

PART 4: TECHNICAL SPECIFICATIONS AND DRAWINGS

Family Recreational Area at Northview Heights, AMP-09

IFB CONTRACT NO. 600-11-26 Rebid

Contains:

- Geotechnical Exploration Report 09-10-24
- Splashpad Stormwater Water Management Report rev10.22.24
- Distribution Manifold Fabrication
- Aquavator Bollard
- Buckettrio With Acrylic Cut Sheet
- Cast in SS Nozzle Socket
- Controller Manifold Drain
- Reeds Cutsheet
- Ripplerrun Cut Sheet
- Triple Arch Jet SS Nozzle Cutsheet
- Uniflow Cut Sheet
- Vaporarc Acrylic Cut Sheet
- Technical Specifications
- Drawings

Technical Specifications



HOUSING AUTHORITY
NORTH VIEW HEIGHTS OF THE
CITY OF PITTSBURGH

SPECIFICATIONS

Family Recreational Area
NORTH VIEW HEIGHTS
TASK ORDER NO. 48



Tusick &
Associates
Architects, Inc.

123 3rd Street
Blawnox, PA 15238

March 26, 2026

Revised 07/31/2026

DIVISION 01

TABLE OF CONTENTS

CONTRACT DOCUMENTS

DIVISION 00 - PROCUREMENT AND CONTRACTING REQUIREMENTS
As per HACP NVH Recreational Area document index.

DIVISION 01 - GENERAL REQUIREMENTS		
00 1000	Table of Contents	1-1
00 1113	Advertisement for Bids	1-2
00 2113	Instructions to Bidders	1-2
00 4100	Bidd Form	1-3
00 4300	Bidd Form Supplements	1-6
00 7200	General Conditions	1-1
00 7300	Supplementary Conditions	1-4
01 4000	Quality Requirements	1-3
01 4500	Quality Control	1-2
DIVISION 02 - EXISTING CONDITIONS		1-2
02 4120	Demolition	
DIVISION 03 - CONCRETE		
03 3000	Cast-in-place Concrete	1-11
03 3000.1	Cast-in-place Concrete	1-6
DIVISION 04 - MASONRY		
04 0513	Mason Mortaring	1-3
04 0516	Grouting	1-2
04 2000	Unit Masonry & Color Code	1-7
04 2300	Glass Unit Masonry	1-
DIVISION 05 - METALS		
05 5213	Pipe and Tube Railings	1-9
DIVISION 06 - WOOD, PLASTICS, AND COMPOSITES		
06 1000	Miscellaneous Carpentry	1-3
06 1100	Framing and sheathing	1-5
06 6423	Fiberglass Columns	1-4
DIVISION 07 - THERMAL AND MOISTURE PROTECTION		
07 4113	Standing Seam Metal Roof System	1-5
07 6223.16	Custom Box Gutters and Smooth Downspouts	1-10
07 9200	Joint Sealers	1-4
DIVISION 08 - DOORS AND WINDOWS		
08 1113	Hollow Metal Doors and Frames	1-3
08 7100	Door Hardware	1-4

DIVISION 09 - FINISHES		
09 2900	Gypsum Board	1-4
09 9100	Painting	1-6

DIVISION 10 - SPECIALTIES

10 1400	Signage Cast Flat Stainless Steel Letters	1-13
10 2113	Toilet Compartments	1-15
10 2813	Toilet and Bath Accessories	1-3
10 2814	Baby Changing Station	1-4

DIVISION 11 - EQUIPMENT **Not Used**

DIVISION 12 - FURNISHINGS

12 9300	Site Furnishing	1-4
---------	-----------------	-----

DIVISION 22 - PLUMBING

22 0500	General Provision & Common Work Results for Plumbing	1-28
22 0519	Meters and Gauges for Plumbing Piping	1-6
22 0523	General - Duty Valves for Plumbing Piping	1-9
22 0529	Hangers and Supports for Plumbing Piping and Equipment	1-11
22 0553	Identification for Plumbing Piping and Equipment	1-5
22 0700	Plumbing Insulation	1-15
22 1116	Domestic Water Piping	1-7
22 1119	Domestic Water Piping Specialties	1-9
22 1316	Sanitary Waste and Vent Pipe	1-10
22 1319	Sanitary Waste Piping Specialties	1-10
22 1413	Storm Drainage Piping	1-7
22 1423	Storm Drainage Specialties	1-6
22 3300	Electric Domestic Water Heaters	1-6
22 4000	Plumbing Fixtures	1-10
22 4700	Drinking Fountains and Water Coolers	1-4

DIVISION 23 - HEATING, VENTILATING, AND AIR-CONDITIONING (HVAC)

23 0500	Common Work Results for HVAC	1-11
23 0510	Basic Electrical Requirements for HVAC Equipment	1-5
23 0513	Common Motor Requirements for HVAC Equipment	1-2
23 0548.13	Vibration Controls for HVAC Piping and Equipment	1-3
23 0593	Testing, Adjusting and Balancing for HVAC	1-8
23 3113	Metal Ducts	1-7
23 3300	Air Duct Accessories	1-6
23 3423	HVAC Power Ventilators	1-5
23 3713	Diffusers, Registers, and Grilles	1-2
23 3733	Louvers	1-4

DIVISION 26 - ELECTRICAL

26 0100	Basic Electrical Requirements	1-17
26 0519	Low Voltage Elect. Power Conductors & Cables	1-7
26 0526	Grounding and Bonding for Electrical Systems pg.2	1-7
26 0529	Hangers and Supports for Electrical Systems	1-5
26 0533	Raceway and Boxes for Electrical Systems	1-11
26 0544	Sleeves and Seals for Electrical Systems	1-9
26 0553	Identification for Electrical Systems	1-4

001000

26 0573	Overcurrent Protective Device Coordination Study	1-3
26 0923	Lighting Controls	1-8
26 2416	Panel Board	1-10
26 2726	Wiring Devices	1-6
26 2813	Fuses	1-4
26 2816	Enclosed Switches and Circuit Breakers	1-4
26 5100	Interior Lighting	1-11
26 5600	Exterior Lighting	1-9

DIVISION 27 - COMMUNICATIONS

Not Used

DIVISION 31 - EARTHWORK

311000	Site Clearing	1-4
311100	Cleaning and Grubbing	1-1
312000	Earth Moving	1-8
312200	Grading	1-2
312300	Excavation and Fill	1-3

DIVISION 32 - EXTERIOR IMPROVEMENTS

32 1216	Asphalt Paving	1-4
32 1313	Concrete Paving	1-12
32 1313.1	Concrete Paving	1-7
32 1373	Concrete Paving Joint Sealents	1-7
32 1713	Parking Bumpers	1-1
32 1723	Pavement Markings	1-2
32 1726	Tactile Warning Surface	1-2
32 1816.13	Playground Surface System	1-7
32 3113	Chain Link Fences and Gates	1-2
32 3119	Decorative Metal Fences and Gates	1-11
32 8400	Planting Irrigation	1-23
32 9300	Plants	1-13

DIVISION 33 - UTILITIES

33 1000	Water Utilities	1-14
33 3000	Sanitary Sewerage Utilities	1-6
33 4200	Storm Water Conveyance	1-10

ADDENDUM

SUPPLEMENTARY CONDITIONS

- A. Related Documents:
1. Document 00 7200 - General Conditions.
 2. Division 01 - General Requirements.

1.2 GENERAL

- A. The following supplements modify, delete from, or add to the General Conditions referenced above.
- B. Where provisions of the General Conditions are modified, unaltered provisions remain in effect.

1.3 SUPPLEMENTS

A. Article 1 - General Provisions:

1. Add Subparagraph 1.1.9:

1.1.8 The term "product" includes materials, systems, and equipment.
2. Add Subparagraph 1.1.10:

1.1.9 The term "furnish" means to supply and deliver to Project site, ready for unloading, unpacking, assembly, erection, placement, or similar requirements.
3. Add Subparagraph 1.1.11:

1.1.10 The term "install" means to unload, unpack, assemble, erect, place, finish, protect, adjust, and clean, or similar requirements.
4. Add Subparagraph 1.1.12:

1.1.11 The term "provide" means to furnish and install.

B. Article 8 - Time:

Not Used ~~1. Add Subparagraph 8.2.4:~~ Refer to Form HUD-5370 General Conditions of the Contract for Construction

~~8.2.4 The Owner will suffer financial loss if Substantial Completion has not been reached on or before the established date. The [Contractor] [Construction Manager] shall be liable for and shall pay to the Owner the sum of \$[] as fixed and agreed liquidated damages for each day of delay until the project is Substantially Complete.~~

C. Article 9 - Payments and Completion:

Not Used ~~1. Add Subparagraph 9.6.8:~~ Refer to Form HUD-5370 General Conditions of the Contract for Construction

~~9.6.8 Until [final payment,] [Substantial Completion,] the Owner will retain [5] [10] [] percent of the amount due the [Contractor] [Construction Manager] on account of progress payments. [Upon Substantial Completion retainage will be reduced to [5] [] percent]~~

D. Article 10 - Protection of Persons and Property:

Not Used

~~1. Add Paragraph 10.3.7:~~

10.3.7 The Contractor shall not knowingly use any materials containing asbestos or other known hazardous materials in the Work.

E. Article 11 - Insurance and Bonds: Type text here

- ~~1. In Subparagraph 11.1.1, following the word "located", add "and against whom the Owner has no reasonable objection."~~
- ~~2. Add the following to the end of Subparagraph 11.1.3: "The form of the Certificate of Insurance shall be [ACORD Form 25S] [acceptable to the Owner.] [____.]"~~
- ~~3. Add Subparagraph 11.1.5:~~

~~11.1.5 Liability insurance shall include all major divisions of coverage and be on a comprehensive basis including:~~

- ~~.1 Premises-Operations including X, C and U coverages as applicable.~~
- ~~.2 Independent Contractors' Protective.~~
- ~~.3 Products and Completed Operations.~~
- ~~.4 Personal Injury Liability with Employment Exclusion deleted.~~
- ~~.5 Contractual, including specified provision for Contractor's obligation under Paragraph 3.18.~~
- ~~.6 Owned, non owned and hired motor vehicles.~~
- ~~.7 Broad Form Property Damage including Completed Operations."~~

- ~~4. Add Subparagraph 11.1.6:~~

Not Used

~~11.1.6 The insurance required by Subparagraph 11.1.1 shall be written for not less than the [following limits] [limits proposed by the Contractor and approved by the Owner] or those required by law, whichever is greater [and shall include the following coverages as a minimum]:~~

- ~~.1 Worker's Compensation:~~
 - ~~(a) State: Statutory.~~
 - ~~(b) Applicable Federal: Statutory.~~
 - ~~(c) Employer's Liability: \$[____] per accident; \$[____] per disease, Policy Limit; \$[____] per disease, each employee.~~
- ~~.2 Comprehensive or Commercial General Liability including Premises-Operations; Independent Contractors' Protective; Products and Completed Operations; Broad Form Property Damage:~~
 - ~~(a) Bodily Injury: \$[____] each occurrence; \$[____] aggregate.~~
 - ~~(b) Property Damage: \$[____] each occurrence; \$[____] aggregate.~~
 - ~~(c) Products and Completed Operations shall be maintained for [1 year] [2 years] after final payment. [Provide evidence of coverage on annual basis.]~~
 - ~~(d) Property Damage Liability: Include X, C and U coverage.~~
 - ~~(e) Broad Form Property Damage shall include Completed Operations.~~
- ~~.3 Contractual Liability:~~
 - ~~(a) Bodily Injury: \$[____] each occurrence; \$[____] aggregate.~~
 - ~~(b) Property Damage: \$[____] each occurrence; \$[____] aggregate.~~
- ~~.4 Personal Injury, with Employment Exclusion deleted: \$[____] aggregate.~~
- ~~.5 Business Automobile Liability including owned, non owned and hired vehicles:~~
 - ~~(a) Bodily Injury: \$[____] each person; \$[____] each occurrence.~~
 - ~~(b) Property Damage: \$[____] each occurrence.~~

Not Used

- .6 If General Liability coverages are provided by a Commercial Liability policy, the:
- (a) General Aggregate shall be not less than \$[] and it shall apply, in total, to this policy only.
 - (b) Fire Damage Limit shall be not less than \$[] on any one Fire.
 - (c) Medical Expense Limit shall be not less than \$[] on any one person.
- .7 Umbrella Excess Liability:
- (a) \$[] over primary insurance.
 - (b) \$[] retention for self insured hazards each occurrence.
- .8 Aircraft Liability, owned and non owned, when Aircraft are used in the performance of the Contract: \$[].
- .9 Watercraft Liability, owned and non owned, when Watercraft are used in the performance of the Contract: \$[].

5 Modify the first sentence of Subparagraph 11.3.1 as follows: Delete "Unless otherwise provided, the Owner"; substitute "The Contractor."

6.Delete Subparagraph 11.4.1; substitute the following:

REFER TO FORM HUD-5369

Not Used

11.4.1 Furnish to Owner performance bond and labor and material payment bond, each equal to the amount of the Contract Sum, with approved surety, covering faithful performance of Contract and payment of obligations incurred in performance of Contract and also for use and benefit of parties who may become entitled to liens under the Contract according to provisions of laws of the State in which the project is located. The form of the bonds shall be acceptable to Owner.

- .1 The Contractor shall deliver the required bonds to the Owner not later than three days following the date of execution of the Owner-Contractor Agreement, or if the Work is to be commenced prior thereto in response to a letter of intent, the Contractor shall, prior to commencement of the Work, submit evidence satisfactory to the Owner that such bonds will be furnished.
- .2 The Contractor shall require the attorney-in-fact who executes the required bonds on behalf of the surety to affix thereto a certified and current copy of the power of attorney.

F. Article 13 - Miscellaneous Provisions:

1.Add Paragraph 13.8: Refer to Form HUD-5370 General Conditions of the Contract for Construction

13.8 Equal Opportunity

Not Used

13.8.1 The [Contractor] [Construction Manager] and Subcontractors shall not discriminate against any employee or applicant for employment because of race, religion, color, sex, or national origin. The [Contractor] [Construction Manager] shall take affirmative action to ensure that applicants are employed, and that employees are treated during employment without regard to their race, religion, color, sex, or national origin. Such action shall include, but not be limited to, the following: employment, upgrading, demotion or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The [Contractor] [Construction Manager] agrees to post in conspicuous places, available to employees and applicants for employment, notices setting forth the policies of nondiscrimination.

13.8.2 The [Contractor] [Construction Manager] and Subcontractors shall, in all solicitations or advertisements for employees placed by them or on their behalf, state that all qualified applicants will receive consideration for employment without regard to race, religion, color, sex, or national origin.]

G. Article 15 - Claims and Disputes:

1. Add Paragraph 15.1.5.3:

Not Used

15.1.5.3 Extensions of time because of inclement weather will be granted only for the following conditions at the site:

- .1 Precipitation, defined as [0.1] [] inch or more of rain, snow, or ice, exceeds the mean for that month as published by the National Oceanic and Atmospheric Administration for the closest reporting station to the Project.
- .2 Freezing weather, defined as a high daytime temperature of [32] [] degrees F or below, exceeds the mean for that month as published by the National Oceanic and Atmospheric Administration for the closest reporting station to the Project.
- .3 Sustained winds exceed [25] [] MPH.
- .4 Mud.
- .5 Standing snow of [1 inch] [] inches or more.
- .6 Claims shall be in whole or half day increments. If both precipitation and freezing weather exceed the norm for any given day, only one day will be counted.

END OF DOCUMENT

SECTION 01 4000

QUALITY REQUIREMENTS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. References.
 - 2. Quality assurance and control of installation.
 - 3. Manufacturer's field services and reports.
 - 4. Design data and calculations.
 - 5. Test reports and certifications.
 - 6. Manufacturer's installation instructions.

1.2 REFERENCES

- A. For products or workmanship specified by reference to association, trade, or industry standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.
- B. Should specified reference standards conflict with Contract Documents, request clarification from the Architect before proceeding.
- C. Conform to this specification, reference all standard in effect as of March 2023 in this Project Manual.
- D. The contractual relationship of the parties to the Contract shall not be altered from the Contract Documents by mention or inference otherwise in any reference document.

