pressure to 200 psi or two times the operating pressure (whichever is greater) by a special pressure pump, taking water from a small tank of proper dimensions for satisfactorily measuring the rate of water pumped into the pipe. This pressure shall be maintained for a minimum of two hours, during which time the line shall be checked for leaks. Measured rate of water leakage shall not exceed the allowable leakage as follows:
 - 1. Domestic water service pipes only, without attached fire service supply: Meet latest edition of AWWA C600 series leakage requirements for the type of pipe being installed.
 - 2. Fire protection piping and domestic water service pipe with attached fire service piping: Meet latest edition of NFPA 24 leakage requirements or latest edition of AWWA C600 series leakage requirements for the type of pipe being installed, whichever criteria is more stringent.
 - 3. Interior piping in vaults, buildings, etc. shall have zero leakage.
 - 4. Should leakage exceed the above rates, the Contractor shall immediately locate the leak or leaks and repair them. Pipe will be accepted only when leakage is zero, or less than the allowable amount. Approval does not absolve the Contractor from responsibility if leaks develop later within the period of warranty.

3.16 DISINFECTION

- A. Before being placed in service, all new water pipe shall be chlorinated in accordance with ANSI/AWWA C651 Standard for Disinfecting Water Mains.
- B. The location of the chlorination and sampling points will be determined by the Engineer in the field. Taps for chlorination and sampling shall be installed by the Contractor. The Contractor shall uncover and backfill the taps as required.
- C. The pipe section being disinfected shall be flushed to remove discolored water and sediment from the pipe. A 25 mg/l chlorine solution in approved dosages shall be inserted through a tap at one end while water is being withdrawn at the other end of the pipe section. The chlorine concentration in the water in the pipe shall be maintained at a minimum 25 mg/l available chlorine during filling. To assure that this concentration is maintained, the chlorine residual shall be measured at regular intervals in accordance with procedures described in Standard Methods and AWWA M12, Simplified Procedure for Water Examination, Section K.

- D. During the application of the chlorine, valves shall be manipulated to prevent the treatment dosage from flowing back into the pipe supplying the water. Chlorine application shall not cease until the entire pipe section is filled with chlorine solution. The chlorinated water shall be retained in the pipe for at least a twenty-four hour period. The treated water shall contain a chlorine residual throughout the length of the pipe section as indicated in AWWA C651.
- E. Following the chlorination period, all treated water shall be flushed from the pipe section and replaced with water from the distribution system. Prior to disposal of treated water, the Contractor shall check with local authorities to determine if the discharge will cause damage to the receiving body or sewer and, if required, the Contractor shall neutralize the chlorinated water in accordance with Appendix B, AWWA C650. Bacteriological sampling and analysis of the replacement water shall then be made by the Contractor in full accordance with AWWA Specification C651. A minimum of three samples shall be taken by the Contractor at locations directed by the Engineer along the length of water pipe being chlorinated and sent to a state-approved private laboratory for analyses. The Contractor shall rechlorine if the samples show presence of coliform, and the pipe section shall not be placed in service until all of the repeat samples show no presence of coliform.
- F. Furnish two (2) copies of a Certificate of Disinfection Report to the Engineer.
- G. The Contractor shall pay all costs for all testing, flushing, chlorinating; laboratory analyses, sampling, water supply, and municipal charges.

END OF SECTION

SECTION 333900

SANITARY UTILITY SEWERAGE STRUCTURES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This Section specifies requirements for sanitary utility sewerage structures for a gravity flow sewerage system.
- B. The work includes furnishing and installing all pipe, fittings manholes, structures and appurtenances required for the proposed system to convey sewage by gravity flow conditions.
- C. Work and materials shall be performed in accordance with the State Plumbing Code.

1.2 RELATED SECTIONS

- A. Sections which directly relate to the work of this Section include:
 - 1. Section 033055 – CAST-IN-PLACE CONCRETE (SITE).
 - 2. Section 312319 - DEWATERING.
 - 3. Section 334000 - STORM DRAINAGE UTILITIES.
 - 4. Geotechnical Report prepared by Carlin Simpson & Associates.

1.3 SUBMITTALS

- A. Materials List and Shop Drawings
 - 1. Materials list of materials proposed.
 - 2. Shop drawings for all material and structures prior to ordering materials.
- B. As-Built Drawings
 - 1. Submit three (3) copies of As-Built Drawings upon completion and acceptance of work.
 - 2. As-Built Drawings shall be complete and shall indicate the true measurement and location, horizontal and vertical, of all new construction. As-Built Drawings shall include a minimum of three (3) ties to each manhole from fixed permanent objects. As-Built Drawings shall also contain any additional information required by the municipality and shall be stamped with the seal of a licensed land surveyor and licensed professional engineer.

1.4 INSPECTION

- A. The manufacturer/supplier is responsible for the provisions and all test requirements specified in ASTM D3034 for SDR 35 gravity pipe and ASTM D2241 for PVC pressure rated sewer pipe. In addition, all PVC pipe may be inspected at the plant for compliance with these specifications by

an independent testing laboratory selected and paid by the Owner. The Contractor shall require the manufacturer's cooperation in these inspections.

- B. Inspection of the pipe may also be made after delivery. The pipe shall be subject to rejection at any time on account of failure to meet any of the specification requirements, even though pipe samples may have been accepted as satisfactory at the place of manufacture. Pipe rejected after delivery shall be marked for identification and shall be removed from the site at once.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. All materials shall be adequately protected from damage during transit. Pipes shall not be dropped.
- B. All pipe and other appurtenances shall be inspected before placement in the work and any found to be defective from any cause, including damage caused by handling, and determined by the Engineer to be unrepairable, shall be replaced at no cost to the Owner.
- C. Storage and handling of pipes, manholes and other sewer system appurtenances shall be in accordance with the manufacturer's recommendations, subject to the approval of the Engineer.

PART 2 - PRODUCTS

2.1 POLYVINYL CHLORIDE PIPE (PVC)

- A. Pipe and Fittings: Polyvinyl chloride pipe and fittings (4 inches to 15 inches) shall be Type PSM polyvinyl chloride (PVC) SDR 35 with full diameter dimensions conforming to the specifications for Type PSM Polyvinyl Chloride (PVC) Sewer Pipe and Fittings, ASTM D3034.
- B. Joints: PVC pipe shall have an integral wall bell and spigot push-on joint with elastomeric gaskets secured in place in the bell of the pipe. The bell shall consist of an integral wall section with a solid cross section elastomeric gasket, factory assembled, securely locked in place to prevent displacement during assembly. Elastomeric gaskets shall conform to ASTM D3212.
- C. Spigot pipe ends shall be supplied with bevels from the manufacturer to ensure proper insertion. Each spigot end shall have an "assembly stripe" imprinted thereon to which the bell end of the mated pipe will extend upon proper joining of the two pipes.

2.2 DUCTILE IRON PIPE (GRAVITY)

- A. Ductile Iron Pipe: ASTM A746, Extra Heavy type, bell and spigot end, with epoxy lining per manufacturer's recommendation.
- B. Ductile Iron Pipe Joint: ANSI A21.11, rubber gasket joint.

2.3 CAST IRON PIPE

- A. Cast Iron Soil Pipe: ANSI/ASTM A74, Extra Heavy type, bell and spigot end, inside to be asphalt coated per manufacturer standard.
- B. Cast Iron Pipe Joint: ASTM C564, rubber gasket joint devices.

2.4 MANHOLES

- A. Precast Concrete Units:

1. Structure: 4 foot minimum inside diameter precast concrete units (4,000 psi minimum compressive strength) with eccentric cone section tapering to 30-inch diameter, or flat top, and one pour monolithic base section conforming to ASTM C478. All units to be designed for HS-20 loading.
2. Precast Unit Joint: Preformed butyl rubber section joint conforming to ASTM C990.
3. The date of manufacture and the name or trademark of the manufacturer shall be clearly marked on the inside of each precast section.