1.3 QUALITY ASSURANCE AND CONTROL OF INSTALLATION

- A. Monitor quality control over suppliers, manufacturers, Products, services, site conditions, and workmanship, to produce Work of specified quality.
- B. Comply fully with manufacturers' instructions, including each step in sequence.
- C. Should manufacturers' instructions conflict with Contract Documents, request clarification from the Architect before proceeding.
- D. Comply with specified standards as a minimum quality for the Work except when more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- E. Perform work by persons qualified to produce workmanship of specified quality.
- F. Secure Products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion or disfigurement.
- G. Removal:
 - 1. Mockups may remain as part of the Work only when so designated in individual specification sections.
 - 2. Do not remove mockups until removal is approved by the Architect or upon Final Completion.
 - 3. Where mockup is not permitted to remain as part of the Work, clear area after removal of mockup has been approved by the Architect.

1.4 MANUFACTURERS' FIELD SERVICES AND REPORTS

- A. When specified in individual specification Sections, require material or Product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, or startup of equipment, as applicable, and to initiate instructions when necessary.
- B. Individuals to report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.
- C. Submit one copy electronically in Adobe PDF format] within 10 days after each observation.

1.5 DESIGN DATA AND CALCULATIONS

- A. When specified in individual specification Sections, require material or Product suppliers or manufacturers to provide design data and calculations.
- B. Accuracy of design data and calculations is the responsibility of the Contractor.
- C. When so specified, prepare design data and calculations under the direction of a professional engineer licensed in the state in which the Project is located. Affix engineer's seal to submittal s.
- D. Submit one copy. [Submit electronically in Adobe PDF format.]

1.6 TEST REPORTS AND CERTIFICATIONS

- A. When specified in individual specification sections, require material or product suppliers or manufacturers to provide test reports and manufacturers' certifications.
- B. Indicate that material or Product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.
- C. Submittals may be recent or previous test results on material or Product but must be acceptable to the Architect.
- D. Submit one copy.[Submit electronically in Adobe PDF format.]

1.7 MANUFACTURER'S INSTALLATION INSTRUCTIONS

- A. When Contract Documents require that Products be installed in accordance with manufacturer's instructions:
 - 1. Submit manufacturer's most recent printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing, as applicable.
 - a. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.
 - b. Identify conflicts between manufacturers' instructions and requirements of Contract Documents.
 - 2. Perform installation of Products to comply with requirements of manufacturer's instructions.
 - 3. If installation cannot be performed in accordance with manufacturer's instructions, notify the Architect and await instructions.
 - 4. Submit one copy. [Submit electronically in Adobe PDF format.]

PART 2 PRODUCTS

Not used

PART 3 EXECUTION

Not used

OF SECTION END

**SECTION 014500
PROJECT QUALITY CONTROL**

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes administrative and procedural requirements for quality assurance and quality control.
- B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
 - 1. Specific quality-assurance and -control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.

1.2 CONFLICTING REQUIREMENTS

- A. General: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer uncertainties and requirements that are different, but apparently equal, to Architect for a decision before proceeding.

1.3 SUBMITTALS

- A. Permits, Licenses, and Certificates: For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

1.4 QUALITY ASSURANCE

- A. General: Qualifications paragraphs in this Article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.
- B. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.
- C. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- D. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 548; and with additional qualifications specified in individual Sections; and where required by authorities having jurisdiction, that is acceptable to authorities.
 - 1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.

2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.

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

1.5 QUALITY CONTROL

- A. Contractor's Responsibilities: Where quality-control services are indicated as Contractor's responsibility, Contractor will engage a qualified testing agency to perform these services.
1. Costs for retesting and reinspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor.
- B. Provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
- C. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

- A. Prepare a record of tests and inspections. Include the following:
1. Date test or inspection was conducted.
 2. Description of the Work tested or inspected.
 3. Date test or inspection results were transmitted to Architect.
 4. Identification of testing agency or special inspector conducting test or inspection.

3.2 REPAIR AND PROTECTION

- A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
- B. Protect construction exposed by or for quality-control service activities.
- C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 014500

DIVISION 02

SECTION 02 4120
LANDSCAPE DEMOLITION

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Removal of designated trees and debris.

1.2 REGULATORY REQUIREMENTS

- A. Conform to applicable code for demolition work, safety of structure, and dust control.
- B. Obtain required permits from authorities.
- C. Notify affected utility companies before starting work and comply with their requirements.
- D. Conform to applicable codes when hazardous or contaminated materials are discovered.
- E. Do not close or obstruct exits.
- F. Do not disable or disrupt building fire or life safety systems without 3 days prior written notice to Owner.

1.3 PROJECT CONDITIONS

- A. Minimize interference with streets, walks, public right-of-ways, and adjacent facilities.
- B. If hazardous materials are discovered, notify Architect and await instructions.
- C. If any of the following conditions are encountered, cease work immediately, notify Architect, and await instructions:
 - 1. Structure is in danger of movement or collapse.
 - 2. Materials or conditions encountered differ from those designated in the Contract Documents.

PART 2 PRODUCTS

Not used

PART 3 EXECUTION

3.1 PREPARATION

- A. Erect temporary partitions, barricades, warning devices, and controls.
- B. Provide protective coverings, shoring, bracing, and supports for construction designated to remain.
- C. Temporarily or permanently disconnect utilities as required.

3.2 DEMOLITION

- A. Remove existing tree, refer to demolition drawings. Do not remove more than is necessary to allow for new construction.
- B. Do not damage work designated to remain.
- C. Minimize noise and spread of dirt and dust.
- D. Assign work to trades skilled in procedures involved.
- E. Plug ends of disconnected utilities with threaded or welded caps.
- F. Protect and support active utilities designated to remain. Post warning signs showing location and type of utility and type of hazard.
- G. Store items designated to remain property of Owner where directed by Owner.
- H. Remove and dispose of waste materials off site.

END OF SECTION

DIVISION 03

**SECTION 03 3000
CAST-IN-PLACE CONCRETE**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section specifies cast-in place concrete, including form work, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:
 - 1. Concrete Stairs.
- B. Related Sections include the following:
 - 1. Division 31 Section "Earth Moving" for drainage fill under slabs-on-grade.

1.3 DEFINITIONS

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

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
 - 1. Indicate amounts of mixing water to be withheld for later addition at Project site.
- C. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.
- D. Welding certificates.
- E. Qualification Data: For Installer.
- F. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:
 - 1. Aggregates.

G. Material Certificates: For each of the following, signed by manufacturers:

1. Cementitious materials.
2. Admixtures.
3. Form materials and form-release agents.
4. Steel reinforcement and accessories.
5. Curing compounds.
6. Floor and slab treatments.
7. Semi-rigid joint filler.
8. Joint-filler strips.
9. Repair materials.

H. Floor surface flatness and levelness measurements to determine compliance with specified tolerances.

I. Field quality-control reports.

J. Minutes of pre-installation conference.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI - certified Flat work Technician and Finisher and a supervisor who is an ACI-certified Concrete Flat work Technician.

B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.

1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

C. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated, as documented according to ASTM E 548.

1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-01 or an equivalent certification program.
2. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Grade II.

D. Source Limitations: Obtain each type or class of Cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from one source, and obtain admixtures through one source from a single manufacturer.

E. Welding: Qualify procedures and personnel according to AWS D1.4, "Structural Welding Code-Reinforcing Steel."

F. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.

- G. Pre-installation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
 - a. Contractor's superintendent.
 - b. Independent testing agency responsible for concrete design mixtures.
 - c. Ready-mix concrete manufacturer.
 - d. Concrete contractor.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.

1.7 FIELD CONDITIONS

- A. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
1. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
 2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen sub-grade or on sub-grade containing frozen materials.
 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.
- B. Hot-Weather Placement: Comply with ACI 301 and as follows:
1. Maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
 2. Fog-spray forms, steel reinforcement, and sub-grade just before placing concrete. Keep sub-grade uniformly moist without standing water, soft spots, or dry areas.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

- A. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents.
1. ACI 301
 2. ACI 117

2.2 FORM-FACING MATERIALS

- A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
 - 1. Plywood, metal, or other approved panel materials.
 - 2. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
 - a. B-B (Concrete Form), Class 1 or better; mill oiled and edge sealed.
- B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.
- C. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.
- D. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.
- E. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
 - 1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
- F. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
 - 1. Furnish units that will leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.

2.3 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.
- B. Steel Bar Mats: ASTM A 184/A 184M, fabricated from ASTM A 615/A 615M, Grade 60, deformed bars, assembled with clips.
- C. Plain-Steel Wire: ASTM A 82, as drawn.
- D. Plain-Steel Welded Wire Reinforcement: ASTM A 185, plain, fabricated from as-drawn steel wire into flat sheets.

2.4 REINFORCEMENT ACCESSORIES

- A. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60, plain-steel bars, cut bars true to length with ends square and free of burrs.
- B. Epoxy-Coated Joint Dowel Bars: ASTM A 615/A 615M, Grade 60, plain-steel bars, ASTM A 775/A 775M epoxy coated.
- C. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports

from steel wire, plastic, or pre-cast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:

1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.

2.5 CONCRETE MATERIALS

- A. Cementitious Material: Use the following Cementitious materials, of the same type, brand, and source, throughout Project:

1. Portland Cement: ASTM C 150, Type I, Type II, or Type I/II, gray. Supplement with the following:
 - a. Fly Ash: ASTM C 618, Class F.
 - b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.

- B. Normal-Weight Aggregates: ASTM C 33, Class **3S** coarse aggregate or better, graded. Provide aggregates from a single source with documented service record data of at least 10 years' satisfactory service in similar applications and service conditions using similar aggregates and Cementitious materials.

1. Maximum Coarse-Aggregate Size: 1 inch nominal.
2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

2.6 ADMIXTURES

- A. Air-Entraining Admixture: ASTM C 260/C 260M.

- B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
2. Retarding Admixture: ASTM C 494/C 494M, Type B.
3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

- C. Water: ASTM C 94/C 94M and potable.

2.7 VAPOR RETARDERS

- A. Sheet Vapor Retarder: Polyethylene sheet ASTM D 4397, not less than 10 mils thick cross linked.

2.8 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
 - 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. Bon Tool Co.
 - c. Dayton Superior.
 - d. Euclid Chemical Company (The); an RPM company.
 - e. Sika Corporation.
 - f. W.R. Meadows, Inc.
 - g. Approved equal.
- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.
- C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- D. Water: Potable.
- E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.
 - 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. Dayton Superior.
 - c. Euclid Chemical Company (The); an RPM company.
 - d. W.R. Meadows, Inc.
 - e. Approved equal.

2.9 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated Cellulosic fiber or ASTM D 1752, cork or self-expanding cork.
- B. Epoxy Joint Filler: Two-component, semi-rigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 per ASTM D 2240.
- C. Elastomeric Joint Filler: ASTM C 920.

2.10 CONCRETE MIXTURES

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.
 - 1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.
- B. Cementitious Materials: Limit percentage, by weight, of Cementitious materials other than Portland cement in concrete as follows:
 - 1. Fly Ash: 25 percent.
 - 2. Ground Granulated Blast-Furnace Slag: 50 percent.
 - 3. Combined Fly Ash or Pozzolans, Ground Granulated Blast-Furnace Slag, and Silica Fume: 50 percent with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.
- C. Admixtures: Use admixtures according to manufacturer's written instructions.
 - 1. Use water-reducing, high-range water-reducing, or plasticizing admixture in concrete, as required, for placement and workability.
 - 2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
 - 3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.
- D. Proportion normal-weight concrete mixture for exterior exposed elements as follows:
 - 1. Minimum Compressive Strength: 4000 psi at 28 days.
 - 2. Cement Type I/II; Minimum cementitious materials: 520 lbs/cuyd.
 - 3. Maximum Water-Cementitious Materials Ratio: 0.45.
 - 4. Slump Limit: 4 inches plus or minus 1 inch.
 - 5. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery.

2.11 FABRICATING REINFORCEMENT

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.12 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M, and furnish batch ticket information.
 - 1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 FORM WORK

- A. Design, erect, shore, brace, and maintain form-work, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.
- B. Construct form-work so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
- C. Do not chamfer exterior corners and edges of permanently exposed concrete.
- D. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- E. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

3.3 VAPOR RETARDERS

- A. Plastic Vapor Retarders: Place, protect, and repair vapor retarders according to ASTM E 1643 and manufacturer's written instructions.
 - 1. Lap joints 6 inches and seal with manufacturer's recommended tape.

3.4 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
 - 1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

- B. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- C. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

3.5 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
- C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:
 - 1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
 - 2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch-wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.
- D. Isolation Joints in Slabs-on-Grade: After removing form-work, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
- E. Waters-tops: Install in construction joints and at other locations indicated, according to manufacturer's written instructions.

3.6 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of form-work, reinforcement, and embedded items is complete and that required inspections have been performed.
- B. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
 - 1. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
- C. Cold-Weather Placement: Comply with ACI 306.1.
- D. Hot-Weather Placement: Comply with ACI 301.

3.7 FINISHING FORMED SURFACES

- A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
 - 1. Apply to concrete surfaces not exposed to public view.
- B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
 - 1. Apply to concrete surfaces exposed to public view.
- C. Rubbed Finish: Apply the following to smooth-formed finished as-cast concrete where indicated:
 - 1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.
 - 2. Grout-Cleaned Finish: Wet concrete surfaces and apply grout of a consistency of thick paint to coat surfaces and fill small holes. Mix one part Portland cement to one and one-half parts fine sand with a 1:1 mixture of bonding admixture and water. Add white Portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Scrub grout into voids and remove excess grout. When grout whitens, rub surface with clean burlap and keep surface damp by fog spray for at least 36 hours.
 - 3. Cork-Floated Finish: Wet concrete surfaces and apply a stiff grout. Mix one part Portland cement and one part fine sand with a 1:1 mixture of bonding agent and water. Add white portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Compress grout into voids by grinding surface. In a swirling motion, finish surface with a cork float.
- D. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

3.8 FINISHING FLOORS AND SLABS

- A. General: Comply with ACI 302.1R recommendations for screeding, re-straightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, and ramps, and elsewhere as indicated.
 - 1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

3.9 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.
- B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- C. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
 - 1. Moisture Curing: Keep surfaces continuously moist for not less than seven days.
 - 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
 - 3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
 - a. After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer.
 - 4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Re-coat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.10 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.
- B. Concrete where samples do not achieve specified 28 day strength or material where same day test strengths vary by 20% is subject to more extensive field testing by core sampling performed and paid for by the contractor.
- C. Concrete with strength below the specified strength is subject to removal and replacement by the contractor at no expense to the Owner.

3.11 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Owner will engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

END OF SECTION 033000

SECTION 03 3000

CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Cast-in-place concrete for piers, foundations and slabs on grade,
 - 2. Equipment pads.
 - 3. Bases for lighting fixtures
- B. Related Sections:
 - 1. Division 01: Administrative, procedural, and temporary work requirements.

1.2 REFERENCES

- A. American Concrete Institute (ACI):
 - 1. 301 - Structural Concrete for Buildings.
 - 2. 305R - Hot Weather Concreting.
 - 3. 306R - Cold Weather Concreting.
 - 4. 308 - Standard Practice for Curing Concrete.
 - 5. 318 - Building Code Requirements for Structural Concrete.
- B. ASTM International (ASTM):
 - 1. C31 - Standard Test Method for Method of Making and Curing Concrete Test Specimens in the Field.
 - 2. C33 - Standard Specification for Concrete Aggregates.
 - 3. C39 - Standard Test Method for Test Method for Compressive Strength of Cylindrical Concrete Specimens.
 - 4. C94 - Standard Specification for Ready-Mixed Concrete.
 - 5. C143 - Standard Test Method for Slump of Portland Cement Concrete.
 - 6. C150 - Standard Specification for Portland Cement.
 - 7. C171 - Standard Specification for Sheet Materials for Curing Concrete.
 - 8. C172 - Standard Test Method for Method of Sampling Freshly Mixed Concrete.
 - 9. C231 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
 - 10. C260 - Standard Specification for Air-Entraining Admixtures for Concrete.
 - 11. C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
 - 12. C330 - Standard Specification for Lightweight Aggregates for Structural Concrete.
 - 13. C494 - Standard Specification for Chemical Admixtures for Concrete.
 - 14. C618 - Standard Specification for Fly Ash and Raw or Calcined Natural Pozzolans for Use as a Mineral Admixture in Portland Cement Concrete.
 - 15. C1116 - Standard Specification for Fiber-Reinforced Concrete and Shotcrete.
 - 16. D1752 - Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.

1.3 SUBMITTALS

- A. Submittals for Review:
 - 1. Concrete Mix Designs: Include:
 - a. Proportions of cement, fine and coarse aggregates, [fibrous reinforcing,] and water.
 - b. Combined aggregate gradation.
 - c. Aggregate specific gravities and gradations.
 - d. Water/cement ratio, design strength, slump, and air content.
 - e. Type of cement and aggregates.
 - f. Air dry density and split cylinder ratio for lightweight concrete.
 - g. Type and proportion of admixtures.

- h. Special requirements for pumping.
- i. Range of ambient temperature and humidity for which design is valid.
- j. Special characteristics of mix requiring precautions in mixing, placing, or finishing techniques to achieve finished product.

- B. Sustainable Design Submittals
 - 1. Regional Materials.

1.4 QUALITY ASSURANCE

- A. Concrete Mix Design: In accordance with ACI 301, Method 1 or 2.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Mix and deliver concrete to project ready mixed in accordance with ASTM C94.
- B. Schedule delivery so that pours will not be interrupted for over 15 minutes.
- C. Place concrete on site within 90 minutes after proportioning materials at batch plant.

1.6 PROJECT CONDITIONS

- A. Cold Weather Placement - Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures. Comply with ACI 306R and following requirements:
 - 1. Air temperature at or expected to fall below 40 degrees F, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 degrees F and not more than 80 degrees F at point of placement.
 - 2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen sub-grade or on sub-grade containing frozen materials.
 - 3. Do not use calcium chloride, salt, and other materials containing antifreeze agents or chemical accelerators unless otherwise accepted in mix designs.
- B. Hot Weather Placement - Place concrete in accordance with ACI 305R and following requirements:
 - 1. Cool ingredients before mixing to maintain concrete temperature at time of placement below 90 degrees F. Use chilled mixing water or chopped ice if water equivalent of ice is calculated in total amount of mixing water.
 - 2. If required, cover reinforcing steel with water-soaked burlap so that steel temperature will not exceed ambient air temperature.
 - 3. Fog spray forms, reinforcing steel, and sub-grade just before concrete is placed.
 - 4. Use water-reducing retarding admixture when required by high temperatures, low humidity, or other adverse placing conditions.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers - Concrete Chemicals:

1. Burke by Edoco. (www.burkebyedeco.com)	Not Used
2. Conspec Marketing and Manufacturing. (www.conspecmkt.com)	Not Used
3. Dayton/Richmond. (www.daytonrichmond.com)	Not Used
4. BASF Admixtures, Inc. (www.masterbuilders.com)	
5. W. R. Meadows, Inc. (www.wrmeadows.com)	
6. Nox-Crete Products Group. (www.nox-crete.com)	
- B. Substitutions: Not permitted.

2.2 MATERIALS

- A. Portland Cement: ASTM C150, Type I or III, gray color.
- B. Aggregates:
 - 1. Fine: ASTM C33, clean, hard, durable, uncoated natural sand, free from silt, loam, and clay.
 - 2. Coarse: ASTM C33, clean, hard, durable, uncoated crushed stone, maximum size No. ASSHTO 67
 - 3. Lightweight: ASTM C330, expanded shale or clay produced by rotary kiln method.
- C. Fly Ash: ASTM C618, maximum 2 percent loss on ignition.
- D. Fibrous Reinforcing: ASTM C1116, 100 percent virgin polypropylene, free from reprocessed olefin materials and specifically manufactured for use as concrete secondary reinforcement.

2.3 ACCESSORIES

- A. Water: Clean and potable.
- B. Admixtures:
 - 1. Water reducing or water reducing/set retarding: ASTM C494, Type A or D.
 - 2. Air entraining: ASTM C260. – Required for Slabs – on- Grade Only
- C. Expansion Joint Filler: ASTM D1752, Non-alphabetic type.
- D. Non-Shrink Grout: Premixed, consisting of non-metallic aggregate, cement, water reducing and plasticizing agents; minimum 7,000 psi compressive strength at 28 days.
- E. Bonding Agent: Two component modified epoxy resin.
- F. Curing Compound: ASTM C309, water based type.
- G. Curing Paper: ASTM C171, waterproof paper or polyethylene film.

2.4 MIXES

- A. Proportions: In accordance with ACI 301.
- B. Design concrete to yield characteristics indicated on Drawings.
- C. Air Entrained Concrete: Provide air entraining admixture to produce 4 to 6 percent air by volume of concrete.
- D. Fibrous Reinforced Concrete:
 - 1. Add fibrous reinforcing to concrete at time concrete is batched to provide 3,000 pounds of reinforcing per cubic yard of concrete.
 - 2. Ensure complete distribution.
- E. Use accelerating admixture in cold weather only when approved by Architect. Use of admixtures will not reduce cold weather placement requirements.

PART 3 EXECUTION

3.1 PREPARATION

- A. Notify Architect and Testing Laboratory minimum 48 hours prior to placing concrete.
- B. Accurately position anchor bolts, sleeves, conduit, inserts, and accessories. Do not cut reinforcing steel to facilitate installation of inserts or accessories.

- C. Remove water and debris from forms and excavations.
- D. Close openings left in forms for cleaning and inspection.
- E. Prepare previously placed and existing concrete surfaces by cleaning with steel wire brush and applying bonding agent in accordance with manufacturer's instructions.
- F. Where new concrete is doweled to existing, drill holes in existing concrete, insert steel dowels, and pack holes solid with non-shrink grout.

3.2 PLACEMENT OF CONCRETE

- A. Place concrete in accordance with ACI 301 and ACI 318.
- B. Ensure reinforcement, inserts, and embedded parts are not disturbed during concrete placement.
- C. Deposit concrete as nearly as possible in its final position to minimize handling and flowing.
- D. Place concrete continuously between predetermined expansion, control, and construction joints.
- E. Do not place partially hardened, contaminated, or re-tempered concrete.
- F. Do not allow concrete to free fall over 3 feet; provide tremie, chutes, or other means of conveyance.
- G. Consolidate concrete with mechanical vibrating equipment. Hand compact in corners and angles of forms.
- H. Scream slabs level, to flatness tolerance of 1/8 inch in 10 feet.

3.3 PLACEMENT OF SEPARATE FLOOR TOPPINGS

- A. Prior to placing toppings, remove deleterious material from concrete substrates; broom surfaces clean.
- B. Apply bonding agent to concrete substrate; follow manufacturer's instructions.

3.4 PLACEMENT OF GROUT

- A. Remove loose and foreign matter from concrete; lightly roughen bonding surface.
- B. Just prior to grouting, thoroughly wet concrete surfaces; remove excess water.
- C. Mix grout in accordance with manufacturer's instructions. Do not re-temper.
- D. Place grout continuously, by most practical means; avoid entrapped air. Do not vibrate grout.

3.5 PROTECTION

- A. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.
- B. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.
- C. Provide artificial heat to maintain temperature of concrete above minimum specified temperature for duration of curing period.

- D. Keep forms sufficiently wet to prevent cracking of concrete or loosening of form joints.

3.6 CURING

- A. Cure concrete in accordance with ACI 308:
1. Horizontal surfaces:
 - a. Surfaces to receive additional toppings or setting beds: Use curing paper method.
 - b. Other surfaces: Use either curing paper or curing compound method.
 2. Vertical surfaces: Use either wet curing or curing compound method.
- B. Curing Compound Method:
1. Spray compound on surfaces in two coats, applying second at right angle to first, at minimum rate recommended by manufacturer.
 2. Restrict traffic on surfaces during curing.
- C. Curing Paper Method:
1. Spread curing paper over surfaces, lapping ends, and sides minimum 4 inches; maintain in place by use of weights.
 2. Remove paper after curing.
- D. Wet Curing Method: Spray water over surfaces and maintain wet for 7 days.

3.7 CLEANING

- A. Remove efflorescence, stains, oil, grease, and foreign materials from exposed surfaces.

3.8 FIELD QUALITY CONTROL

- A. Testing and Inspection Services:
1. Certify each delivery ticket.
 2. Record time at which concrete was discharged from truck.
 3. Monitor and record amount of water and water reducing admixture added to concrete at project site.
 4. Determine ambient temperature and temperature of concrete sample for each set of test cylinders.
 5. Test cylinders:
 - a. Make test cylinders in accordance with ASTM C172; one set of 3 cylinders for each 25 cubic yards or fraction thereof placed in any one day, for each different class of concrete.
 - b. Mold and cure cylinders in accordance with ASTM C31; test cylinders in accordance with ASTM C39; one at 7 days and two at 28 days.
 6. Slump tests: Make slump tests at the beginning of each day's placement and for each set of test cylinders in accordance with ASTM C143.
 7. Air content: Determine total air content of air entrained concrete for each strength test in accordance with ASTM C231.

3.9 CONCRETE SCHEDULE

Minimum 28 Day Compressive Strength	Slump	Comments	Uses
3000psi	4 to 6inches		Piers &Footings
4000psi	3 to 5 inches	Fibrous reinforcing	Slabs on grade

END OF SECTION

DIVISION 04

SECTION 04 0513

MASONRY MORTARING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Mortar for masonry.
- B. Related Sections:
 - 1. Division 01: Administrative, procedural, and temporary work requirements.
 - 2. Section 04 2000 - Unit Masonry.
 - 3. Section 04 2300 - Glass Unit Masonry.

1.2 REFERENCES

- A. ASTM International (ASTM):
 - 1. C91 - Standard Specification for Masonry Cement.
 - 2. C144 - Standard Specification for Aggregate for Masonry Mortar.
 - 3. C150 - Standard Specification for Portland Cement.
 - 4. C199 - Standard Test Method for Pier Test for Refractory Mortar.
 - 5. C207 - Standard Specification for Hydrated Lime for Masonry Purposes.
 - 6. C270 - Standard Specification for Mortar for Unit Masonry.
 - 7. C1329 - Standard Specification for Mortar Cement.
- B. The Masonry Society (TMS):
 - 1. 402 - Building Code for Masonry Structures.
 - 2. 602 - Specification for Masonry Structures.

1.3 SUBMITTALS

- A. Quality Control Submittals:
 - 1. Test reports: Indicating mortar compliance with ASTM C270.
 - 2. Delivery tickets: If mortar is delivered to site dry and pre-blended, furnish delivery tickets indicating quantity, mortar type, and date of manufacture.

1.4 QUALITY ASSURANCE

- A. Perform Work in accordance with TMS 402 and 602.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Deliver cement and lime in manufacturer's original, unopened packages or containers.
- B. Protect materials from moisture absorption and damage; reject damaged containers.
- C. Store aggregate to prevent inclusion of foreign matter.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers - Cement:
1. Essroc Cement Corp. (www.essroc.com)
 2. ~~LaFarge North America, Inc. (www.lafarge-na.com)~~ **Not Used**
 3. Lehigh Cement Co. (www.lehighcement.com)
 4. Texas Industries, Inc. (www.txi.com)
- B. Acceptable Manufacturers - Lime:
1. ~~Chemical Lime Co. (www.chemicallime.com)~~ **Not Used**
 2. Graymont Dolime (OH) Inc. (www.graymont-oh.com)
 3. ~~Rockwell Lime Co. (www.rockwelllime.com)~~ **Not Used**
- C. Acceptable Manufacturers - Preblended Mortars and Grouts:
1. Quikrete Companies. (www.quikrete.com)
- D. Acceptable Manufacturers - Colorants:
1. ~~Arizona Oxides LLC. (www.arizonaoxides.com)~~ **Not Used**
 2. Davis Colors. (www.daviscolors.com)
 3. Solomon Colors. (www.solomoncolors.com)
- E. Substitutions: Not permitted.

2.2 MATERIALS

- A. Masonry Cement: ASTM C91, Type S.

2.3 MIXES

- A. Mortar Mixes: To ASTM C270 using the Proportion Method.
1. Concrete unit masonry: Type S, gray color.
 2. Glass unit masonry: Type S, gray color.

2.4 MIXING

- A. Mix mortar in accordance with ASTM C270.
- B. Job site Proportioning of Mortar:
1. Mix using mechanical mixer. Hand mixing not permitted.
 2. Mix approximately three-quarters of required water, all of cement and lime, and one-half of aggregate for minimum of 2 minutes.
 3. Add remainder of water and aggregate; mix for minimum of 3 minutes.
- C. Dry Preblended Mortar:
1. Mix using continuous, self-cleaning mixer mounted at apex of silo cone.
 2. Set water flow valve to provide workable consistency.
- D. Provide uniformity of color in exposed mortar.
- E. Thoroughly mix ingredients in quantities needed for immediate use.
- F. Discard lumpy, caked, frozen, and hardened mixes.
- G. Mortar may be re-tempered by adding water as required. Use mortar within 2-1/2 hours after initial mixing at ambient temperatures below 80 degrees F and within 1-1/2 hours after

- H. Do not add accelerators, retarders, water repellents, antifreeze compounds, or other additives without Architect's approval.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Follow requirements specified in referenced sections.

INSTALLATION INFORMATION:

For the glazed face of every connection that is intended to make face to face adhesion use the following.
Laticrete Spectralock pro premium grout Part A & B.

B. Special features and Performance

1. Stainproof, Part number: 0229-0060-21
2. Improved non-sag formula for walls and floors
3. Uniform color—no blotchiness or shading
4. Never needs sealing
5. Easy to maintain, cleanable to the original color
6. Meets performance requirements of ANSI A118.3
7. 80 minutes working time at 70 ° F (21 ° C)
8. Equipped with antimicrobial product protection to fight the growth of stain-causing mold and mildew
9. Ideal for installations at wide temperature ranges
10. Tough, durable and crack resistant
11. Outperforms cement based grout
12. Can be used with optional SPECTRALOCK DAZZLE™ additive grout
13. Can be used for grout joints from 1/16-1/2"
14. Available in 40 standard grout colors

C. Cleaning

1. Stainproof, to common household cleaners, liquids and other goods. Clean all spills immediately.

D. PRODUCT COMPARABILITY

1. SPECTRA GLAZE BLOCK

E. PACKAGING SUMMARY

Unit Size	Yield	Parts A & B	Part C Color Powder
3.2 US gal (12.0 L)		A: 4 x 18.1 fl.oz. (536.1 mL) B: 4 x 18.6 fl.oz. (549.3 mL) C: 4 x 9.0 lb (4.0 kg)	S-4, Light Frost Gray

F. INSTALLATION INSTRUCTIONS

1. REQUIRED SUBMITTAL LATICRETE **INSTALLATION INSTRUCTIONS ds-6815-la-en.pdf**
2. REQUIRED SUBMITTAL LATICRETE **PRODUCT DATA SHEETS PART A, B & C**
3. REQUIRED SUBMITTAL LATICRETE **SAFETY DATA SHEETS PART A, B & C**

END OF SECTION

SECTION 04 0516

MASONRY GROUTING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Grout for masonry.
- B. Related Sections:
 - 1. Division 01: Administrative, procedural, and temporary work requirements.
 - 2. Section 04 2000 - Unit Masonry.

1.2 REFERENCES

- A. ASTM International (ASTM):
 - 1. C91 - Standard Specification for Masonry Cement.
 - 2. C150 - Standard Specification for Portland Cement.
 - 3. C207 - Standard Specification for Hydrated Lime for Masonry Purposes.
 - 4. C404 - Standard Specification for Aggregates for Masonry Grout.
 - 5. C476 - Standard Specification for Mortar and Grout for Reinforced Masonry.
- B. The Masonry Society (TMS):
 - 1. 402 - Building Code for Masonry Structures.
 - 2. 602 - Specification for Masonry Structures.

1.3 SUBMITTALS

- A. Quality Control Submittals:
 - 1. Test reports: Indicating grout compliance with ASTM C476.