B. Masonry Units:

1. Brick shall conform to ASTM C32, Grade SM for construction of inverts and adjusting manholes to grade.
2. Concrete block shall be solid block and conforming to ASTM C139.
3. Mortar shall be in conformance with ASTM C270, Type M. The mortar shall be composed of Portland cement hydrated lime, and sand, in the proportions of 1 part cement to 1/4 part hydrated lime, to 3-1/2 parts sand, by volume.
4. Cement shall be Type I or II Portland cement conforming to ASTM C150. Where masonry is exposed to salt water, Type II shall be used.
5. Hydrated lime shall be Type S conforming to ASTM C207.
6. Sand for masonry mortar shall conform to the gradation requirements of ASTM C144.

- C. Manhole Frame and Cover: Grey iron casting conforming to ASTM A48, heavy duty, with the word SEWER embossed on cover. Letter size shall be three inches. Frame and cover shall be East Jordan Iron Works 2008Z/2006A or approved equivalent, with a minimum clear opening of 30 inches.

- D. Pipe Connections: Flexible sleeve or rubber gaskets shall be Lock Joint, Kor-n-Seal, A-Lok or approved equivalent.

- E. Steps: Steps for steel reinforced copolymer polypropylene step with at least a 14-inch wide stepping surface conforming to ASTM C478.

2.5 GREASE TRAP

A. Precast Unit

1. Grease traps shall be made of precast concrete of the capacity and dimensions shown on the Drawings and as manufactured by Scituate Precast, or approved equivalent.
2. Precast sections shall be cured by an approved ASTM method and shall not be shipped nor subject to loading until the concrete compressive strength has attained 5,000 psi. Portland cement shall be Type II, ASTM C150.
3. Precast units shall be designed for the following loads and possible combinations thereof:
 - a. H-20 loading, manhole riser with frame and cones, plus the weight of soil above.
 - b. Weight of precast concrete structure.

c. Initial handling and erection loadings.

B. Precast Unit Joints: Butyl rubber section joint conforming to ASTM C990.

C. Manhole riser sections, manhole steps, frames and covers shall be as specified in Section 2.04.

2.6 BITUMASTIC COATINGS

A. The entire exterior surface of all masonry and concrete (whether precast or cast-in-place) structures associated with sewerage systems, such as manholes, grease traps, holding tanks, tight tanks, septic tanks, aeration tanks, pump stations, valve pits, etc., shall receive two coats of waterproofing such as Carboline Bitumastic 300M as manufactured by Carboline Company, St. Louis, MO 63144-1599, Sonoshield HLM 5000 as manufactured by Degussa Building Systems, Shakopee, MN 55379, applied at a minimum thickness of 7 mils per coat and a total thickness of 14 mils, however in no case shall the thickness per coat be less than that recommended by the manufacturer.

PART 3 - EXECUTION

3.1 EXCAVATION AND BACKFILLING

A. The type of materials to be used in bedding and backfilling and the method of placement shall conform to the requirements of Section 310000, EARTHWORK and the details shown on the Drawings.

3.2 PIPE INSTALLATION

A. All sewer pipe shall be laid accurately to the lines and grades shown in the Drawings and in conformance with pipe manufacturer's recommended procedures.

B. Notch under pipe bells and joints, where applicable, to provide for uniform bearing under entire length of pipe.

C. Laying Pipe: Each length of pipe shall be laid with firm, full and even bearing throughout its entire length, in a prepared trench. Pipe shall be laid with bells upgrade unless otherwise approved by the Engineer. Do not permanently support pipes on bells.

1. Every length of pipe shall be inspected and cleaned of all dirt and debris before being laid. The interior of the pipe and the jointing seal shall be free from sand, dirt and trash. Extreme care shall be taken to keep the bells of the pipe free from dirt and rocks so that joints may be properly lubricated and assembled. No pipe shall be trimmed or chipped to fit.

2. No length of pipe shall be laid until the proceeding lengths of pipe have been thoroughly embedded in place, to prevent movement or disturbance of the pipe alignment.

3. All piping shall be laid in the dry with the spigot ends pointing in the direction of flow. Installation shall proceed from the downstream to upstream in all cases.

D. Pipe Extension: Where an existing pipe is to be extended, the same type of pipe shall be used, unless otherwise approved by the Engineer.

- E. Full Lengths of Pipe: Only full lengths of pipe shall be used in the installation except that partial lengths of pipe may be used at the entrance to structures, and to accommodate the required locations of service connection fittings.
- F. Pipe Entrances to Structures: All pipe entering structures shall be cut flush with the inside face of the structure, and the cut ends of the pipe surface within the structure shall be properly rounded and finished so that there will be no protrusion, ragged edges, or imperfections that will impede or affect the hydraulic characteristics of the sewage flow. The method of cutting and finishing shall be subject to the approval of the Engineer.
- G. Protection During Construction: The Contractor shall protect the installation at all times during construction, and movement of construction equipment, vehicles and loads over and adjacent to any pipe shall be performed at the Contractor's risk.
1. At all times when pipe laying is not in progress, all open ends of pipes shall be closed by approved temporary water-tight plugs. If water is in the trench when work is resumed, the plug shall not be removed until the trench has been dewatered and all danger of water entering the pipe has been eliminated.
- H. Water Pipe - Sewer Pipe Separation: When a sewer pipe crosses above or below a water pipe, the Contractor shall comply with the following procedures:
1. Relation to Water Mains
- a. *Horizontal Separation*: Whenever possible sewers shall be laid at a minimum at least 10 feet, horizontally, from any existing or proposed water main. Should local conditions prevent a lateral separation of 10 feet, a sewer may be laid closer than 10 feet to a water main if:
- 1) it is laid in a separate trench, or if
- 2) it is laid in the same trench with the water mains located at one side on a bench of undistributed earth, and if
- 3) in either case the elevation of the top (crown) of the sewer is at least 18 inches below the bottom (invert) of the water main.
- b. *Vertical Separation*: Whenever sewers must cross under water mains, the sewer shall be laid at such an elevation that the top of the sewer is at least 18 inches below the bottom of the water main. When the elevation of the sewer cannot be varied to meet the above requirements, the water main shall be relocated to provide this separation or reconstructed with mechanical-joint pipe for a distance of 10 feet on each side of the sewer. One full length of water main should be centered over the sewer so that both joints will be as far from the sewer as possible.
- c. When it is impossible to obtain horizontal and/or vertical separation as stipulated above, both the water main and sewer shall be constructed of mechanical-joint cement lined ductile iron pipe or other equivalent based on watertightness and structural soundness. Both pipes shall be pressure tested by an approved method to assure watertightness or both pipes shall be encased in concrete.
- I. Sewer Pipes-Laser Installation: Sewer pipes shall be laid to required grades by use of a laser and target system, unless otherwise specifically approved in writing by Engineer.

3.3 PIPE JOINTS

- A. All joints shall be made water-tight.
- B. Pipe shall be jointed in strict accordance with the pipe manufacturer's instruction. Jointing of all pipe shall be done entirely in the trench.
 - 1. Lubricant for jointing of PVC pipe shall be applied as specified by the pipe manufacturer. Use only lubricant supplied by the pipe manufacturer.
 - 2. PVC pipe shall be pushed home by hand or with the use of bar and block. The use of power equipment, such as a backhoe bucket, shall only be used at the direction of the manufacturer.
 - 3. Field-cut pipe ends shall be cut square and the pipe surface beveled to the size and shape of a factory-finished beveled end. All sharp edges shall be rounded off.
- C. Jointing of ductile iron and cast iron pipe shall be in accordance with Section 331000, WATER UTILITIES.
- D. Jointing of concrete pipe and reinforced concrete pipe shall be in accordance with Section 334000, STORM DRAINAGE UTILITIES.