1.4 QUALITY ASSURANCE

- A. Perform Work in accordance with TMS 402 and 602.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Deliver cement and lime in manufacturer's original, unopened packages or containers.
- B. Protect materials from moisture absorption and damage; reject damaged containers.
- C. Store aggregate to prevent inclusion of foreign matter.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers - Cement:
 - 1. Essroc Cement Corp. (www.essroc.com)
 - 2. ~~LaFarge North America, Inc. (www.lafarge-na.com)~~ **Not Used**
 - 3. Lehigh Cement Co. (www.lehighcement.com)
 - 4. Texas Industries, Inc. (www.txi.com)
- B. Acceptable Manufacturers - Lime:

1. ~~Chemical Lime Co. (www.chemicallime.com)~~ **Not Used**
2. Graymont Dolime (OH) Inc. (www.graymont-oh.com)
3. ~~Rockwell Lime Co. (www.rockwelllime.com)~~ **Not Used**

C. Substitutions: Not permitted.

2.2 MATERIALS

- A. Portland Cement: ASTM C150, Type I.
- B. Aggregate: ASTM C404.
- C. Lime: ASTM C207, Type S.
- D. Water: Clean and free from oils, acids, alkalies, organic matter, and other substances in amounts deleterious to mortar or metals in masonry.

2.3 MIXES

- A. Grout Mix:
 1. ASTM C476, coarse grout.
 2. Compressive strength: Minimum 2500 psi at 28 days.
 3. Slump: 7 to 8 inches.

2.4 MIXING

- A. Mix grout in accordance with ASTM C476.
- B. Thoroughly mix ingredients in quantities needed for immediate use.
- C. Mix dry ingredients mechanically until uniformly distributed; add water to achieve workable consistency.
- D. Discard lumpy, caked, frozen, and hardened mixes.
- E. Use grout within 2-1/2 hours after initial mixing at ambient temperatures below 80 degrees F and within 1-1/2 hours after initial mixing at ambient temperatures over 80 degrees F.
- F. Do not add accelerators, retarders, water repellents, antifreeze compounds, or other additives without Architect's approval.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Follow requirements specified in referenced sections.

END OF SECTION

SECTION 04 2000

UNIT MASONRY

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Concrete unit Masonry.
- B. Related Sections:
 - 1. Division 01: Administrative, procedural, and temporary work requirements.
 - 2. Section 04 0513 - Masonry Mortaring.
 - 3. Section 04 0516 - Masonry Grouting.
 - 4. Section 07 9200 - Joint Sealers.

1.2 REFERENCES

- A. ASTM International (ASTM)
 - 1. A153/A153M - Standard Specification for Zinc-Coating (Hot Dip) on Iron and Steel Hardware.
 - 2. A167 - Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
 - 3. A615/A615M - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
 - 4. A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
 - 5. A951 - Standard Specification for Masonry Joint Reinforcement.
 - 6. B370 - Standard Specification for Copper Sheet and Strip for Building Construction.
 - 7. C27 - Standard Classification of Fireclay and High-Alumina Refractory Brick.
 - 8. C67 - Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile.
 - 9. C90 - Standard Specification for Hollow Loadbearing Concrete Masonry Units.
 - 10. C129 - Standard Specification for Hollow Nonloadbearing Concrete Masonry Units.
 - 11. C216 - Standard Specification for Facing Brick (Solid Units Made from Clay or Shale).
 - 12. C315 - Standard Specification for Clay Flue Linings.
 - 13. C652 - Standard Specification for Hollow Brick (Hollow Masonry Units Made From Clay or Shale).
 - 14. C744 - Standard Specification for Prefaced Concrete and Calcium Silicate Masonry Units.
 - 15. C780 - Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Concrete.
 - 16. C1019 - Standard Test Method for Sampling and Testing Grout.
 - 17. C1261 - Standard Specification for Firebox Brick for Residential Fireplaces.
 - 18. C1283 - Standard Practice for Installing Clay Flue Linings.
 - 19. C1314 - Standard Test Method for Compressive Strength of Masonry Prisms.
 - 20. C1386 - Standard Specification for Precast Autoclaved Aerated Concrete (PAAC) Wall Construction Units.
- B. The Masonry Society (TMS):
 - 1. 402 - Building Code for Masonry Structures.
 - 2. 602 - Specification for Masonry Structures.

1.3 SUBMITTALS

- A. Submittals for Review:
 - 1. Product Data: Provide information on reinforcing and anchors including sizes, profiles, materials, and finishes.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Minimum 5 years [documented] experience in work of this Section.
- B. Perform Work in accordance with TMS 402 and 602.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Store masonry off ground; prevent contact with materials that could cause staining or damage.
- B. Protect reinforcement and anchors from corrosion.

1.6 PROJECT CONDITIONS

- A. Wall Protection:
 - 1. During erection, cover tops of partially completed walls with strong waterproof membrane at end of each day or work stoppage.
 - 2. Extend cover minimum of 24 inches down both sides; hold securely in place.
- B. Load Application:
 - 1. Do not apply uniform loads for at least 12 hours after building masonry columns or walls.
 - 2. Do not apply concentrated loads for at least 3 days after building masonry columns or walls.
- C. Environmental Requirements:
 - 1. Hot weather requirements: If ambient temperature is over 95 degrees F or relative humidity is less than 50 percent, protect from direct sun and wind exposure for minimum 48 hours after installation.
 - 2. Cold weather requirements: Do not use frozen materials or build on frozen work.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers – Standard Concrete Masonry Units:
 - 1. Featherlite Building Products.
- B. Acceptable Manufacturers – Custom Concrete Masonry Units:
 - 1. Spectra Development Corp. (www.spectraglaze.com)
 - 2. Trenwyth Industries. (www.trenwyth.com)
- C. Acceptable Manufacturers - Brick Masonry Units:
 - 1. Spectra-Glaze. <https://spectraglaze.com/>
 - 2. Johnson Concrete Product. <https://johnsonproductsusa.com/>
 - 3. Acme Brick Co. (www.brick.com)
 - 4. Belden Brick Co. (www.beldenbrick.com)
 - 5. Endicott Clay Products. (www.endicott.com)
 - 6. Glen-Gery Corporation. (www.glengerybrick.com)
- D. Acceptable Manufacturers - Autoclaved Aerated Concrete Masonry Units:
- E. Acceptable Manufacturers - Fireclay Brick Masonry Units:
- F. Acceptable Manufacturers - Masonry Accessories:
 - 1. Blok-Lok Ltd. (www.blok-lok.com)
 - 2. Dur-O-Wal. (www.dur-o-wal.com)
 - 3. Heckmann Building Products. (www.heckmannbuildingprods.com)
 - 4. Hohmann and Barnard, Inc. (www.h-b.com)

- G. Substitutions: Not permitted.

2.2 MATERIALS

- A. Standard Concrete Masonry Units: Spectra Glaze.
 - 1. ASTM C90, hollow load bearing type, normal weight, Type I - Moisture Controlled.
 - 2. ASTM C652, Grade [SW,] [MW,] [SW,] Type [HBS.] [HBX.] [HBA.] [HBB.]
 - 3. Modular Size: 1-1/4" x 7-5/8" high x 11-5/8" wide x 15-5/8" long.
 - 4. Modular Size: 1-1/4" x 7-5/8" high x 5-5/8" wide x 15-5/8" long
 - 5. Surface texture: Glaze
 - 6. Special shapes: As indicated on Drawings.
 - 7. Provide solid units where holes would otherwise occur on exposed faces.

2.3 ACCESSORIES

- A. Mortar: Specified in Section 04 0513.
- B. Grout: Specified in Section 04 0516.
- C. Single Wythe Joint Reinforcement:
 - 1. Ladder type; ASTM A951, hot-dip galvanized steel wire.
 - 2. Width: Nominal wall thickness less 1-1/2 inches.
 - 3. Corner and tee fittings: Type to match reinforcement.

PART 3 EXECUTION

3.1 PREPARATION

- A. Wet block having an absorption rate in excess of 20 g per 30 square inches per minute as determined by ASTM C67 so that absorption rate when laid does not exceed this amount.
- B. Remove dirt, loose rust, and other foreign matter from reinforcement and anchors.

3.2 INSTALLATION

- A. Establish lines, levels and courses indicated. Protect from displacement.
- B. Maintain masonry courses to uniform dimensions. Form horizontal and vertical joints of uniform thickness.
- C. Lay concrete masonry in stacked bond. Course one masonry unit and one mortar joint to equal 8 inches.
- D. Lay block masonry in stacked bond.
- E. Lay masonry plumb and level. Do not adjust masonry units after mortar has set.

- F. Lay solid masonry units in full mortar bed, with full head joints. Lay hollow masonry units with face shell bedding on head and bed joints.
- G. Do not butter corners or excessively furrow joints.
- H. Machine cut masonry with straight cuts and clean edges; prevent over sized or undersized joints. Discard damaged units. Do not expose cut cells.
- I. Isolate masonry from structural members with compressible filler.
- J. When joining fresh masonry to partially set masonry, remove loose masonry and mortar; clean and lightly wet exposed surface of set masonry.
- K. Stop horizontal runs by racking back normal bond unit in each course. Toothing not permitted.
- L. Horizontal Reinforcement:
 - 1. Place reinforcement at maximum 16 inches on center vertically, at topmost course, and at first two courses above and below openings.
 - 2. Extend minimum 24 inches each side of openings.
 - 3. Center reinforcing in wall.
 - 4. Lap ends 6 inches minimum; use fabricated tee and corner fittings at corners and intersections.
- M. Control Joints:
 - 1. Do not continue horizontal joint reinforcement through joints.
 - 2. Keep joints free from mortar and grout.
 - 3. Install joint backing and joint sealer at control joints in accordance with Section 07 9200.
 - 4. Form expansion joint as indicated on Drawings.
- N. Finishing Mortar Joints:
 - 1. Exposed locations: Tool joints to concave profile.
 - 2. Concealed locations: Cut joints flush.
- O. Reinforcing Bars:
 - 1. Position reinforcing accurately and hold securely in place to prevent displacement. Maintain minimum 1 inch space between masonry and reinforcing.
 - 2. Grout at intervals of not more than 60 inches in 6 to 8 inch lifts.
 - 3. Vibrate grout during and after placement to ensure complete filling.
 - 4. Stop grout 1-1/2 inch below top of masonry if grouting is stopped for 1 hour or more, except where completing grouting of finished wall.
- P. Flashings:
 - 1. Install flashing with outer edge flush with outside face of masonry; extend up backup 8 inches minimum and [build into masonry, seal.
 - 2. Lap end joints 4 inches minimum and seal.
 - 3. Form end dams where flashing is stopped or interrupted.
 - 4. Apply trowel coat of mastic along flashing at top edge, seams, cuts, and penetrations.
- Q. Install mortar dropping control continuously in cavities above flashings.
- R. Installation Tolerances; Maximum variation from:
 - 1. Alignment face to face of adjacent units: Plus, or minus 1/8 inch.
 - 2. Vertical alignment of head joints: Plus, or minus 1/2 inch in 10 feet.
 - 3. True plane of wall: Plus or minus 1/4 inch in 10 feet and 1/2 inch in 20 feet or more.
 - 4. Plumb: Plus, or minus 1/4 inch in 10 feet noncumulative; 1/2 inch in 20 feet or more.

5. Level coursing: Plus, or minus 1/8 inch in 3 feet; 1/4 inch in 10 feet; 1/2 inch in 30 feet.
6. Joint thickness: Plus, or minus 1/8 inch.
7. Cross sectional thickness of walls: Plus, or minus 1/4 inch.

3.3 FIELD QUALITY CONTROL

- A. Testing and Inspection Services:
 1. Masonry units: Inspect masonry units prior to and during installation for compliance with specified requirements.
 2. Masonry assemblies:
 - a. Determine compressive strength of masonry by the prism method, ASTM C1314.
 - b. Verify dimensions and condition of grout spaces and type, quantity, and placement of reinforcement during installation and just prior to closing of clean-outs.
 - c. Verify type, quantity, and installation of reinforcement, anchors, and ties.
 - d. Inspect placement of grout.
 3. Grout: Mould and test one set of compressive strength cubes in accordance with ASTM C1019 for each (5,000 square feet) of masonry wall area or fraction thereof. Each side of the building.

3.4 CLEANING

- A. Protect adjacent and underlying surfaces.
- B. Apply masonry cleaner in accordance with manufacturer's instructions.
- C. Thoroughly rinse surfaces with clean water after completion of cleaning; remove all traces of cleaning solution.

END OF SECTION

20-C

HONEY

82-A

ASH GRAY

10

CHIPPED
ICE WHITE

72

COCOA
BROWN

22-A1

SEA GREEN

18-C

CORAL
REEF

26

ASH BROWN

76-S

MOJAVE
TAN

88-C

TERRA
COTTA

20-A

HONEY
PEBBLE

30

BERMUDA
BROWN

78

BRICK RED

54-M

WHEAT

3K-2

CHOCOLATE

10-AGB

PEWTER

16-A

GRAPHITE

31

MAROON

10-A

CHIPPED
WHITE

36-B4

HERSHEY
BROWN

22-B

SAGE
GREEN

14-G

GRANITE

84

FRACKVILLE
BROWN

10-GB

POWDER
GRAY

18-B

ROSE

36

RUSTIC
BROWN

80

MOCASSIN
BROWN

14-A1

LIMESTONE
GRAY

36-B

EARTH
BROWN

12

SANDSTONE
BEIGE

86

MONROE
BLACK

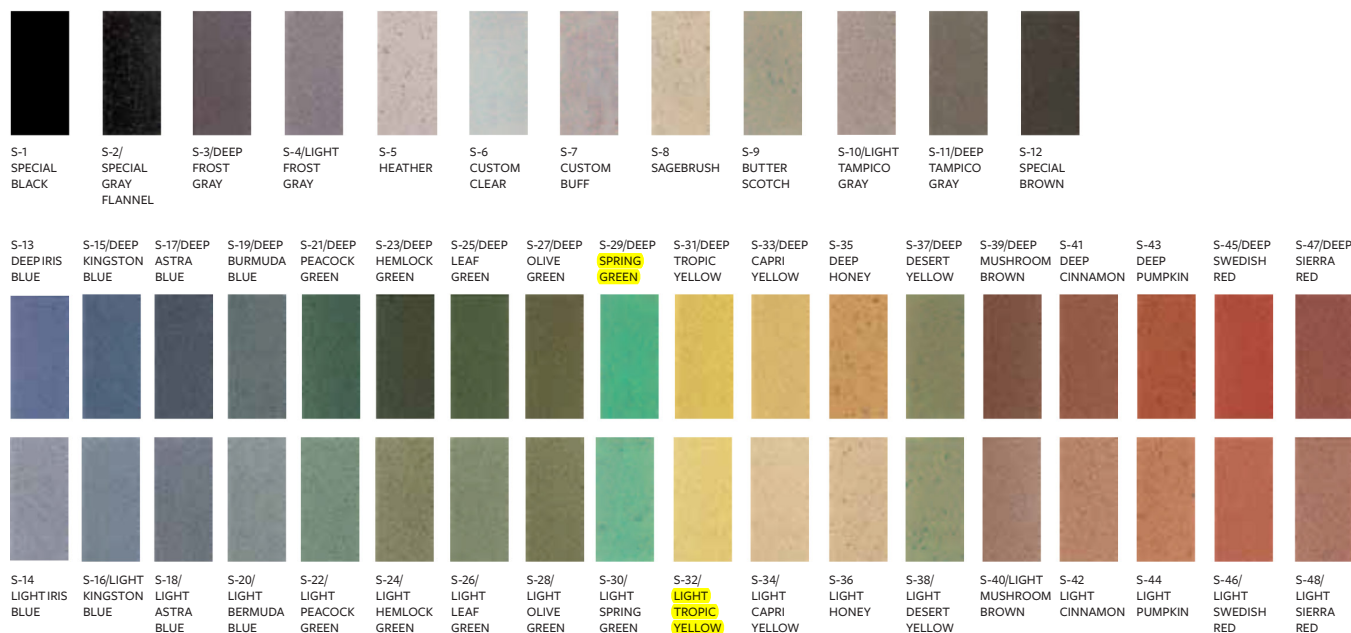
16

CHARCOAL

10-Y1

IVORY

Standard Colors



Vari-Tone® Series

of variegated earthtones perfect for exterior use.

A sound economic alternative with the appearance of natural materials, including granite, stone and marble.



Designer Colors Series

The Signature Collection



CUSTOM COLORS too...

We match anything! Custom colors can be developed to match your requirements. Consult local manufacturer for availability.