3.4 MANHOLES

- A. General Requirements: All manholes shall be built in accordance with the Details and in the locations shown on the Drawings.
 - 1. Structures shall be constructed of brick masonry, precast solid concrete block, cast-in-place concrete, or precast concrete.
 - 2. All masonry shall be installed by personnel experienced and skilled in this work, and any person not deemed to be such by the Engineer shall be removed and replaced by a person so qualified.
 - 3. Manholes shall be constructed as soon as the pipe laying reaches the location of the manhole. Should the Contractor continue pipe laying without making provision for completion of the manhole, the Engineer shall have the authority to stop the pipe laying operations until the manhole is completed.
 - 4. The Contractor shall accurately locate each manhole and set accurate templates to conform to the required line and grade. Any manhole which is mislocated or oriented improperly shall be removed and rebuilt in its proper location, alignment, and orientation at no additional cost to the Owner.
- B. Foundations: All manholes shall be constructed on a 12-inch layer of compacted bedding material. The excavation shall be dewatered to provide a dry condition while placing bedding material and setting the base.
- C. Masonry: All brick or concrete block shall be thoroughly wetted before laying.
 - 1. The first course of masonry shall be embedded in the concrete foundation immediately after the foundation has been poured.
 - 2. All masonry shall be laid in the flat position in a full bed of mortar, and all vertical and horizontal joints shall be filled solid with mortar. Vertical joints on each succeeding

course shall be staggered. Joints shall be not less than 3/8 inch wide or more than 1/2 inch wide. Joints on the inside of the structure shall be neatly struck and pointed.

3. The exterior and interior surface of the walls shall be plastered with a one-half inch (1/2 in.) coat of 1:2 cement mortar.

- D. Invert: Brick invert channels shall be constructed in all manholes to provide a smooth channel for sewage flow through the structure, and shall correspond in shape to the lower half of the pipe. At changes in directions, the inverts shall be laid out in curves of the longest possible radii tangent to the centerline of the sewer pipes at the manhole side. Shelves shall be constructed to the elevation of the highest pipe crown and sloped to drain toward the flow channel.

1. Special care shall be taken in laying brick inverts. Joints shall not exceed three-sixteenth inch (3/16 in.) in thickness and each brick shall be carefully laid in full cement mortar joints on bottom, side and end in one operation. No grouting or working in of mortar after laying of the brick will be permitted. Bricks forming the shaped inverts in manholes shall be laid on edge.
2. Invert channels shall be built for future extensions where shown on the Drawings and where directed by the Engineer.

- E. Steps: Steps shall be installed in all manholes, spaced twelve inches (12 in.) on center vertically and set securely in place during the construction of the masonry wall. Precast sections shall be arranged such that internal steps are in alignment.

- F. Precast Manholes: Precast manholes shall be installed only after shop drawings have been approved.

1. The top grade of the precast concrete cone section shall be set sufficiently below finished grade to permit a maximum of five and a minimum of two courses (laid in the flat position) of eight inch (8 in.) brick to be used as risers to adjust the grade of the manhole frame. Manhole frames shall be set on a grout pad to make a water-tight fit.
2. Grout fill lifting holes on all manhole sections.

3.5 CONNECTIONS TO EXISTING FACILITIES

- A. General Requirements: The Contractor shall make all required connections of the proposed sewer into existing sewer system, where and as shown on the Drawings and as required by the Engineer.
- B. Contractor shall verify the location, size, invert and type of existing pipes at all points of connection prior to ordering new utility materials.
- C. Compliance with Requirements of Owner of Facility: Connections into existing sewer facilities shall be performed in accordance with the requirements of the owner of the facility. The Contractor shall comply with all such requirements, including securing of all required permits, and paying the costs thereof. The costs of making the connections in accordance with the requirements of the owner of the existing facility shall be included in the Contract Sum.

3.6 MANHOLE CONNECTIONS

- A. Manhole pipe connections for precast manhole bases may be accomplished by any method described below. The Contractor shall make sure that the outside diameter of the pipe is compatible with the particular pipe connection used.

1. A tapered hole filled with non-shrink waterproof grout after the pipe is inserted. This connection method will not be allowed when connecting PVC pipe to manholes.
 2. The LOCK JOINT Flexible Manhole Sleeve cast in the wall of the manhole base. The stainless steel strap and exposed sleeve shall be protected from corrosion with a bitumastic coating.
 3. PRESS WEDGE II gasket cast into the wall on the manhole base. The rubber wedge shall only be driven into the V slot from the outside of the manhole.
 4. The RES-SEAL, a cast iron compression ring which compresses a rubber "O" ring gasket into a tapered hole in the wall of the manhole base. Exposed metal shall be protected from corrosion with a bitumastic coating.
 5. KOR-N-SEAL neoprene boot cast into the manhole wall. The stainless steel clamp shall be protected from corrosion with a bitumastic coating.
- B. Sewer manholes shall be constructed with drop connections when the proposed invert of the connection is at least 2 feet (2 ft.) above the manhole invert. Drop connections for differences of less than 2 feet (2 ft.) shall also be provided if required by the governing authority.

3.7 SERVICE CONNECTIONS

- A. General Requirements: The Contractor shall make all required connections of the building sewer service pipes into the sewer system. Work shall include making the service pipe connections into the sewer system pipes or into the manholes located ten feet (10 ft.) outside of the proposed building lines. If stubs are constructed for later connection to the building pipes, the ends shall be sealed with watertight plugs.
- B. Coordination with Building Contractor: The Contractor shall coordinate the work with the work of the building contractor to determine the exact location and elevation of the point of entry into the building.
- C. Connection into Sewer System: Sewer service pipe connections to the pipe of the sewer system shall be made with fittings supplied by the pipe manufacturer.
1. The Contractor shall install 45 degree wye branch or 90 degree tee fittings in the sewer pipes at all locations where building sewer service pipe connections are shown on the Drawings. Connections of the sewer service pipes shall be made into the wye branches or tees by means of 45 degree bends. The connections shall be made thoroughly watertight and concrete shall be placed under each connection to bear on undisturbed earth and firmly support the connection. Sewer chimneys shall be encased in concrete unless directed otherwise by the Engineer.

3.8 GREASE TRAP

- A. Precast grease traps shall be installed in accordance with the manufacturer's recommendations. The precast base section shall be set on 12 inches of compacted gravel borrow placed on compacted subgrade. Joints of field assembled precast sections shall be waterproof. Manhole riser sections, frames and covers shall be installed as required.

3.9 LEAKAGE TESTS

- A. General Requirements: The Contractor shall test the completed sewer system, including manholes and service connections, for leakage by infiltration, exfiltration, or low-pressure air exfiltration tests. Manhole structures may be tested by a low pressure air vacuum test. The tests shall be conducted as approved by the Engineer. The Contractor shall furnish all necessary equipment, materials and labor for performing the tests.
1. The Contractor shall notify the Engineer at least 48 hours prior to the start of testing. Testing shall only be performed in the presence of the Engineer.
 2. Sections of pipe tested for infiltration and exfiltration prior to completion of the Contract shall be subject to additional leakage tests, if warranted, in the opinion of the Engineer, prior to acceptance of the Work.
- B. Infiltration and Exfiltration Testing: The test length intervals for either type of leakage test shall be approved by the Engineer, but in no event shall they exceed one thousand feet (1,000 ft.). Where sewer pipe is laid on steep grades, the length to be tested by exfiltration at any one time shall be limited by the maximum allowable internal pressure on the pipe and joints at the lower end of the line. The maximum internal pressure at the lowest end shall not exceed 25 feet of water or 10.8 psi.
1. The test period, wherein the measurements are taken, shall not be less than four (4) hours in either type of test.
 2. Depending on field conditions, the following tests for leakage shall be employed:
 - a. Infiltration Test: The test may be used only when ground water levels are at least five feet (5 ft.) above the top of the pipe for the entire length of the section to be tested during the entire period of the test. Ground water levels may be measured in an open trench or in standpipes previously placed in backfilled trenches during the backfilling operations. When standpipes are installed in the backfill for ground water measurement, the lower ends shall be satisfactorily embedded in a mass of crushed stone or gravel to maintain free percolation and drainage. Infiltration through joints shall be measured by using a watertight weir or any other approved device for volumetric measurement installed at the lower end of the section under test.
 - b. Exfiltration Test: This test consists of filling the pipe with water to provide a head of at least five feet (5 ft.) above the top of the pipe or five feet (5 ft.) above ground water, whichever is higher, at the highest point of the pipe section under test, and then measuring the loss of water from the line by the amount which must be added to maintain the original level. In this test, the pipe must remain filled with water for at least twenty-four (24) hours prior to the taking of measurements. Exfiltration shall be measured by the drop of water level in a closed-end standpipe or in one of the sewer manholes available for convenient measuring. When a standpipe and plug arrangement is used in the upper manhole of a section under test, a positive method of releasing entrapped air in the sewer shall be installed prior to taking measurements.
 - c. Leakage Requirements: The total leakage of any section tested shall not exceed the rate of 50 gallons per day per mile per inch of nominal pipe diameter. For purposes of determining the maximum allowable leakage, manholes shall be considered as sections of 48-inch diameter pipe, five feet (5 ft.) long, and the equivalent leakage allowance shall be 2.25 gallons per manhole per 24 hours.