NOTE: The colors in this brochure and in color chip kits are for preliminary selection only. Request full size sample to see actual color selection. Specify and erect a sample panel at least 4' x 4' at job site to show typical variation, range, and approval for each color, type, and size of block selected.

Natural and organic pigments incur natural change on the exterior, some more than others. Standard colors have been tested via 12 month exterior evaluations in Florida by the South Florida Test Service, Inc. and under ASTM C-744 for 500 hours of weatherometer. All colors are colorfast for interior use. The best colors for exterior have an asterisk(*) and are whites and pastels. Consult local manufacturer for field experience in your area and test data. Follow proper masonry industry recommended design and installation (see page 14). Specify Spectra-Glaze II Plus units with the Block Rite™ System for raw block and mortar and use as intended in weathertight and breathable wall designs for durable long-lasting masonry. Where appropriate, specify water based epoxy grout for pointing exterior joints and joints in sanitary and food applications.

ALL COLORS ARE LIGHT STABLE FOR INTERIOR USE. SOME FLORESCENT LIGHT GIVES OFF ULTRA-VIOLET RAYS WHICH MAY CAUSE A SLIGHT COLOR SHIFT, EVEN IN LIGHT STABLE PIGMENTS, AFTER MANY YEARS OF EXPOSURE. CONTACT YOUR LOCAL MANUFACTURER FOR DATA ON EXTERIOR FIELD PERFORMANCE.

SECTION 04 2300

GLASS UNIT MASONRY

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Glass Unit Masonry.
- B. Related Sections:
 - 1. Division 01: Administrative, procedural, and temporary work requirements.
 - 2. Section 04 0513 - Masonry Mortaring.

1.2 REFERENCES

- A. ASTM International (ASTM):
 - 1. A153/A153M - Standard Specification for Zinc-Coating (Hot Dip) on Iron and Steel Hardware.
 - 2. A951 - Standard Specification for Masonry Joint Reinforcement.
- B. The Masonry Society (TMS):
 - 1. 402 - Building Code for Masonry Structures.
 - 2. 602 - Specification for Masonry Structures.

1.3 SUBMITTALS

- A. Submittals for Review:
 - 1. Product Data: Provide information on reinforcing and anchors including sizes, profiles, materials, and finishes.

1.4 QUALITY ASSURANCE

- A. Perform Work in accordance with TMS 402 and 602.
- B.
 - a. Masonry units, reinforcing, and anchors.
 - b. Mortar joint size, color, and profile.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Store masonry off ground; prevent contact with materials that could cause staining or other damage.
- B. Protect reinforcement from elements.

1.6 PROJECT CONDITIONS

- A. Wall Protection:
 - 1. During erection, cover tops of partially completed walls with strong waterproof membrane at end of each day or work stoppage.
 - 2. Extend cover minimum of 24 inches down both sides; hold securely in place.
- B. Environmental Requirements:

1. Hot weather requirements: If ambient temperature is over 95 degrees F or relative humidity is less than 50 percent, protect from direct sun and wind exposure for minimum 48 hours after installation.
2. Cold weather requirements: Do not use frozen materials or build upon frozen work.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers - Glass Unit Masonry:
1. Seves Glass Block, Inc. (<https://sevesglassblockinc.com/>)
 2. ~~Spectrum Block. (www.spectrumblock.com)~~ **Not Used**
 3. Weck Glass Block/Glashaus, Inc. (<https://www.pittsburghglassblock.com/>)
- B. Acceptable Manufacturers - Masonry Accessories:
1. Blok-Lok Ltd. (www.blok-lok.com)
 2. Dur-O-Wal. (www.dur-o-wal.com)
 3. Heckmann Building Products. (www.heckmannbuildingprods.com)
 4. Hohmann and Barnard, Inc. (www.h-b.com)
- C. Substitutions: Not permitted.

2.2 MATERIALS

- A. Glass Block:
1. Size: Nominally 8 x 8 inches x 4 inches thick.
 2. Color: Clear.
 3. Pattern: Decora wave.

2.3 ACCESSORIES

- A. Mortar: Specified in Section 04 0513.
- B. Joint Reinforcing: Ladder type; ASTM A951, galvanized steel wire, 9 gage side rods with 9 gage cross ties.
- C. Anchors: 1-3/4 inches wide x 24 inches long, 20 gage perforated steel strips, hot dip galvanized, ASTM A153/A153M, B2 finish].

Fasteners: Stainless steel.

- D. Expansion Strips: Manufacturer's standard.
- E. Asphalt Emulsion: Water based.
- F. Cleaner: or approved substitute. Type recommended by masonry manufacturer.

PART 3 EXECUTION

3.1 PREPARATION

- A. Remove dirt, loose rust, and other foreign matter from reinforcement and anchors.

3.2 INSTALLATION

- A. Establish lines, levels and courses indicated. Protect from displacement.

- B. Maintain masonry courses to uniform dimensions. Form horizontal and vertical joints of uniform thickness.
- C. Lay units in stack bond. Course one unit and one mortar joint to equal 8" inches.
- D. Cover sills with heavy coat of asphalt emulsion.
- E. Adhere expansion strips to head and jambs with spot applications of asphalt emulsion; extend expansion joints completely to sill.
- F. Lay masonry plumb and level. Do not adjust masonry units after mortar has set.
- G. Lay masonry units in full mortar bed, with full head joints.
- H. Do not butter corners or excessively furrow joints.
- I. Isolate masonry from structural members with compressible filler.
- J. Place reinforcing at maximum 24 inches on center vertically. Lap ends 6 inches minimum.
- K. Place anchors at jambs at maximum 24 inches on center.
- L. Tool mortar joints to concave profile. Rake out joints requiring sealant.
- M. Remove excess mortar from exposed faces immediately.
- N. Installation Tolerances; Maximum variation from:
 - 1. Alignment face to face of adjacent units: Plus, or minus 1/8 inch.
 - 2. Vertical alignment of head joints: Plus or minus 1/2 inch in 10 feet.
 - 3. True plane of wall: Plus, or minus 1/4 inch in 10 feet and 1/2 inch in 20 feet or more.
 - 4. Plumb: Plus, or minus 1/4 inch in 10 feet.
 - 5. Level coursing: Plus, or minus 1/8 inch in 3 feet; 1/4 inch in 10 feet; 1/2 inch in 30 feet.
 - 6. Joint thickness: Plus, or minus 1/8 inch.

3.3 CLEANING

- A. Protect adjacent and underlying surfaces.
- B. Apply masonry cleaner in accordance with manufacturer's instructions.
- C. Thoroughly rinse surfaces with clean water after completion of cleaning; remove all traces of cleaning solution.

END OF SECTION

DIVISION 05

**SECTION 05 5213
PIPE AND TUBE RAILINGS**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Aluminum pipe and tube railings.

1.3 REFERENCES

- A. Aluminum Association (AA)
 - 1. ABH-21 Aluminum Brazing Handbook
 - 2. ASD-1 Aluminum Standards and Data
 - 3. DAF-45 Designation System for Aluminum Finishes
 - 4. SAA-46 Standards for Anodized Architectural Aluminum
- B. American Architectural Manufacturers Association (AAMA)
 - 1. AAMA 605.1 Specification for High Performance Organic Coatings on Architectural Extrusions and Panels.
 - 2. AAMA 606.1 Voluntary Guide Specifications and Inspection Methods of Integral Color Anodic Finishes for Architectural Aluminum.
 - 3. AAMA 607.1 Voluntary Guide Specifications and Inspection Methods for Clear Anodic Finishes for Architectural Aluminum.
 - 4. AAMA 608.1 Voluntary Guide Specifications and Inspection Methods for Electrolytically Deposited Color Anodic Finishes for Architectural Aluminum.
- C. American Society for Testing and Materials (ASTM)
 - 1. B 209 Specification for Aluminum and Aluminum Alloy Sheet and Plate.
 - 2. B 210 Specification for Aluminum and Aluminum Alloy Drawn Seamless Tubes.
 - 3. B 211 Aluminum and Aluminum Alloy Bar, Rod and Wire
 - 4. B 221 Specification for Aluminum-Alloy Bars, Rods, Wires, Shapes and Tubes
 - 5. B 241 Specification for Aluminum and Aluminum Alloy Seamless Pipe and Seamless Extruded Tube.
 - 6. B 429 Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.
 - 7. B 483 Specification for Aluminum and Aluminum-Alloy Drawn Tubes for General Purpose Applications.
 - 8. D 1730 Recommended Practices for Preparation of Aluminum and Aluminum Alloy Surfaces for Painting.

9. E 894 Standard Test Methods for Anchorage of Permanent Metal Railing Systems and Rails for Buildings.
 10. E 935 Standard Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings.
 11. E 985 Specification for Permanent Metal Railing Systems and Rails for Buildings.
- D. National Association of Architectural Metal Manufacturers (NAAMM) and National Ornamental and Miscellaneous Metals Association (NOMMA)
1. Metal Finishes Manual

1.4 PERFORMANCE REQUIREMENTS

- A. General: In engineering railings to withstand structural loads indicated, determine allowable design working stresses of railing materials based on the following:
1. Aluminum: The lesser of minimum yield strength divided by 1.65 or minimum ultimate tensile strength divided by 1.95.
- B. Structural Performance: Provide railings capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
1. Handrails:
 - a. Concentrated load of 200 lb f applied in any direction.
 2. Top Rails of Guards:
 - a. Uniform load of 50 lb f/ ft. applied horizontally and concurrently with 100 lb f/ ft. applied vertically downward.
 3. Infill of Guards:
 - a. Concentrated load of 50 lb f applied horizontally on an area of 1 sq. ft. (0.093 sq. m).
- C. Thermal Movements: Provide exterior railings that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, over-stressing of components, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.
- D. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1.5 SUBMITTALS

- A. Product Data: For the following:
1. Manufacturer's product lines of mechanically connected railings.

2. Grout, anchoring cement, and paint products.
 - B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 1. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - a. Show sections and plans of stairs, dimensions and assembly of components.
 - 1) Railings
 - 2) Handrail
 - 3) Brackets
 - 4) Reinforcements
 - 5) Anchors
 - 6) Welded and bolted connections
 - b. Show all field connections
 - c. Provide setting diagrams for installation of anchors, location of pockets, weld plates for attachment of rails to structure, and blocking for attachment of wall rail.
 - d. Specify adequate back up support for anchoring handrail bracket.
 - e. Indicate all required field measurements.
 - C. Samples for Initial Selection: For products involving selection of color, texture, or design, including mechanical finishes on stainless steel.
 - D. Samples for Verification: For each type of exposed finish required.
 1. Sections of each distinctly different linear railing member, including handrails, top rails, posts, and balusters.
 2. Fittings and brackets.
 3. Assembled Sample of railing system, made from full-size components, including top rail, post, handrail, and infill. Sample need not be full height.
 - a. Show method of finishing members at intersections.
 - E. Welding certificates.
 - F. Qualification Data: For testing agency.
 - G. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, according to ASTM E 894 and ASTM E 935.
- 1.6 QUALITY ASSURANCE
- A. Source Limitations: Obtain each type of railing through one source from a single manufacturer.
 - B. Welding: Qualify procedures and personnel according to the following:
 1. AWS D1.2, "Structural Welding Code—Aluminum.

1.7 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with railings by field measurements before fabrication and indicate measurements on Shop Drawings.
 - 1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating railings without field measurements. Coordinate wall and other contiguous construction to ensure that actual dimensions correspond to established dimensions.
 - 2. Provide allowance for trimming and fitting at site.

1.8 COORDINATION AND SCHEDULING

- A. 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.
- B. 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.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- 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. Aluminum Pipe and Tube Railings:
 - a. AlumaGuard Corp.
 - b. ATR Technologies, Inc.
 - c. Blum, Julius & Co., Inc.
 - d. Braun, J. G., Company; a division of the Wagner Companies.
 - e. CraneVeyor Corp.
 - f. Hollaender Manufacturing Company.
 - g. Moultrie Manufacturing Company.
 - h. Pisor Industries, Inc.
 - i. Sterling Dula Architectural Products, Inc.
 - j. Superior Aluminum Products, Inc.
 - k. Thompson Fabricating, LLC.
 - l. Tubular Specialties Manufacturing, Inc.
 - m. Tuttle Aluminum & Bronze.
 - n. Wagner, R & B, Inc.; a division of the Wagner Companies.
 - o. Approved Equal

2.2 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.

2.3 ALUMINUM

- A. Aluminum, General: Provide alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with not less than the strength and durability properties of alloy and temper designated below for each aluminum form required.
- B. Extruded Bars: ASTM B 221 (ASTM B 221M), Alloy 6063-T52.
- C. Extruded Structural Pipe and Round Tubing: ASTM B 429, Alloy 6063-T6.
 - 1. Provide Standard Weight (Schedule 40) pipe, unless otherwise indicated.
- D. Drawn Seamless Tubing: ASTM B 210 (ASTM B 210M), Alloy 6063-T832.
- E. Plate and Sheet: ASTM B 209 (ASTM B 209M), Alloy 6061-T6.
- F. Die and Hand Forgings: ASTM B 247 (ASTM B 247M), Alloy 6061-T6.
- G. Castings: ASTM B 26/B 26M, Alloy A356.0-T6.
- H. Woven-Wire Mesh: Intermediate-crimp, diamond pattern, 2-inch (50-MM) woven-wire mesh, made from 0.162-inch (4.1-MM) nominal diameter wire complying with ASTM B 211 (ASTM B 211M), Alloy 6061-T94.

2.4 FASTENERS

- A. General: Provide the following:
 - 1. Aluminum Railings: Type 304 stainless-steel fasteners.
- 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 otherwise indicated.
 - 2. 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.
 - 3. Provide square or hex socket flat-head machine screws for exposed fasteners, unless otherwise indicated.

- D. Anchors: Provide cast-in-place chemical or [torque-controlled expansion anchors, fabricated from corrosion-resistant materials with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry and equal to four times the load imposed when installed in concrete, as determined by testing per ASTM E 488 conducted by a qualified independent testing agency.

2.5 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
 - 1. For aluminum railings, provide type and alloy as recommended by producer of metal to be welded and as required for color match, strength, and compatibility in fabricated items.
- B. Non-shrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, non-gaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- C. Anchoring Cement: Factory-packaged, non shrink, 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.

2.6 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. Assemble railings in the shop 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. Form rail-to-end post connections and all changes in rail direction by miter elbows.
- D. Cut material square and remove burrs from all exposed edges, with no chamfer.
- E. Make exposed joints butt tight and flush.
- F. Close exposed ends of handrail by use of appropriate end cap.
- G. For posts set in concrete, furnish matching sleeves or inserts not less than 5 inches long.
- H. Locate intermediate rails equally spaced between top rail and finished floor or center line of tread.
- I. Verify dimensions on site prior to shop fabrication.

2.7 FINISHES, GENERAL

- 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: 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.
- D. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.

2.8 ALUMINUM FINISHES

- A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- B. Class I, Clear Anodic Finish: AA-M12C22A41 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine plaster and gypsum board assemblies, where reinforced to receive anchors, to verify that locations of concealed reinforcements have been clearly marked for Installer. Locate reinforcements and mark locations if not already done.

3.2 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 have been 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.

- C. Corrosion Protection: Coat concealed surfaces of aluminum that will be in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.
- 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.

3.3 RAILING CONNECTIONS

- A. Nonwelded Connections: Use mechanical or adhesive joints for permanently connecting railing components. Use wood blocks and padding to prevent damage to railing members and fittings. 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 Part 2 "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 beyond joint on either side, fasten internal sleeve securely to 1 side, and locate joint within 6 inches of post.

3.4 ANCHORING POSTS

- A. Form or core-drill holes not less than 5 inches (125 MM) deep and 3/4 inch (20 MM) larger than OD of post for installing posts in concrete. 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.
- B. Cover anchorage joint with flange of same metal as post, attached to post with set screws.
- C. Leave anchorage joint exposed; wipe off surplus anchoring material; and leave 1/8-inch (3-MM) buildup, sloped away from post.
- D. Anchor posts to metal surfaces with oval flanges, angle type, or floor type as required by conditions, connected to posts and to metal supporting members as follows:
 - 1. For aluminum pipe railings, attach posts using fittings designed and engineered for this purpose.

3.5 ANCHORING RAILING ENDS

- A. Anchor railing ends to concrete and masonry with round flanges connected to railing ends and anchored to wall construction with anchors and bolts.