C. Low-Pressure Air Exfiltration Testing

1. The sewer pipes and service pipes shall be tested for leakage by the use of low-pressure air as approved by the Engineer. The test length shall not exceed one length of pipe between two manholes. Air test procedures may be dangerous and the Contractor shall take all necessary precautions to prevent blowouts.
 - a. Pneumatic plugs shall have a sealing length equal to or greater than the diameter of the pipe to be tested.
 - b. Pneumatic plugs shall resist internal test pressures without requiring external bracing or blocking.
 - c. All air used shall pass through a single control panel.
 - d. Three individual hoses shall be used for the following connections:
 - 1) from control panel to pneumatic plugs for inflation;
 - 2) from control panel to sealed line for introducing the low pressure air;
 - 3) from sealed line to control panel for continually monitoring the air pressure rise in the sealed line.
2. The following testing procedures shall be explicitly followed:
 - a. All pneumatic plugs shall be seal tested before being used in the actual test installation. One length of pipe shall be laid on the ground and sealed at both ends with the pneumatic plugs to be checked. Air shall be introduced into the plugs to 25 psig. The sealed pipe shall be pressurized to 5 psig. The plugs shall hold against this pressure without bracing and without movement of the plugs out of the pipe.
3. After the pipe has been backfilled and cleaned, pneumatic plugs shall be placed in the line at each manhole and inflated to 25 psi. Low-pressure air shall be introduced into this sealed line until the internal air pressure reaches 4 psi greater than the average back pressure of any ground water that may be over the pipe. At least two (2) minutes shall be allowed for the air pressure to stabilize.
 - a. After the stabilization period (3.5 psi minimum pressure in the pipe), the portion of pipe tested shall be acceptable if the time required in minutes for the pressure to decrease from 3.5 to 3.0 psi (greater than the average back pressure of any ground water that may be over the pipe) is not less than the time indicated in the following table:

<u>Pipe Size (in.)</u>	<u>Time (sec.)</u>
4	0.190L
6	0.427L
8	0.760L
10	1.187L
12	1.709L
15	2.671L

Where L = length of pipe being tested

- D. Vacuum Testing of Manholes: New sewer manholes shall be vacuum tested in accordance with procedure and standards in ASTM C1244.
- E. Correction of Defective Work: If leakage exceeds the specified amount, the Contractor shall make the necessary repairs or replacements required to permanently reduce the leakage to within the specified limit, and the tests shall be repeated until the leakage requirement is met.
- F. Compliance with Agency Requirements: In the event of conflict between the leakage test requirements specified herein with the leakage test requirements of agencies having jurisdiction over all or any portion of the sewer system installed under this Contract, the more restrictive requirements shall govern.

3.10 PIPE DEFLECTION MEASUREMENT

- A. In accordance with ASTM D3034, no less than 30 days after completion of the PVC sewer pipe installation, the Contractor shall test the pipeline for deflection using a 'go/no-go' deflection mandrel having a minimum of nine evenly spaced arms or prongs. The 'go/no-go' gauge shall be hand pulled through all sections of the pipeline by the Contractor. The Contractor shall submit drawings of the 'go/no-go' gauge to the Engineer for approval prior to testing. Complete dimensions of the gauge for each diameter of pipe to be tested shall be in accordance with ASTM D3034.
- B. Any section of pipe found to exceed 7.5 percent (7.5%) deflection shall be deemed a failed pipe and shall be excavated and replaced by the Contractor at his own expense.

3.11 CLEANING AND REPAIR

- A. The Contractor shall clean the entire sewer system of all debris and obstructions. This shall include removal of all formwork from structures, concrete and mortar droppings, construction debris and dirt. The system shall be thoroughly flushed clean and the Contractor shall furnish all necessary hose, pumps, pipe and other equipment that may be required for this purpose. No debris shall be flushed into existing sewers, storm drains, and or streams.
- B. All work of cleaning and repair shall be performed at no additional cost to the Owner.

3.12 FINAL INSPECTION

- A. Upon completion of the work, and before final acceptance by the Engineer, the entire sewer system shall be subjected to a final inspection in the presence of the Engineer. The work shall not be considered as complete until all requirements for line, grade, cleanliness, leakage tests and other requirements have been met.

END OF SECTION

SECTION 334000

STORM DRAINAGE UTILITIES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This Section specifies requirements for furnishing and installing the site storm drainage utilities system, as indicated on the Drawings and as specified herein.
- B. The work shall include but not be limited to the following:
 - 1. Site storm drainage system.
 - 2. Connection of building drains from a point ten feet (10 ft.) outside of the building or structure foundation.
 - 3. Site underdrains, headwalls, flared end sections and underground stormwater infiltration facilities.
 - 4. Drainage to dedicated systems on the site shall conform to the State Plumbing Code.

1.2 RELATED SECTIONS

- A. Carefully examine all of the Contract Documents for requirements which affect the Work in this Section. Other specification sections, which directly relate to the Work of this section include, but are not limited to, the following:
 - 1. Section 312319 – DEWATERING.
 - 2. Section 312500 - EROSION AND SEDIMENTATION CONTROL.
 - 3. Section 331000 – WATER UTILITIES.
 - 4. Section 333900 – SANITARY UTILITY SEWERAGE STRUCTURES.
 - 5. Section 033055 – CAST-IN-PLACE CONCRETE (SITE).
 - 6. Geotechnical Report prepared by Carlin Simpson & Associates.

1.3 SUBMITTALS

- A. Shop Drawings
 - 1. Materials list of items proposed for the work.
 - 2. Shop drawings or descriptive literature, or both, showing dimensions, joint and other details of all materials proposed for the work. Shop drawings shall be submitted to the Engineer for approval prior to ordering material.
- B. As-Built Drawings

1. Submit three (3) copies of As-Built Drawings upon completion and acceptance of work.
2. As-Built Drawings shall be complete and shall indicate the true measurement and location, horizontal and vertical, of all new drainage system construction. As-Built drawings shall include a minimum of three (3) ties showing the distance to each catch basin and manhole from fixed permanent objects. As-Built Drawings shall also contain any additional information required by the municipality, and shall be stamped with the seal of a licensed land surveyor and licensed professional engineer.

1.4 QUALITY ASSURANCE

- A. Work shall comply with the State Plumbing Code.

1.5 COORDINATION AND VERIFICATION

- A. Coordinate the work with the termination of storm drain connections at buildings, connections to municipal systems, and trenching operations.
- B. The Contractor shall field verify and survey the size, location and elevations of all existing pipe and utility lines prior to ordering of materials for this utility system. A report of the findings of the verification survey shall be submitted to the Engineer for information and comment.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. All materials shall be adequately protected from damage during transit. Pipes shall not be dropped.
- B. All pipe and other appurtenances shall be inspected before placement in the work and any found to be defective from any cause, including damage caused by handling, and determined by the Engineer to be unrepairable, shall be replaced at no cost to the Owner.
- C. Storage and handling of pipes, manholes, catch basins, oil-grit separators, treatment units and other system appurtenances shall be in accordance with the manufacturer's recommendations.

1.7 INSPECTION

- A. The manufacturer/supplier is responsible for the provision of all test requirements specified for each type of pipe. In addition, any pipe may be inspected at the plant for compliance with these specifications by an independent testing laboratory selected and paid by the Owner. The Contractor shall require the manufacturer's cooperation in these inspections.
- B. Inspection of the pipe may also be made after delivery. The pipe shall be subject to rejection at any time on account of failure to meet any of the specification requirements, even though pipe samples may have been accepted as satisfactory at the place of manufacture. Pipe rejected after delivery shall be marked for identification and shall be removed from the site at once.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All materials for storm drainage utilities system shall be new and unused.

2.2 PIPE

- A. Reinforced Concrete Pipe: Pipe shall comply with the requirements of ASTM C76. All pipe 18 inches and smaller shall be Class V. All other pipe shall be Class III unless indicated otherwise on the Drawings.
1. Joints for the reinforced concrete pipe shall be the tongue and groove or bell and spigot type with rubber gasket conforming to ASTM C443.
 2. Flared end pipe sections shall be constructed in conformance with ASTM C76, Class V requirements and shall be supplied by the same manufacturer as the pipe.
- B. Corrugated Aluminized Steel Pipe: Aluminized steel pipe, Type 2, 16 ga., shall meet AASHTO M 274-791 and shall be metallic coated and manufactured to meet the requirements of AASHTO M 36.
1. Corrugated aluminized steel pipe shall be round pipe, pipe arch, or slotted drain as indicated on the Drawings.
 - a. Slotted drain pipe shall have 1.75 inch wide drain waterway opening and solid WEB spacer at 6 inches on center.
 2. Pipe shall be as manufactured by Contech Construction Products, Inc., or approved equivalent.
- C. Perforated Steel Pipe Underdrain: Conforming to AASHTO M 36, Type III, Classes I, II or III and shall be ARMCO aluminized steel Type 2 (Hel-Cor) as manufactured by Contech Construction Products, Inc. or approved equivalent.
1. Fully perforated pipe shall be perforated with 3/8-inch diameter holes meeting the requirements of AASHTO M 36 Class 2.
 2. Joints: Connecting bands for corrugated steel pipe shall be aluminized steel Type 2 Hugger Band with O-ring gaskets, double bolt bar and strap connector as manufactured by Contech Construction Products, Inc., or approved equivalent. Pipe shall conform to the manufacturer's requirements and procedures.
- D. Slotted Corrugated Plastic Pipe for Subdrain: Materials, dimensions, physical properties and fabrication of pipe or tubing, couplings and fittings shall be in conformance with AASHTO M 252.
1. Piping and fittings (3 to 6 inches in diameter) shall conform to ASTM F405.
 2. Piping and fittings over 6 inches in diameter shall conform to ASTM F667.
- E. Filter Fabric for Underdrains: Equal to Mirafi 140N.
- F. Filter Fabric for Flared End Sections and Headwalls with Stone Protection: Equal to Mirafi 600X, or approved equivalent.
- G. High Density Corrugated Polyethylene Pipe and Fittings, Smooth Interior: Shall meet the requirements of ASTM D3350. Four-inch through 10-inch diameter pipe corrugated polyethylene drainage pipe shall meet the requirements of AASHTO M 252. Twelve-inch through 60-inch diameter corrugated polyethylene pipe shall meet the requirements of AASHTO

M 294, Types S. Standard Fitting connections shall be fabricated to sizes shown on the Drawings.

1. Pipe joints and fittings shall conform to the requirements of AASHTO M 252 or AASHTO M 294. Pipe joints shall be Bell and Spigot soil tight joints and gaskets shall meet the requirements of ASTM F477. Fittings shall also be soil tight and gasketed.
2. Where called for on the Drawings, corrugated pipe shall be slotted or perforated by the manufacturer prior to delivery to the job site. Coupling bands shall conform to the manufacturer's specifications. Couplers shall cover not less than one corrugation on each section of pipe.

H. Polyvinyl Chloride (PVC) Pipe:

1. Pipe and fittings shall comply with the requirements of ASTM D3034, rated SDR 35 and ASTM D2665 for Schedule 40 and Schedule 80 pipe and fittings. Pipe shall be continually marked with manufacturer's name, pipe size, cell classification, SDR rating, and ASTM D3034 classification.

I. Ductile Iron Pipe

1. Ductile iron pipe shall be designed in accordance with ANSI A21.50/AWWA C150 and manufactured in accordance with ANSI A21.51/AWWA C151.
2. Ductile iron pipe shall be thickness Class 52, furnished in 18-foot or 20-foot nominal lengths.

2.3 STORM DRAIN MANHOLES

A. Precast Concrete Construction:

1. Structure: 48-inch minimum inside diameter, precast concrete units (4,000 psi minimum compressive strength) with eccentric cone section tapering to 24-inch diameter and monolithic base section meeting the requirements of ASTM C478. All structures shall be designed for HS-20 loading, and shall be sized to accept pipe penetrations as shown on the Drawings.
2. Precast Unit Joint Seals: Preformed butyl rubber O-ring type seals meeting the requirements of ASTM C990.
3. Openings for pipe and materials to be embedded in the walls of the manholes sections for joint seals shall be cast in the sections at the required locations during manufacture. Sections with incorrectly cast and patched pipe openings will be rejected.
4. Openings shall be cast into the manhole sections to receive entering pipes during manufacture. The openings shall be sized to provide a uniform 2 inch maximum annular space between the outside of the pipe wall and the opening in the riser. After the pipe is in position, the annular space shall be solidly filled with nonshrink mortar. Care shall be taken to assure that the openings are located to permit setting of the entering pipe at its correct elevation.

B. Unit Masonry Construction:

1. Brick shall be sewer brick conforming to ASTM C32, Grade MS or building brick conforming to ASTM C62, Grade SW.

2. Concrete block shall be solid block and shall conform to the ASTM C139.
3. Mortar shall be in conformance with ASTM C270, Type M. The mortar shall be composed of Portland cement hydrated lime, and sand, in the proportions of 1 part cement to 1/4 part hydrated lime to 3-1/2 parts sand by volume.
4. Cement shall be Type I or II Portland cement conforming to ASTM C150. Where masonry is exposed to salt water, Type II shall be used.
5. Hydrated lime shall be Type S conforming to ASTM C207.
6. Sand for masonry mortar shall conform to the gradation requirements of ASTM C144.

C. Steps:

1. Steps for manholes shall be steel reinforced copolymer polypropylene plastic step with at least a 14-inch wide stepping surface conforming to ASTM C478 and ASTM A615.

- D. Manhole Frame and Cover: Grey iron casting conforming to ASTM A48, heavy duty, with word "DRAIN" embossed on cover. Letter size shall be three inches (3 in.). Frame and cover shall have a minimum clear opening of 24 inches and have a minimum weight of 475 pounds. Frame and cover shall be East Jordan Iron Works 2114Z/2110A , or approved equal.