3.6 ATTACHING HANDRAILS TO WALLS

- A. Attach handrails to wall with wall brackets. Provide brackets with 1-1/2-inch (38-MM) clearance from inside face of handrail and finished wall surface.
 - 1. Use type of bracket with flange tapped for concealed anchorage to threaded hanger bolt.
 - 2. Use type of bracket with predrilled hole for exposed bolt anchorage.
- B. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.
- C. Secure wall brackets 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.

3.7 ADJUSTING AND CLEANING

- A. Clean aluminum and stainless steel by washing thoroughly with clean water and soap and rinsing with clean water.

3.8 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.
- B. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit or provide new units.

END OF SECTION 05 5213

DIVISION 06

**SECTION 061000
MISCELLANEOUS CARPENTRY**

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Prefinished interior / exterior standing and running trim (White).
2. At Contractor's option Simulated Wood Trim specified as exterior trim may be used on the interior if volume of material order provides greater cost efficiency.

B. Related Sections include the following:

1. Division 06 Section "Miscellaneous Carpentry – Sill and Ledger Framing" for wood furring, blocking, shims, and hanging strips required for installing woodwork and concealed within other construction before woodwork installation.
2. Division 06 Section "Simulated Wood Trim" for installation of exterior trim.

1.2 DEFINITIONS

A. Interior finish carpentry includes wood furring, blocking, shims, and hanging strips for installing woodwork items unless concealed within other construction before woodwork installation.

1.3 SUBMITTALS

1. Trim Board: Pre-finish in standard white factory applied paint.

1.4 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who fabricate products similar to those required for this Project and whose products have 5 years, record of successful in-service performance.
- B. Quality Standard: Unless otherwise indicated, comply with AWI's "Architectural Woodwork Quality Standards" for grades of interior architectural woodwork indicated for construction, finishes, installation, and other requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver woodwork until painting and similar operations that could damage woodwork have been completed in installation areas. If woodwork must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Project Conditions" Article.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install woodwork until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Provide materials that comply with requirements of AWI's quality standard for each type of woodwork and quality grade specified, unless otherwise indicated.
- B. Wood Products: Comply with the following:
 - 1. Hardboard: AHA A135.4.
 - 2. Provide species and grades listed for materials to be paint finished.
 - a. Grade: Comply with WWPA G-5 standard grading rules.
 - b. Species: Aspen, Douglas Fir-Larch, Douglas Fir South, Engelmann Spruce-Lodgepole, Pine, Engelmann Spruce, Hem-Fir, Idaho White Pine, Lodgepole Pine, Mountain Hemlock, Mountain Hemlock-Hem-Fir, or Ponderosa Pine-Sugar Pine, (Ponderosa Pine-Lodgepole Pine).
- C. Style: General: as required.
- D. Adhesive: Liquid Nails or equal and 23 gauge headless.
- E. Corners: Square with top rail and bottom sill extending over side trim.

2.2 MISCELLANEOUS MATERIALS

- A. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls and elsewhere as required for corrosion resistance. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.
- B. Adhesives, General: Do not use adhesives that contain urea formaldehyde.
- C. VOC Limits for Installation Adhesives and Glues: Use installation adhesives that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
 - 1. Wood Glues: 30 g/L.
 - 2. Contact Adhesive: 250 g/L.

2.3 FABRICATION, GENERAL

- A. Interior Woodwork Grade: Unless otherwise indicated, provide Premium-grade interior woodwork fabrication methods complying with referenced quality standard.

- B. Wood Moisture Content: Comply with requirements of referenced quality standard for wood moisture content in relation to ambient relative humidity during fabrication and in installation areas.
- C. Fabricate woodwork to dimensions, profiles, and details indicated. Ease edges to radius indicated for the following:

PART 3 - EXECUTION

3.1 PREPARATION

- A. Before installation, condition woodwork to average prevailing humidity conditions in installation areas.
- B. Before installing architectural woodwork, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming.

3.2 INSTALLATION

- A. Install woodwork level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb (including tops) to a tolerance of 1/8 inch in 96 inches.
- B. Scribe and cut woodwork to fit adjoining work, refinish cut surfaces, repair damaged finish at cuts.
- C. Anchor woodwork to blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing as required for complete installation. Use fine finishing nails for exposed fastening, countersunk and filled flush with woodwork and matching final finish if transparent finish is indicated.
- D. Standing and Running Trim: Install with minimum number of joints possible, using full-length pieces (from maximum length available) to greatest extent possible. Do not use pieces less than 48 inches long, except where window is shorter than 48 inches use single piece entire width/length of window.
 - 1. Install standing and running trim with no more variation from a straight line than 1/8 inch in 96 inches.

3.3 ADJUSTING AND CLEANING

- A. Repair damaged and defective woodwork, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.
- B. Clean woodwork on exposed and semi-exposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

END OF SECTION 061000

SECTION 06 1100

FRAMING AND SHEATHING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Roofs sheathing.
 - 2. Wood blocking and furring.
 - 3. Roof Framing
 - 4. Preservative and fire retardant treatment of wood.
- B. Related Sections:
 - 1. Division 01: Administrative, procedural, and temporary work requirements.

1.2 REFERENCES

- A. American Wood Protection Association (AWPA):
 - 1. C2 - Lumber, Timber, Bridge Ties, and Mine Ties, Pressure Treatment.
 - 2. C9 - Plywood, Pressure Treatment.
 - 3. C20 - Structural Lumber, Fire-Retardant Pressure Treatment.
 - 4. C27 - Plywood, Fire-Retardant Pressure Treatment.
- B. ASTM International (ASTM):
 - 1. A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - 2. A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
 - 3. E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
 - 4. F593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws and Studs.
- C. Engineered Wood Association (APA) PRP-108 - Performance Standards and Qualification Policy for Structural-Use Panels.
- D. Forest Stewardship Council (FSC) STD-40-004 - Chain of Custody Standard.
- E. National Institute of Standards and Technology (NIST) - Product Standard PS 20 - American Softwood Lumber Standard.
- F. Northeastern Lumber Manufacturers Association (NELMA) - Standard Grading Rules for Northeastern Lumber.
- G. National Lumber Grades Authority (NLGA) - Standard Grading Rules for Canadian Lumber.
- H. Redwood Inspection Service (RIS) - Standard Specifications for Grades of California Redwood Lumber.
- I. Southern Pine Inspection Bureau (SPIB) - Standard Grading Rules for Southern Pine Lumber.
- J. West Coast Lumber Inspection Bureau (WCLIB) - Standard Grading Rules for West Coast Lumber.
- K. Western Red Cedar Lumber Association (WRCLA) - Grading Rules.
- L. Western Wood Products Association (WWPA) G-5 - Western Lumber Grading Rules.

1.3 SUBMITTALS

1.4 QUALITY ASSURANCE

- A. Lumber Grading Agency: Certified to NIST PS 20.
- B. Identify lumber and panel products by official grade mark.
- C. Fire Retardant Treated Products: Bear label of recognized independent testing laboratory indicating flame spread rating of 25 or less, tested to ASTM E84.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Store materials minimum 6 inches above ground on framework or blocking and cover with protective waterproof covering providing for adequate air circulation.
- B. Do not store seasoned or treated materials in damp location.
- C. Protect edges and corners of sheet materials from damage.

1.6 WARRANTIES

- A. Provide manufacturer's 20 year warranty against rot and termite damage for composite wood.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers - Laminated Veneer Lumber:
 - 1. Boise Cascade Corporation. (www.bc.com)
 - 2. Georgia-Pacific Corporation. (www.gp.com)
 - 3. LP Corp. (www.lpcorp.com)
- B. Acceptable Manufacturers - Prefabricated Wood I Joists:
 - 1. Boise Cascade Corporation. (www.bc.com)
 - 2. Georgia-Pacific Corporation. (www.gp.com)
 - 3. LP Corp. (www.lpcorp.com)
 - 4. Weyerhaeuser. (www.weyerhaeuser.com)
 - 5. Western Wood Structures, Inc. <https://westernwoodstructures.com/>
- C. Acceptable Manufacturers - Composite Wood:
 - 1. CertainTeed Corp.
 - 2. Elk Corporation.
 - 3. Trex Co.
- D. Substitutions: [Under provisions of Division 01.] [Not permitted.]

2.2 MATERIALS

- A. Dimension Lumber:
 - 1. Grading rules: [NELMA.] [NLGA.] [RIS.] [SPIB.] [WCLIB.] [WRCLA.] [WWPA.] [____.]
 - 2. Species: Spruce-Pine - Fir
 - 3. Grade: #1
 - 4. Surfacing: Surfaced four sides (S4S) [unless otherwise indicated].
 - 5. Maximum moisture content: [19.
- B. Laminated Veneer Lumber:
 - 1. Fabricated by laminating wood veneers under pressure using exterior type adhesive with grain of veneers parallel with length.
 - 2. Veneer: [Douglas Fir] [or] [Southern Pine].

- C. Prefabricated Wood I Joists:
 - 1. Fabricated by bonding stress graded lumber flanges to webs with exterior type adhesive.
 - 2. Flange material: Laminated veneer lumber.
 - 3. Web material: Oriented strand board.
- D. Composite Joists and Headers:
 - 1. Fabricated by laminating wood veneers to narrow oriented strand board to produce rectangular members with veneers making up not less than 32percent of total cross section.
- E. Composite Wood:
 - 1. Extruded product consisting of polyethylene and wood fibers with integral coloring.
 - 2. Color: to be selected from manufacturer's full color range.
- F. Panel Products:
 - 1. Type: APA [Plywood.] [Oriented Strand Board.] [COM-PLY.]
 - 2. Panel grade:
 - a. [Floor] [wall] [and] [roof] sheathing: APA Structural I Rated Sheathing.
 - b. Combination subfloor / underlayment: APA Sturd-I-Floor.
 - c. Underlayment: APA Underlayment.
 - 3. Exposure:
 - a. Exterior applications: Exterior.
 - b. Interior applications: Exposure 1.

2.3 ACCESSORIES

- A. Fasteners:
 - 1. Type and size: As required by conditions of use.
 - 2. Exterior locations and treated products: Hot-dip galvanized steel.,
 - 3. Other interior locations: Plain steel.
- B. [Metal Connectors:] [Joist Hangers:]
 - 1. Galvanized steel, ASTM A653/A653M, coating class.
 - 2. Size and shape: To suit framing conditions.
- C. Subflooring Adhesive:
 - 1. Waterproof, water based, air cure type, in cartridge dispensers.
- D. Sill Gasket: 1/4inch thick, plate width, closed cell polyethylene or urethane foam from continuous rolls.
- E. Termite Shield: Galvanized sheet steel, minimum 26gage.

2.4 FABRICATION

- A. Preservative Treatment:
 - 1. Treat wood in following locations:
 - a. Where in contact with roofing and related flashings.
 - b. Where in contact with [masonry or] cementitious materials.
 - c. [Where in contact with ground.]
 - d. [Exterior].
 - 2. Lumber: Treat in accordance with AWPA C1 with retention of 0.25 to 0.40 PCF.
 - 3. Panel products: Treat in accordance with AWPA C9, with retention of 0.25 to 0.40 PCF.
- B. Fire Retardant Treatment:
 - 1. Treat [interior] [and] [exterior] wood.
 - 2. Lumber: Treat in accordance with AWPA C20.

3. Panel products: Treat in accordance with AWP C27, [Exterior Type.] [Interior Type A - Low Temperature (LT).] [Interior Type A - High Temperature (HT).]

PART 3 EXECUTION

3.1 INSTALLATION

- A. Set members level, plumb, and rigid.
- B. Make provisions for erection loads, and for temporary bracing to maintain structure safe, plumb, and in true alignment until completion of erection and installation of permanent bracing.
- C. Place beams, joists, and rafters with crown edge up.
- D. Construct load bearing framing members full length without splices.
- E. Sills:
 1. Place full width continuous sill flashings under framed walls on cementitious foundations. Lap flashing joint 4 inches.
 2. Place sill gasket directly on sill flashing. Fit tight to protruding foundation anchor bolts.
 3. Anchor sills to foundation with anchor bolts.
- F. Joist Framing:
 1. Provide minimum 1-1/2 inches of bearing.
 2. Lap members framing from opposite sides minimum 4 inches.
 3. Construct double joist headers at floor and ceiling openings and under wall stud partitions that are parallel to floor joists. Frame rigidly into joists.
 4. Bridge joists at mid span for spans in excess of 8 feet.
- G. Stud Framing:
 1. Provide single bottom plate and double top plates for load bearing partitions.
 2. Provide single bottom and top plates for non load bearing partitions.
 3. Anchor bottom plates to concrete structure with anchor bolts expansion fasteners driven fasteners.
 4. Triple studs at corners and partition intersections.
 5. Anchor studs abutting masonry or concrete with toggle or expansion bolts.
 6. Frame openings with double studs and headers. Space short studs over and under opening to stud spacing.
 7. If wood sheathing is not installed. At corners, provide diagonal 1 x 4 inch bracing; notch studs to fit.
- H. Rafter Framing:
 1. Notch to fit exterior wall plates.
 2. Double rafters at roof openings; support with metal hangers.
 3. At ridge, place rafters directly opposite each other and secure to ridge member.
 4. At hips and valleys, bevel ends for bearing against hip or valley rafter.
 5. Locate collar ties at every third pair of rafters, one third of the distance to ceiling joists; cut ends to fit slope and secure to rafters.
- I. Beams:
 1. Provide minimum end bearing of 4 inches.
 2. Nail built-up members with two rows of nails spaced 6 inches on center maximum.
- J. [Lumber] [Composite Wood] Decking:
 1. Place decking to span two or more supports, with ends occurring over supports.
 2. Stagger end joints in adjacent rows.
 3. Secure to each support with 2 fasteners.
- K. Roof Sheathing:

1. Place panels perpendicular to framing members with ends staggered and sheet ends over firm bearing.
 2. [If tongue-and-groove panels are not used,] Install sheathing clips between adjacent sheets between roof framing members.
 3. Leave 1/8 inch expansion space at panel ends and edges.
 4. Secure to supports with [nails] [screws] spaced maximum 6 inches on center along edges and maximum 12 inches on center in field of panels.
- L. Wall Sheathing:
1. Place panels [parallel] [perpendicular] to framing members, with ends over firm bearing [and staggered].
 2. At corners, place sheathing for a horizontal distance of 48 inches.
 3. Leave 1/8 inch expansion space at panel ends and edges.
 4. Secure to supports with [nails] [screws] spaced maximum 6 inches on center along edges and maximum 12 inches on center in field of panels.
- M. Floor Decking:
1. Place panels perpendicular to framing members, with ends over firm bearing and staggered.
 2. Leave 1/8 inch expansion space at panel ends and edges.
 3. Secure to supports with [nails] [screws] spaced maximum 12 inches on center along edges and in field of panels.
- N. Subflooring:
1. Install flooring underlayment after dust and dirt generating activities have ceased and prior to application of finished flooring.
 2. Install building felt between floor decking and subflooring.
 3. Apply perpendicular to decking; stagger joints of underlayment in adjacent rows.
 4. Leave 1/8 inch expansion space at panel ends and edges.
 5. Secure to supports with [adhesive and] [nails] [screws] spaced maximum [6 inches on center along edges and maximum 12 inches on center in field of panels.
- O. Provide blocking, nailer, grounds, furring, and other similar items required to receive and support work.
- P. Curb roof openings except where prefabricated curbs are provided. Form corners by alternating lapping side members.
- Q. Install telephone and electrical panel backboards where indicated: Oversize panel by [12] [] inches on all sides.

3.2 TOLERANCES

- A. Framing Members: 1/4 inch from true position, maximum.
- B. Surface Flatness of Floor: 1/4 inch in 10 feet maximum.

END OF SECTION

SECTION 066423

FIBERGLASS-REINFORCED POLYMER (FRP) COLUMNS

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:

1. Load-bearing and non-load-bearing fiberglass-reinforced polymer (FRP) columns, including shafts, capitals, and bases.
2. Round and square, tapered and non-tapered, plain and fluted shafts.
3. Split columns for pilasters or encasement where indicated.

B. Related Sections:

1. Section 03 30 00 – Cast-in-Place Concrete (for footings/anchors).
2. Section 06 10 00 – Rough Carpentry (wood blocking or headers).
3. Section 09 91 00 – Painting (field finishing where required).