2.4 CATCH BASINS AND DROP INLET

- A. Precast catch basins and drop inlets shall be manufactured in accordance with ASTM C478 (4,000 psi minimum compressive strength) to the diameters and depths shown on the Drawings. All structures shall be designed for HS-20 loading. Precast unit joints shall be sealed with butyl rubber in accordance with ASTM C990.
- B. Where required for hood, a slot and opening shall be cast in the catch basin wall for mounting the cast iron hood over the outlet pipe.
- C. When approved by the Engineer, catch basins and drop inlets may be constructed with brick or concrete block walls and poured reinforced concrete bases as an alternative to precast concrete units.
- D. Brick and concrete block and other materials shall conform to Article 2.03B.
- E. Cast iron frames and grate shall conform to ASTM A48, Class 30. When located in accessible ways, grate openings shall meet the requirements of federal, state, and local regulations adopted under the Americans with Disabilities Act (ADA).
- F. Single catch basin frame and grate shall be East Jordan Iron Works 5546Z/5520M5 or approved equivalent with four flanges or with three flanges for use with gutter inlet or abutting vertical curb. Frame and grate for catch basin with shallow cover shall be East Jordan Iron Works 5525Z/5520M5 or approved equivalent.
- G. Double catch basin frame and grate shall be East Jordan Iron Works 5448Z/5520M5 or approved equivalent, with four flanges or with three flanges for use with gutter inlet or abutting vertical curb.
- H. Catch basin oil and debris traps (i.e., hoods, eliminators, etc.) shall be manufactured by the following, or approved equal:

1. 'Eliminator' by Ground Water Rescue, Inc.
2. 'Hood' by Neenah Foundry Company

- I. Openings at top of concrete structures where curb inlets are required shall be 24 inches by 27 inches.
- J. Landscape drains (area drains) shall be ADS manufacturer, 'NYOPLAST' In-Line drain with cast ductile iron dome grate.

2.5 SUSPENDED SOLIDS/GRIT AND OIL SEPERATOR

A. Separation Unit

1. The separation unit shall be a manufactured stormwater treatment unit suitable for installation in a precast concrete structure. Suspended solids separators shall be made of precast concrete sections and shall be of the capacity and dimensions indicated on the Drawings. Suspended solids separators shall be CDS2015-4-C as manufactured by Contech; or approved equal.

B. Precast Unit

1. Precast sections shall be cured by an approved ASTM method and shall not be shipped nor subject to loading until the concrete compressive strength has attained 5,000 psi. Portland cement shall be Type II, ASTM C150.
2. Precast units shall be designed for the following loads and possible combinations thereof:
 - a. H-20 loading, manhole riser with frame and cones, plus the weight of soil above and the soil loading due to the depth of the structure below finished grade.
 - b. Weight of precast concrete structure.
 - c. Initial handling and erection loadings.

C. Precast Unit Joints: Butyl rubber section joint conforming to ASTM C990.

D. Manhole riser sections, manhole steps, frames and covers shall be as specified in Article 2.03.

2.6 STORMWATER RETENTION CHAMBERS

A. Stormwater retention chambers shall be Retain-It 1.5' chambers, manufactured by Arrow Concrete.

1. Chambers shall meet ASTM F2418 and the structural design shall be in accordance with AASHTO Section 12.12.
2. The units shall be manufactured of concrete and constructed on a cast-in-place slab where specified.
3. The nominal dimensions of each chamber shall be in accordance with the manufacturer's standard.
4. Each chamber shall interlock with the adjacent chamber per manufacturer requirements.

2.7 OUTLET CONTROL MANHOLES OR STRUCTURES AND HEADWALLS

- A. Outlet structures shall be in accordance with section 2.3 for precast concrete Storm Drain Manholes and shall have a inside diameter as noted on the plans, with a minimum of 60 inches.
- B. Precast sections shall be cured by an approved ASTM method and shall not be shipped nor subject to loading until the concrete compressive strength has attained 4,000 psi minimum and 28 days after fabrication. Portland cement shall be Type II, ASTM C150.
- C. The precast unit shall be designed for the following loads and possible combinations thereof:
 - 1. H-20 loading, manhole riser with frame and cones, plus the weight of soil above and the soil loading due to the depth of the structure below finished grade.
 - 2. Weight of precast concrete structure.
 - 3. Initial handling and erection loading.
 - 4. Cast in place concrete shall be constructed in accordance with Section 033055 – CAST-IN-PLACE CONCRETE (SITE).
- D. Construction joints shall be sealed with a butyl rubber-based sealant.
- E. Manhole riser sections, manhole steps, frames and covers shall be as specified for precast concrete storm drain manholes.
- F. Grates and grills for outlet structures, which are not manufactured cast iron standards shall be hot dip galvanized iron units shop constructed to fit the dimensions indicated on the drawings. Safety bars shall be 60 ksi reinforcing steel.

2.8 SILT SACKS/SEDIMENT CONTROL DEVICES

- A. Install at locations shown on the Drawings.
- B. Manufacturer: ACF Environmental, Inc.; or approved equal.
- C. Material shall be a polypropylene geotextile fabric with strength per ASTM D4884.

2.9 TRENCH DRAIN

- A. Trench drain shall be ACO Quicklock Trench Drain System as manufactured by ACO Polymer Products, Inc., 12080 Revenna Road, Chardon, OH 44024 (800-543-4764), or approved equal.
 - 1. The channels shall be made with chemically resistant polyester or vinylester resin polymer concrete with a minimum 28 day compressive strength of 11,000 psi, and shall meet or exceed the testing requirements of ASTM C39.
- B. Trench drain shall be heavy duty type designed for HS-20 loading.
- C. Pre-cast polymer concrete trench drainage channel sections shall be set in cast-in-place concrete with a minimum 28 day compressive strength of 4,000 psi, using ASTM C150, Type II Portland cement.

- D. Cast iron grates shall conform to ASTM A48, Class 30. When located in accessible ways, grate openings shall meet the requirements of federal, state, and local requirements adopted under the American with Disabilities Act (ADA).
- E. Each trench drain system shall include the following, all made by one manufacturer.
 - 1. Channel.
 - 2. Catch basin.
 - 3. Inlet and outlet caps.
 - 4. Quicklock gratings.

2.10 INFILTRATION

- A. Infiltration systems shall consist of any of the following and combinations thereof:
 - 1. Chambers, plastic or concrete pipes, etc.
 - 2. Ponds constructed for this purpose.
 - 3. Precast concrete leaching structures.
- B. For the long-term function of the infiltration system, care shall be taken in these areas during construction in accordance with the following:
 - 1. The infiltration basin shall not be used as a construction sediment basin without prior approval of the Engineer.
 - 2. Stormwater runoff from exposed surfaces shall be directed away from the infiltration basin.
 - 3. Construction equipment, vehicular traffic, parking of vehicles, and stockpiling of construction materials shall be outside of the infiltration system area.
 - 4. Excavation for construction of the infiltration system shall ensure that the soil at the bottom of the excavation is not compacted or smeared.
 - 5. The perimeter of the infiltration system shall be staked and flagged to prevent the use of the area for activities that might damage the infiltration ability of the system.

PART 3 - EXECUTION

3.1 GENERAL

- A. Contractor shall verify the location, size invert and type of existing pipes at all points of connection prior to ordering new utility materials.
- B. All pipe shall be laid accurately to the lines and grades shown on the Drawings and in conformance with the pipe manufacturer's recommendations.
- C. As soon as the trench is excavated to the normal grade of the bottom of the trench, the Contractor shall immediately place the bedding material in the trench. The pipe shall be firmly

bedded in the compacted bedding material accurately to the lines and grades shown on the Drawings.