1.2 REFERENCES

- A. ASTM E84 – Surface Burning Characteristics of Building Materials.
- B. ASTM D638 – Tensile Properties of Plastics.
- C. ASTM D790 – Flexural Properties of Unreinforced and Reinforced Plastics.
- D. ASTM D256 – Izod Impact Strength.
- E. Load-bearing capacity per manufacturer's published data (minimum 8,000–20,000 lbs concentric load depending on diameter).

1.3 SUBMITTALS

- A. Product Data: Manufacturer's technical data sheets, load tables, and installation instructions.
- B. Shop Drawings: Show column dimensions, entasis / taper, capital/base details, split configurations, and attachment methods.
- C. Samples: 12-inch shaft section with finish, plus capital and base segments.
- D. Warranty Documentation.

1.4 QUALITY ASSURANCE

- A. Manufacturer: Minimum 10 years' experience producing fiberglass architectural columns.
- B. Columns shall be factory-finished with high-quality exterior-grade gel coat or primed for field painting.

C. Flame Spread: Class A (≤ 25) per ASTM E84 when required for interior use.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver columns in protective packaging.

B. Store flat and level, off ground, protected from weather and construction damage.

1.6 WARRANTY

A. Limited Lifetime Warranty against defects in materials and workmanship for original owner when installed per manufacturer's instructions.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Basis of Design:

FGC Manufacturing, LLC, d/b/a
212 W. Troy St, Suite B
Dothan, AL 36303, <https://fiberglasscolumns.com/>

**AIC Millworks, LLC, PO Box
2331, Riverview, FL 33547,
<https://www.aicmillworks.com/>**

2.2 MATERIALS

A. Fiberglass

1. Resin: Premium isophthalic polyester or equivalent fire-retardant resin.
2. Reinforcement: Continuous strand fiberglass mat, woven roving, and/or chop-strand with minimum 25–35% glass content.
3. Wall Thickness: 3/8" to 3/4" nominal depending on diameter/height.
4. Finish: Exterior-grade gel coat or factory-primed white surface ready for latex or oil-based paint.

2.3 COLUMN TYPES AND SIZES

A. Round Tapered Columns:

- Available nominal diameters (bottom): 6", 8", 10", 12", 14", 16", 18", 20", 24", 30".
- Standard heights: 6'–30' (custom heights available).
- Entasis: Classical Greek/Roman taper (approximately 1/3 astragal to 2/3 shaft).
- Concentric load capacity (minimum):
 - 6"–8": 8,000–10,000 lbs
 - 10"–12": 14,000–18,000 lbs
 - 14"+: 20,000 lbs

B. Round Straight (Non-Tapered) and Square Columns: Available in similar diameters/widths and heights.

C. Surface Finish: Plain (smooth) or fluted (standard classical fluting).

D. Split Columns: Factory-split halves or 3/4 sections for encasement of structural members.

2.4 CAPITALS AND BASES

A. Styles (as scheduled):

1. Tuscan Capital and/or base - Square or Round
2. Roman Doric - Round Only
3. Attic Base(Only) - Square or Round
4. Roman Ionic - Square or Round
5. Greek Ionic - Square or Round
6. Roman Corinthian - Square or Round
7. Scamozzi - Square or Round
8. Temple of Winds - Square or Round

B. Material: Matching FRP composite; split where required.

2.5 ACCESSORIES

A. Adhesives, fasteners, flashing, and mounting hardware as recommended by manufacturer. Split kits, and Installation kits can be purchased separately.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Verify substrate and opening dimensions. Confirm structural support is adequate for imposed loads.

B. Do not proceed until unsatisfactory conditions are corrected.

3.2 INSTALLATION

A. Install columns plumb and true in accordance with manufacturer's published instructions.

B. Load-Bearing Columns:

1. Distribute load evenly over full shaft circumference at top and bottom.
2. Use steel or aluminum plates where required to transfer load.
3. Secure using manufacturer-recommended anchors (galvanized or stainless steel).

C. Non-Load-Bearing/Decorative: Secure to substrate and soffit with adhesive and mechanical fasteners.

D. Split Columns: Join halves with manufacturer-approved adhesive and fiberglass reinforcement; seal joints.

E. Caulk all joints with high-quality polyurethane sealant; tool smooth.

3.3 FIELD FINISHING

A. Lightly sand gel-coat or primed surfaces with 100–120 grit paper.

B. Apply one coat premium exterior primer (if not factory primed).

C. Apply two finish coats premium acrylic latex exterior paint (Sherwin-Williams Duration, Benjamin Moore MoorGlo, or equal).

3.4 CLEANING AND PROTECTION

A. Clean columns with mild detergent and water.

B. Protect installed columns from damage until Substantial Completion.

END OF SECTION

DIVISION 07

238T

Aluminum

Standing Seam Metal Roof System (SSMRS)

Text in red are instructions to the specifier and should be deleted.

Text in blue are choices that need to be made, with those not selected, deleted.

McElroy Metal, Inc.
1500 Hamilton Road
Bossier City, LA 71111
Phone: (800) 562-3576
Phone: (318) 747-8097
Fax: (318) 747-8099
Email: info@mcelroymetal.com
www.mcelroymetal.com
April 15, 2013

SECTION 07 4113

STANDING SEAM METAL ROOF PANELS

PART 1 GENERAL

1.1 SUMMARY

A. SECTION INCLUDES

1. Standing-seam metal roof panels, including trim and accessories

2. RELATED SECTIONS

- a) Section 05 3123 - Steel Roof Decking
- b) Section 07 2200 - Roof and Deck Insulation
- c) Section 07 6200 - Sheet Metal Flashing and Trim
- d) Section 07 7200 - Roof Accessories
- e) Section 07 9200 - Joint Sealants

1.2 REFERENCES

- A. AISI S-100 – North American Specification for the Design of Cold-Formed Steel Structural Members
- B. ASCE-7: American Society of Civil Engineers -Minimum Design Loads for Buildings and Other Structures; version adopted by local Building Code authority having jurisdiction.
- C. ASTM B209 - Specification for Aluminum-Alloy Sheet and Plate
- D. ASTM E1592 - Standard Test Method for Structural Performance of Sheet Metal Roof and Siding System by Uniform Static Air Pressure Difference
- E. UL 580 - Tests for Uplift Resistance of Roof Assemblies

1.3 ADMINISTRATIVE REQUIREMENTS

A. Pre-installation Meetings:

1. Schedule meeting to discuss roof project requirements, substrate conditions, manufacturer's installation instructions, and manufacturer's warranty requirements before start of work onsite.
2. Required attendees: Contractor, metal deck & roof installer, and any other subcontractors who have equipment penetrating the roof or Work that requires roof access or traffic.

1.4 SUBMITTALS

A. Product Data: Manufacturer literature indicating product specifications, installation instructions, and standard construction details for specified products.

B. Shop Drawings: To be prepared by metal roof system manufacturer.

1. Submit roof plan showing panel layout, profiles, components, accessories, finish colors, gutters and downspouts as applicable.

a) Indicate layout of roofing panels and roof panel sizes, including custom fabricated roofing panels if indicated, indicate each trim condition.

b) Include details of each condition of installation, including the locations and types of fasteners, sealants and accessories. Indicate locations, gauges, shapes, and methods of attachment of all panels, accessories and trim.

c) Indicate products/materials required for construction activities of this section not supplied by manufacturer of products of this section.

d) Indicate locations of field applied sealant.

e) Indicate locations of field worked conditions.

2. Roof Panel Attachment:

a) Roof plan with wind uplift pressure calculations at field, corner and perimeter areas according to version of ASCE-7 referenced by locally-adopted Building Code and the authority having jurisdiction.

b) Roof plan indication roof clip spacing pattern at field, corner, perimeters and where panels are to be fixed from thermal movement.

c) Roof panel attachment plan must be stamped by licensed engineer in State in which project is constructed, certifying roof attachment meets local Building Code requirements for wind uplift.

C. Samples:

1. Submit two samples, 12" long, full width panel, showing metal gauge, and seam.

2. Two samples each for roof panel clip, bearing plate and clip fastener.

3. Submit color samples for Architect's selection.

4. Submit sample warranties:

a) Manufacturer Finish Warranty

b) Manufacturer Weathertightness Warranty complying with this Specification

c) Installer Warranty

D. Certificates:

-
1. Submit roof panel manufacturer's certification that fasteners, clips, backup plates, closures, roof panels and finishes meet the specification requirements.
 2. Submit roof panel manufacturer's certification that installer meets requirements to install roof system and is qualified to obtain required warranties.
- E. Delegated Design Submittals: Submit engineering calculations indicating wind uplift pressure calculations according to local building code for project location with respect to appropriate Importance Factor, Exposure category and Safety Factor. Calculations shall be sealed by a professional engineer licensed to practice structural engineering in the state in which project is located.
- F. Test and Evaluation Reports - Certified test results that indicate roof system meets or exceeds design and performance criteria. Testing to include:
1. ASTM E1592 - Manufacturers test data, signed and sealed by a registered professional engineer, substantiating that roof system will meet the allowable wind pressures using an appropriate Factor of Safety in accordance with AISI S-100.
- G. Qualification Statements: For Manufacturer and Installer.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: Manual indicating requirements and recommendations, to maintain the roof system in good working condition.
- B. Warranty Documentation: Submit final warranties required in this section.

1.6 QUALITY ASSURANCE

- A. Qualifications:
1. Manufacturer Qualifications: Manufacturer shall have a minimum of ten years experience in the manufacturing of metal roof systems similar to those required for this project. Manufacturer must have a current installer training program.
 2. Installer Qualifications: Installer ("roofer") to perform the work of this section shall have no fewer than 5 years of successful experience with the installation of metal roof systems similar to those required for this project. The installer shall be qualified by the roof panel manufacturer for installation of manufacturer-warranted systems.
- B. Field Measurements: Prior to fabrication of panels, take field measurements of structure or substrates to receive panel system. Allow for trimming panel units, where final dimensions cannot be established prior to fabrication.
- C. Mock-Ups: Install a 30 foot wide, quality control area of metal roofing, for review by the Architect. The Architect shall approve the quality of installation for the roof, prior to installing additional metal panels.

1.7 DELIVERY, STORAGE AND HANDLING

-
- A. Delivery and Acceptance Requirements: Deliver panels to jobsite properly packaged to provide protection against transportation damage. Panels too long to ship shall be site formed onto the roof by manufacturer's factory personnel using manufacturer's factory roll forming equipment.
 - B. Storage and Handling Requirements:
 - 1. Exercise care in unloading, storing and erecting panels to prevent bending, warping, twisting, and surface damage.
 - 2. Store all material and accessories above ground on well skidded platforms. Store under waterproof covering. Provide proper ventilation to panels to prevent condensation build-up between each panel.
 - 3. Remove from site and replace panels which are damaged, or become water-stained during storage and handling.

1.8 WARRANTIES

- A. Manufacturer Warranties:
 - 1. Panel Coating: Furnish manufacturer's 40-year warranty panel coating warranty covering cracking, checking, and peeling, and 30 year warranty covering fade and chalk.
 - 2. Metal Roof Weathertightness Warranty:
 - a) Manufacturer's **McElroy Metal** Weathertightness Warranty
 - (1) Warranty term: **20** years commencing on date of substantial completion.
 - (2) Total manufacturer's liability: NO REPAIR LIMIT THE TOTAL sq. ft.
 - (3) Warranty must cover: Pipe and Curb Penetrations; Wind Speeds up to 75 mph
 - (a) Pipes must be centered in pan or a pipe curb must be used. Pipe must be flashed with an EPDM dektite.
 - (b) Curbs must be all welded aluminum or stainless steel.
 - (c) Manufacturer must supply engineered installation drawings signed and sealed by an engineer registered in the state in which the project is located.
- B. Installer Warranty: Installer to provide warranty agreeing to repair or replace metal roof panels, trim, or accessories that fails due to poor workmanship or faulty installation.
 - 1. Warranty term: 2 years commencing on date of substantial completion.

PART 2 - PRODUCTS

2.1 ROOF PANEL SYSTEM

A. Basis of Design: 238T by McElroy Metal, Inc. Bossier City, LA, or approved substitute.

B. Substitution Limitations

1. Requests for approval must be submitted in writing at least ten (10) days prior to bid date, and are accompanied by all related test reports and design calculations listed in section 1.4 and Design and Performance criteria Section 2.2.
2. Substitute manufacturers will be approved by written addendum to all bidders. Voluntary alternates will not be considered. Substitutions will not be permitted after the bid date of this project.
3. Roof panels proposed for substitution shall fully comply with specified requirements in appearance, assembly, and performance.

C. Product Options

1. Factory-formed panel, width of 24 inches. Panels shall be symmetrical in design and shall be mechanically seamed with a field operated electric seaming machine approved by the manufacturer.
2. Minimum seam height 2 3/8 inches. Integral seam, double lock and snap together type panels are not acceptable
3. Seam cap matching panel finish with two rows of integral factory hot applied sealant. Sealant should not come in contact with clip, and clip should not require sealant to maintain a weathertight condition.
4. Aluminum-alloy sheet in accordance with ASTM B209.
 - a) Alloy: 3105 H14
 - b) Thickness: 0.040 inches
5. Finish: Two coat coil applied, baked-on full-strength (70% resin, PVF2) fluorocarbon coating consisting of a nominal 0.25 mil dry film thickness primer, and a nominal dry film thickness of 0.7 - 0.8 mil color coat for a total 0.9 to 1.1 mil total system dry film thickness. Finish to be selected from manufacturer's standard color selection. The back side of the material should be 0.25 mil primer and 0.25 mil polyester wash coat.
6. Roof panel system must allow individual roof panel removal and replacement from any point on the roof without damage to adjacent roof panel(s).
7. Roof panel system must be approved by manufacturer to be installed on slopes as low as ½:12.
8. Panels must be furnished and installed in continuous lengths from ridge to eave with no overlaps. Panels too long to ship will be manufactured on site using manufacturer's employees and equipment.
9. Panel surface characteristics to be Smooth.

10. Manufacturer weathertightness warranty meeting requirements of this Section.

2.2 PERFORMANCE/DESIGN CRITERIA

- A. Thermal Movement: Metal Roofing system, including flashing, shall accommodate unlimited thermal movement without buckling or excess stress on the structure.
- B. Roof panel and trim attachments will be designed to satisfy the requirements of the roof design (shown in shop drawings).
- C. Maximum wind uplift capacity of roof system shall be determined using ASTM E 1592 test results, with an appropriate Factor of Safety in accordance with AISI S-100.
- D. Panel system shall be designed in accordance with the local building code and ASCE7 for project location with respect to appropriate Exposure category, Importance Factor and Factor of Safety in accordance with AISI S-100.
- E. Tested and listed by Underwriters Laboratories to comply with UL 580 for wind uplift Class 90 rating.

2.3 ACCESSORIES

- A. Panel Clip Screw - screw required in wind uplift rating requirements and design specification for application, with corrosion-resistant coating, in length necessary to penetrate substrate minimum 3/4 inch., as supplied by roof panel manufacturer.
- B. Roof Panel Clip:
 - 1. Intermittent Clip: 16 gauge galvanized steel, one-piece, designed to allow roof panel thermal movement and not contact roof panel cap, as supplied by roof panel manufacturer, meeting wind uplift requirements and design criteria of this section.
 - 2. Intermittent Clip Bearing Plate: If required, in gauge, size and finish as supplied by and approved by roof panel manufacturer for use in roof panel manufacturer's full assembly warranted systems.
 - 3. Multi-Span Clip: as provided by roof panel manufacturer for full assembly warranted systems.
- C. Trim and flashing will be of the same gauge and finish unless approved otherwise by the metal roof system manufacturer.
 - 1. Ridge closures, consisting of metal channel surrounding factory precut closed cell foam, will not be secured through the field of the panel.
 - 2. Trim will be installed specifically as displayed in the manufacturer provided shop drawings. Proposed changes must be approved in writing by the metal roof system manufacturer.
- D. Concealed supports, angles, plates, accessories and brackets: gauge and finish as recommended, and furnished by manufacturer.