- D. Laying Pipe: Each length of pipe shall be laid with firm, full and even bearing throughout its entire length, in a prepared trench. Pipe shall be laid with bells upgrade unless otherwise approved by the Engineer.
 - 1. Every length of pipe shall be inspected and cleaned of all dirt and debris before being laid. The interior of the pipe and the jointing seal shall be free from sand, dirt and trash. Extreme care shall be taken to keep the bells of the pipe free from dirt and rocks so that joints may be properly lubricated and assembled. No pipe shall be trimmed or chipped to fit.
 - 2. No length of pipe shall be laid until the proceeding lengths of pipe have been thoroughly embedded in place, to prevent movement or disturbance of the pipe alignment.
- E. Notch under pipe bells and joints where required to provide for uniform bearing under entire length of pipe.
- F. Excavation, backfilling and compaction shall be as specified in Section 310000 - EARTHWORK.
- G. Maintain optimum moisture content of bedding material to attain required compaction density.
- H. Pipe Extension: Where an existing pipe is to be extended, the same type of pipe shall be used, unless otherwise approved by the Engineer.
- I. Full Lengths of Pipe: Only full lengths of pipe shall be used in the installation except that partial lengths of pipe may be used at the entrance to structures, and to accommodate the required locations of service connection fittings.
- J. Pipe Entrances to Drainage Structures: All pipe entering drainage structures shall be cut flush with the inside face of the structure, and the cut ends of the pipe surface within the structure shall be properly rounded and finished so that there will be no protrusion, ragged edges or imperfections that will impede or affect the hydraulic characteristics of the stormwater flow. The method of cutting and finishing shall be subject to the approval of the Engineer.
- K. Protection During Construction: The Contractor shall protect the installation at all times during construction, and movement of construction equipment, vehicles and loads over and adjacent to any pipe shall be performed at the Contractor's risk.
 - 1. At all times when pipe laying is not in progress, all open ends of pipes shall be closed by approved temporary watertight plugs. If water is in the trench when work is resumed, the plug shall not be removed until the trench has been dewatered and all danger of water entering the pipe eliminated.
- L. Water Pipe – Drain Pipe Separation: When a drain pipe crosses above or below a water pipe, the following procedures shall be utilized:
 - 1. Relation to Water Mains
 - a. Horizontal Separation: Whenever possible drains shall be laid at a minimum at least 5 feet, horizontally, from any existing or proposed water main. Should local conditions prevent a lateral separation of 5 feet, a drain may be laid closer than 5 feet to a water main if:

- 1) It is laid in a separate trench, or if
 - 2) It is laid in the same trench with the water mains located at one side on a bench of undistributed earth, and if
 - 3) In either case the elevation of the top (crown) of the drain is at least 12 inches below the bottom (invert) of the water main.
- b. **Vertical Separation:** Whenever drains must cross under water mains, the drain shall be laid at such an elevation that the top of the pipe is at least 12 inches below the bottom of the water main. When the elevation of the drain cannot be varied to meet the above requirements, the water main shall be relocated to provide this separation or reconstructed with mechanical-joint pipe for a distance of 10 feet on each side of the drain. One full length of water main should be centered over the drain so that both joints will be as far from the sewer as possible.
2. When it is impossible to obtain horizontal and/or vertical separation as stipulated above, both the water main and drain shall be constructed of mechanical-joint cement lined ductile iron pipe or other equivalent based on water tightness and structural soundness. Both pipes shall be pressure tested by an approved method to assure water tightness.

3.2 EXCAVATION AND BACKFILLING FOR PIPES

- A. The type of materials to be used in bedding and backfilling and the method of placement shall conform to the requirements of Section 310000 - EARTHWORK, the details shown on the Drawings and the following.
- B. Embedment materials are those used for bedding, haunching and initial backfill around pipes as illustrated on the Drawings.
1. All embedment materials should be free from lumps of frozen soil or ice when placed. Embedment materials should be placed and compacted at optimum moisture content
- C. Trench Bedding: Material must be provided to insure proper line and grade is maintained. Unsuitable or unstable materials shall be undercut and replaced with a suitable bedding material, placed in 6 inch lifts. Other methods of stabilization, such as geotextiles may be appropriate and their use must be approved by the Engineer or Owner's Representative.
1. Provide a stable and uniform bedding for the pipe and any protruding features of its joints and/or fittings. The middle of the bedding equal to 1/3 of the pipe outside diameter should be loosely placed, with the remainder compacted to a minimum of 95 percent Modified Proctor Density.
- D. Haunching: Proper haunching provides a major portion of the pipe's strength and stability. Exercise care to insure placement and compaction of the embedment material in the haunches. For larger diameter pipes (pipes greater than 30 inch diameter), embedment materials should be worked under the haunches by hand. Haunching materials shall be placed and compacted in 6 inch maximum lifts, compacted to 95 percent Modified Proctor Density.
- E. Initial Backfill: The initial backfill shall be from the springline to 24 inches above the pipe to provide protection for the pipe from construction operations during placement of the final backfill and protect the pipe from stones or cobbles in the final backfill. Compact initial backfill per Section 310000 - EARTHWORK.
1. Flooding or jetting as a procedure for compaction are not allowed.

- F. Final Backfill: The final backfill should be the same material as the proposed embankment or surface finishes. Generally, the excavated material may be used as final backfill. Placement should be as specified for the embankment. In lieu of a specification, the final backfill should be placed in 12 inch maximum lifts and compacted to a minimum 95 percent modified proctor density to prevent excessive settlement at the surface. Compaction should be performed at optimum moisture content.
- G. Vehicular and Construction Loads: During construction, avoid heavy equipment loads (greater than 40,000 lbs. per axle) over the pipe. Additional temporary cover should be placed over the pipe for heavy construction load crossings. Hydrohammers or hoe-pak compactors may not be used over the pipe until at least 48 inches of cover have been provided.

3.3 MANHOLES, CATCH BASINS, AND DROP INLETS – PRECAST

- A. Manholes Catch Basins and Drop Inlets: Shall be constructed at the locations and to the lines, grades, dimensions and design shown on Drawings or as required by the Engineer.
- B. Precast Concrete Units: Shall be installed in a manner that ensures watertight construction and all leaks in precast concrete structures shall be sealed. If required, precast concrete structures shall be repaired or replaced to obtain watertight construction.
- C. Stubs shall be short pieces of pipe cut from the bell ends of the pipe. stubs shall be plugged with brick masonry unless otherwise directed by the Engineer.
- D. Manhole Inverts shall conform accurately to the size of the adjoining pipes.
1. Manhole inverts shall be constructed of 3,500 psi concrete as shown the Drawings.
 2. inverts shall be laid out in smooth diameter curves of the longest possible radius to provide uniform flow channels.
 3. Invert shelves shall be graded with a 1 inch drop per one foot length sloped from the manhole walls.
- E. Manhole steps shall be accurately positioned and embedded in the concrete when the section is cast. Precast reinforced concrete manhole sections shall be set vertical and with sections and steps in true alignment.
- F. All holes in sections used for their handling shall be thoroughly plugged with rubber plugs made specifically for this purpose, or with mortar. The mortar shall be one part cement to 1-1/2 parts sand, mixed slightly damp to the touch, hammered into the holes until it is dense and an excess of paste appears on the surface, and finished smooth and flush with the adjoining surfaces.
- G. Precast sections shall be level and plumb with approved joint seals. Water shall not be permitted to rise over newly made joints until after inspection and acceptance. All joints shall be watertight.
- H. Openings which have to be cut in the sections in the field shall be carefully made to prevent damage to the riser. Damaged risers will be rejected and shall be replaced at no additional cost to the Owner.
- I. Change-In-Type Structures. Where indicated on the Drawings, existing subsurface drain structures shall be converted to the new structure types in the following manner:
1. Catch Basins to Manholes

- a. Fill basin sump with 3,000 psi concrete and create new inverts at the elevations and sizes indicated and in accordance with specifications and details for new drain manholes.
 - b. Provide and adjust to grade new drain manhole frame and cover.
 - c. Stockpile existing frame and grade per Owner's directions.
2. Manholes to Catch Basins (inlets).
- a. Where sump is indicated on the Drawings, replace existing manhole structure with new precast concrete catch basin structure.
 - b. Where sump is not indicated on the Drawings, replace existing frame and cover with new frame and grate and adjust to grade per these specifications and details for new catch basins.
 - c. Stockpile existing manhole frame and cover per Owner's directions.

3.4 BRICK MASONRY

- A. Brick masonry structures shall be watertight. All leaks in brick masonry structures shall be sealed. All brick masonry shall be laid by skilled workmen.
- B. All beds on which masonry is to be laid shall be cleaned and wetted properly. Brick shall be wetted as required to be damp, but free of any surface water when placed in the work. Bed joints shall be formed of a thick layer of mortar which shall be smoothed or furrowed slightly. Head joints shall be formed by applying a full coat of mortar on the entire brick end, or on the entire side, and then shoving the mortar covered end or side of the brick tightly against the bricks laid previously. The practice of buttering at the corners of the brick and then throwing the mortar or crappings in the empty joints will not be permitted. Dry or butt joints will not be permitted. Joints shall be uniform in thickness and approximately 1/4 inch thick.
- C. Brickwork shall be constructed accurately to the required structure dimensions and tapered at the top to the dimensions of the flanges of the cast-iron frames, as shown on the Drawings.
- D. Joints on the inside face of walls shall be tooled slightly concave with an approved jointer when the mortar is thumbprint hard. The mortar shall be compressed with complete contact along the edges to seal the surface of the joints.
- E. All castings to be embedded in the brickwork shall be accurately set and built-in as the work progresses.
- F. Water shall not be allowed to flow against brickwork or to rise on the masonry for 60 hours after it has been laid, and any brick masonry damaged in this manner shall be replaced as directed at no additional cost to the Owner. Adequate precautions shall be taken in freezing weather to protect the masonry from damage by frost.

3.5 CONCRETE MASONARY UNITS

- A. Concrete masonry units shall be soaked in water before laying. As circular concrete block walls are laid-up, the horizontal joints and keyways shall be flushed full with mortar. As rectangular blocks are laid-up, all horizontal and vertical joints shall be flushed full with mortar. Plastering of

the outside of block structures will not be required. No structure shall be backfilled until all mortar has completely set.

3.6 MANHOLE STEPS

- A. Steps shall be cast into the precast walls during manufacture.
- B. Steps in brick masonry and concrete units shall be installed as the masonry courses are laid.

3.7 CASTINGS

- A. Cast-iron frames for grates and covers shall be well bedded in cement mortar and accurately set to the proposed grades.
- B. All voids between the bottom flange and the structure shall be completely filled to make a watertight fit. A ring of mortar, at least one-inch (1 in.) thick and pitched to shed water away from the frame shall be placed over and around the outside of the bottom flange. The mortar shall extend to the outer edge of the masonry all around its circumference and shall be finished smooth. No visible leakage will be permitted.
- C. Structures within the limits of bituminous concrete pavement shall be temporarily set at the elevation of the bottom of the binder course. After the binder course has been compacted, the structures shall be set at their final grade. Backfill necessary around such structures after the binder course has been completed shall be made with 3,500 psi concrete.

3.8 CONNECTIONS TO EXISTING FACILITIES

- A. General Requirements: The Contractor shall make all required connections of the proposed drainage system into existing drainage system, where and as shown on the Drawings.
- B. Compliance with requirements of Owner of Facility: Connections into existing drainage system facilities shall be performed in accordance with the requirements of the Owner of the facility. The Contractor shall comply with all such requirements, including securing of all required permits, and paying the costs thereof.

3.9 MANHOLE CONNECTIONS

- A. Manhole pipe connections for precast manhole bases may be accomplished by any method described below. The Contractor shall make sure that the outside diameter of the pipe is compatible with the particular pipe connection used.
 - 1. A tapered hole filled with non-shrink waterproof grout after the pipe is inserted. This connection method will not be allowed when connecting PVC pipe to manholes.
 - 2. The LOCK JOINT Flexible Manhole Sleeve cast in the wall of the manhole base. The stainless steel strap and exposed sleeve shall be protected from corrosion with a bitumastic coating.
 - 3. PRESS WEDGE II gasket cast into the wall on the manhole base. The rubber wedge shall only be driven into the V slot from the outside of the manhole.
 - 4. The RES-SEAL, a cast iron compression ring which compresses a rubber "O" ring gasket into a tapered hole in the wall of the manhole base. Exposed metal shall be protected from corrosion with a bitumastic coating.

5. KOR-N-SEAL neoprene boot cast into the manhole wall. The stainless steel clamp shall be protected from corrosion with a bitumastic coating.

3.10 ROOF DRAIN OR SIMILAR CONNECTIONS

- A. Trench drain and slotted drain installation methods shall be in accordance with the manufacturer's recommendations and the details shown on the Drawings.
- B. The Contractor shall submit the manufacturer's written instructions for installation prior to installation, as required in Article 1.03.

3.11 TRENCH DRAINS AND SLOTTED DRAINS

- A. Trench drain and slotted drain installation methods shall be in accordance with the manufacturer's recommendations and the details shown on the Drawings.
- B. The Contractor shall submit the manufacturer's written instructions for installation prior to installation, as required in Article 1.03.

3.12 CLEANING, TESTING, AND REPAIR

- A. The Contractor shall clean the entire drainage system of all debris and obstructions. Cleaning shall include, removal of all formwork from structures, concrete and mortar droppings, construction debris and dirt. The system shall be thoroughly flushed clean and the Contractor shall furnish all necessary hose, pumps, pipe and other equipment that may be required for this purpose. No debris shall be flushed into existing drains, storm recharge chambers, storm drains and/or streams.
- B. Testing and Correction of Defective Work: If a mandrel with a minimum length that is greater than the pipe diameter and a minimum diameter of 90 percent of the pipe diameter cannot be pulled through the pipe after seven (7) days of completed trench backfill, the pipe line shall be deemed unacceptable and the pipe lines shall be removed and replaced. The Contractor shall make the necessary repairs or replacements required to permanently provide an open and structurally sound drainage system capable of supporting the anticipated loading from all sources throughout the year.

3.13 FINAL INSPECTION

- A. Upon completion of the work, and before final acceptance by the Engineer, the entire drainage system shall be subjected to a final inspection in the presence of the Engineer. The work shall not be considered as complete until all requirements for line, grade, cleanliness, mandrel tests, and other requirements have been met.

END OF SECTION

SECTION 334020

WARNING AND TRACER TAPE

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. This Section covers the furnishing, handling, and installation of warning and tracer tape, as called for on the Drawings.

1.2 SUBMITTALS

- A. In accordance with requirements of General Specifications, submit the following:
 - 1. Six sets of manufacturer's literature on the materials, colors and printing specified herein, shall be submitted to the Engineer for review.
 - 2. Tape samples shall also be submitted to the Engineer for review.

PART 2 - PRODUCT

2.1 ACCEPTABLE MANUFACTURERS

- A. Tape shall be manufactured by: Terra-Tape and Terra-Tape D by Reef Industries, Houston, TX; Markline and Detectatape by Allen Systems, Houston, TX; an equivalent tape by Industrial Tape and Supply Company, Atlanta, GA; or approved equal.

2.2 TAPE

- A. Warning and tracer tape shall be at least 6 inches wide.
- B. Tracer tape for non-ferrous pipe or conduit shall be constructed of a metallic core bonded to plastic layers. The metallic tracer tape shall be a minimum 5-mil thick and shall be located at a depth as indicated on the drawings.
- C. Warning tape for ferrous pipe or conduit shall consist of multiple bonded plastic layers. The non-metallic tracer tape shall elongate at least 500% before breaking.
- D. The tape shall bear the wording (or approved equivalent): 'BURIED DRAIN LINE BELOW' (with 'DRAIN' replaced by 'WATER', 'SEWER', 'ELECTRICAL', 'GAS', 'TELEPHONE', or 'CHEMICAL' as appropriate), continuously repeated every 30 inches to identify the pipe.
- E. Tape colors shall be as follows as recommended by the American Public Works Association (APWA):

Electric
Gas and Oil
Communications

Red
Yellow
Orange

Water
Sewer and Drain
Chemical

Blue
Green
Red (not APWA)

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Warning and tracer tape shall be installed above the pipe or conduit it is to identify at depths as indicated on the Drawings.
- B. Follow the manufacturer's recommendations for installation.

END OF SECTION