-
- E. Accessory Screw: Size and screw type as provided by panel manufacturer for each use, with prefinished hex washer head in color to match panels where exposed to view.
 - F. Rivets: full stainless steel, including mandrel, in size to match application.
 - G. Field Sealant:
 - 1. Exposed Sealant: Color coordinated urethane or polymer sealant as supplied by panel manufacturer.
 - 2. Non-exposed Sealant: Non-curing, non-skinning, butyl tape or tube sealant as supplied by manufacturer.
 - H. Sealant Tape: non-drying, 100 percent solids, high grade butyl tape, as supplied by panel manufacturer, in sizes to match application.
 - I. Pipe Penetration Flashings: 20 year warranted flexible boot type, with stainless steel compression ring. Use silicone type at hot pipes.
 - J. Metal Roof Curbs: 0.063 minimum thickness welded aluminum, or 18 gauge minimum welded stainless steel, factory-insulated, with integral cricket, and designed to fit roof panel module, sized to meet application.

PART 3 - EXECUTION

3.1 INSTALLERS

- A. Must be certified and qualified by Manufacturer.

3.2 EXAMINATION

- A. Verification of Conditions
 - 1. Ensure surfaces are ready for panel application.
 - 2. Inspect and ensure surfaces are free from objectionable warp, wave, and buckle before proceeding with installation of pre-formed metal roofing.
 - 3. Ensure substrate is ready to receive metal roofing. Report items for correction and do not proceed with metal roof panel system installation until resolved.

3.3 PREPARATION

- A. Install substrate boards, hat channels, purlins, or furring channels in accordance with manufacturer's recommendations.
- B. Coordinate Work, with installation of other associated Work, to ensure quality application.
- C. Coordinate Work with installation of associated metal flashings and building walls.
- D. Coordinate Work to minimize foot traffic and construction activity on installed finished surfaces.

-
- E. Coordinate location of pipe penetrations to allow centering of pipe in panel.
 - F. Coordinate location of roof curbs, to allow proper integration with roof panel seams.

3.4 INSTALLATION

- A. Comply with and install roofing and flashings in accordance with all details shown on manufacturer's approved shop drawings and manufacturer's product data, instructions, and installation manuals, within specified erection tolerances.
- B. Install field panels in continuous lengths, without endlaps
- C. Do not install panels damaged by shipment or handling.
- D. Install intermittent clips with bearing plates, if required, and continuous clips, if required, according to the engineered design pattern in the field, perimeter, and corner areas of the roof.
- E. Fix panels at location depicted on reviewed shop drawing(s).
- F. Fold up pan of panel at ridge, hip and headwalls. Commonly referred to as breadpanning.
- G. Allow for required panel clearance at penetrations for thermal movement.
- H. Install concealed supports, angles and brackets as furnished by manufacturer to form complete assemblies.
- I. Remove roof panel and flashing protective film prior to extended exposure to sunlight, heat, and other weather elements.
- J. Field-apply sealant tape and gun-grade sealant according to reviewed shop drawings and manufacturer's requirements for airtight, watertight installation.
- K. Ensure sealant beads and tapes are applied prior to sheet metal installation to achieve a concealed bead. Neatly trim exposed portions of sealant without damaging roof panel or flashing finish.
- L. Align pipe penetrations to occur at center of roof panel. Report and have corrected improperly-placed penetrations before proceeding with panel installation. Remove and replace roof panels which have improperly-placed penetration flashings.
- M. Align roof curbs to fit roof panel module and overlap standing seam(s). Allow for proper drainage on both sides of curb.
- N. Install sheet metal flashings according to manufacturer's recommendations, reviewed shop drawings and in accordance with provision of Section 07 62 00.

3.5 CLEANING

- A. Clean exposed surfaces of work promptly after completion of installation.
- B. Clean mud, dirt, and construction-related debris from panels before panels are scratched or marred.

3.6 PROTECTION

- A. Protect Work as required to ensure roofing will be without damage at time of final completion.
- B. Do not allow excessive foot traffic over finished surfaces.
- C. Do not track mud, dirt, or construction-related debris onto panel surfaces.
- D. Replace damaged Work before final completion.

END OF SECTION

SECTION 07 6223.16
CUSTOM BOX GUTTERS AND SMOOTH RECTANGULAR DOWNSPOUTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Fabricated sheet metal items, including gutters and downspouts

1.02 REFERENCE STANDARDS

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

1.03 SUBMITTALS

- A. See Division 01 for submittal procedures.
- B. Product Data: For each type of product specified including components and accessories.
- C. Shop Drawings: Indicate material profile, joining pattern, joining details, fastening methods, flashings, adjacent construction interface, accessories, and dimensions.
- D. Material Samples: Submit two (2) samples, in manufacturer's standard size, illustrating metal finish color.
- E. Fabrication Samples: Submit one (1) sample(s) of gutter downspout elbow offset gutter support bracket hidden hanger/spacer; and 24" on centers.

1.04 QUALITY ASSURANCE

- A. Perform work in accordance with SMACNA requirements and standard details, unless indicated otherwise.
- B. Fabricator Qualifications:
 - 1. Must source metal from specified supplier.
 - 2. Supply required paint warranty.
 - 3. Roll-form round downspout and half round gutter in size, material and metal thickness indicated. Fabrication of said products with metal folder or press break is not acceptable.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. All materials shall arrive in the original sealed and labeled manufacturer's packaging.
- B. Store materials in a dry, protected, well-vented area. The Contractor shall report damaged material within 48 hours of delivery to the delivering carrier and note such damage on the carrier's freight Bill of Lading. Copies of Bill of Lading noting the damage shall be provided to the manufacturer.

1.06 WARRANTY

- A. Warranty: Warranted materials shall be free of defects in material and workmanship. If, after inspection, the manufacturer agrees that materials are defective, the manufacturer shall at their option repair or replace them.
- B. Fabricator or Metal Supplier: Submit Paint Warranty.

PART 2 PRODUCTS

2.01 QUALIFIED MANUFACTURERS

- A. Gutters and Downspouts:
 - 1. Roof Drainage Components & Accessories, Inc (RDCA); www.rdcaa.com; e-mail: sales@rdcaa.com.
 - 2. Substitutions: Proposals for substitution products or suppliers shall be accepted only from bidding contractors a minimum of ten (10) working days before bid due date. The proposed substitution shall meet the Performance Requirements and Quality Assurance Standards of this specification. See Division 01 section on substitutions for additional requirements.

2.02 CUSTOM BOX GUTTER

- A. As part of a complete prefabricated custom drainage system, the manufacturer shall provide a complete custom box gutter system to include the following:

1. Gutter Support Brackets
 - a. All box gutters to be hung using hidden hangers or hidden spacers and gutter support brackets, as per table below.
 - 1) All gutters and gutter support brackets to be fabricated as per drawings.
 - 2) All gutter support brackets are to be installed per table below, complete with 0.125 inch x 1.0 inch 4-sided galvanized or stainless-steel bar, wrapped on all 4 sides with the same metal and color used to fabricate gutter. One longitudinal seam that is not visible after installation is allowed.
 - 3) No post painting of gutter support brackets

GUTTER MOUNTING SPECIFICATIONS - BOX GUTTERS⁽¹⁾

Gutter Girth ⁽²⁾	Material	Gutter Support Bracket			Spacer (Hidden Hanger)		
		Bar Stock Material	Bar Stock Thickness & Width	Maximum Spacing (O.C.)	Spacer Material*	Spacer Thickness & Width	Maximum Spacing (O.C.)
Up through 16"	Steel	Not required	Not required	Not required	Galvanized Steel*	.063" x 1.5" or .125" x 1.0"	24"
Up through 16"	Copper	Not required	Not required	Not required	Stainless Steel	.063" x 1.5" or .125" x 1.0"	24"
Up through 16"	Aluminum	Not required	Not required	Not required	Stainless Steel	.063" x 1.5" or .125" x 1.0"	24"
Up through 16"	Stainless Steel	Not required	Not required	Not required	Stainless Steel	.063" x 1.5" or .125" x 1.0"	24"
16.01 - 24.0"	Steel	Stainless Steel	.125" x 1.0"	36"	Galvanized Steel*	.063" x 1.5" or .125" x 1.0"	36"
16.01 - 24.0"	Copper	Stainless Steel	.125" x 1.0"	36"	Stainless Steel	.063" x 1.5" or .125" x 1.0"	36"
16.01 - 24.0"	Aluminum	Stainless Steel	.125" x 1.0"	36"	Stainless Steel	.063" x 1.5" or .125" x 1.0"	36"
16.01" - 24.0"	Stainless Steel	Stainless Steel	.125" x 1.0"	36"	Stainless Steel	.063" x 1.5" or .125" x 1.0"	36"
24.01" - 30.0"	Steel	Stainless Steel	.125" x 1.0"	30"	Galvanized Steel*	.063" x 1.5" or .125" x 1.0"	30"
24.01" - 30.0"	Copper	Stainless Steel	.125" x 1.0"	30"	Stainless Steel	.063" x 1.5" or .125" x 1.0"	30"
24.01" - 30.0"	Aluminum	Stainless Steel	.125" x 1.0"	30"	Stainless Steel	.063" x 1.5" or .125" x 1.0"	30"
24.01" - 30.0"	Stainless Steel	Stainless Steel	.125" x 1.0"	30"	Stainless Steel	.063" x 1.5" or .125" x 1.0"	30"
30.01" - 35.0"	Steel	Stainless Steel	.125" x 1.0"	24"	Stainless Steel	.063" x 1.5" or .125" x 1.0"	24"
30.01" - 35.0"	Copper	Stainless Steel	.125" x 1.0"	24"	Stainless Steel	.063" x 1.5" or .125" x 1.0"	24"
30.01" - 35.0"	Aluminum	Stainless Steel	.125" x 1.0"	24"	Stainless Steel	.063" x 1.5" or .125" x 1.0"	24"
30.01" - 35.0"	Stainless Steel	Stainless Steel	.125" x 1.0"	24"	Stainless Steel	.063" x 1.5" or .125" x 1.0"	24"
Over 35"	Subject to review of gutter profile and installation detail.						

*Stainless bar may be substituted.

FOOTNOTES:

(1) Values and information provided in this table do not represent any warranty or guarantee of any kind.

(2) Girth equals the sum of the gutter profile dimensions.

1. Connections:
 - a. All gutter to gutter sections to be joined with interior gutter splices, except for a 4-piece expansion joint a minimum of every 50 feet. Metal for splice plates and expansion joints shall be the same metal and paint finish as the gutter.
 - b. Factory fabricated mitered corners required for all gutter corners.
 - c. Connect all gutters and downspouts with factory fabricated outlet tubes.
 - d. Fabricate end caps from the same metal and color as the gutter.
 - e. Stainless steel rivets for aluminum, steel and stainless-steel products with color of rivet head to match gutter, to be used for all joints requiring fasteners. Copper rivets for copper products.
 - f. No component shall be post painted (after fabrication).
2. Gutter:
 - a. Gutter: custom-sized; as shown on drawings.
 - b. Gutter sections shall be 10 ft to 20 ft in length.
 - c. Refer to drawings for metal, metal thickness and color; however, in no case is the metal thickness for gutter, splice plates and mitered corners to be less than listed in this section. (In the event the drawing calls out a thinner material, this list shall supersede the drawing.)
 - d. Gutter Girth*:
 - 1) Up to 16 inches:
 - (a) Steel: 26 gauge.
 - (b) Copper: 16 ounce.
 - (c) Aluminum: 0.032 inches.
 - (d) Stainless Steel: 26 gauge.
 - 2) 16.01 inches to 24 inches:
 - (a) Steel: 24 gauge.
 - (b) Copper: 16 ounce.
 - (c) Aluminum: 0.032 inches.
 - (d) Stainless Steel: 24 gauge.
 - 3) 24.01 inches to 30.0 inches:
 - (a) Steel: 22 gauge.
 - (b) Copper: 20 ounce.
 - (c) Aluminum: 0.050 inches.
 - (d) Stainless Steel: 22 gauge.
 - 4) 30.01 inches to 35 inches:
 - (a) Steel: 22 gauge.
 - (b) Copper: 24 ounce.
 - (c) Aluminum: 0.050 inches.
 - (d) Stainless Steel: 22 gauge.
 - 5) Over 35 inches: Subject to review of gutter profile and installation detail.

* Girth equals the width of the metal prior to forming the gutter.

2.03 CUSTOM SMOOTH, RECTANGULAR DOWNSPOUT, ELBOWS & OFFSETS

- A. As part of a completely prefabricated custom drainage system, the manufacturer shall provide a complete smooth box-style downspout system to include the following:
 1. Width and depth of downspouts, elbows and offsets are custom sized as per drawings.
 2. Refer to drawings for metal, metal thickness and color; however, in no case is the metal thickness for downspouts, elbows and offsets to be less than listed below.

3. Downspout sections shall be 10 to 20 linear feet.
 4. All downspouts shall be connected to gutters using a factory fabricated outlet tube using the same metal and color as used for the downspout.
 5. All downspouts, elbows and offsets must have interlocking acme seam locks.
 6. Provide minimum two (2) factory fabricated, as per drawing, hemmed downspout anchor straps per 10 linear feet of downspout.
 7. Provide factory fabricated elbows and offsets. One-piece offsets required through a 30" horizontal offset distance.
 8. Stainless steel rivets for aluminum, steel and stainless-steel products, with color of rivet head to match downspout, to be used for all joints requiring fasteners. Copper rivets for copper products.
- B. Plain Rectangular Downspout, Elbows and Offsets: Refer to part drawings for metal, metal thickness and color; however, downspout, elbows and offsets must always have a minimum thickness as shown below. (In the event the drawing calls out a thinner material, this list shall supersede the drawing.)
1. Up to 15-inch Girth*:
 - a. Steel: 26 gauge.
 - b. Copper: 16 ounce.
 - c. Aluminum: 0.032 inches.
 - d. Stainless Steel: 26 gauge.
 2. 15.01 inch to 23.0-inch Girth*:
 - a. Steel: 24 gauge.
 - b. Copper: 16 ounce.
 - c. Aluminum: 0.040 inches.
 - d. Stainless Steel: 24 gauge.
 3. 23.01 inch to 47.0-inch Girth*:
 - a. Steel: 22 gauge.
 - b. Copper: 20 ounce
 - c. Aluminum: 0.050 inches.
 - d. Stainless Steel: 22 gauge.
- * Girth equals (2 x width) + (2 x depth)

2.04 EXTERIOR FINISHES

- A. Aluminum:
1. Natural Mill Finish.
 - a. Superior Performance Organic Coating System: Comply with AAMA 2605 for aluminum preparation, pretreatment, primer and finish coat system; provide thermally cured 70-percent PVDF or FEVE fluoropolymer systems.
 - b. Color: As selected from manufacturer's **custom REGAL BLUE** colors.
 2. Clear Anodized Finish: AA-M12C22A41, Class I, clear anodic coating not less than 0.7 mil, 0.0007 inch (0.018 mm) thick.
 3. Color Anodized Finish: AA-M12C22A42/44, Class I, integrally or electrolytically colored anodic coating not less than 0.7 mil, 0.0007 inch (0.018 mm) thick.
 - a. Color: As selected from manufacturer's **[standard] [full] [custom] []** colors.
- B. Galvanized and/or Galvalume Steel:
1. Superior Performance Organic Coating System: Comply with AAMA 2605 for galvanized steel preparation, pretreatment, primer and finish coat system; provide thermally cured 70-percent PVDF or FEVE fluoropolymer systems.
 - a. Color: As selected from manufacturer's **RDCA custom** colors.
- C. Stainless Steel: Mil Finish. **2B**
- D. Copper: Natural Finish.

2.05 FABRICATION

- A. Form sections true to shape, accurate in size, square, and free from distortion or defects.
- B. Form gutters and downspouts in 10' – 20' lengths.
- C. With components requiring a seam, use an interlocking, watertight seam (acme lock), except where otherwise indicated.
- D. Fabricate all downspout, elbows and offsets with interlocking (acme lock) seams, except where otherwise indicated.
- E. All gutter corners to use watertight factory fabricated miters. Same material as gutter fabrication required.
- F. No painting of parts after their fabrication.
- G. Stainless steel rivets for aluminum, steel and stainless-steel products with color of rivet head to match downspout, to be used for all joints requiring fasteners. Copper rivets for copper products.

2.06 ACCESSORIES

- A. Provide all accessories and components, including but not limited to gutter corners, end caps, splice plates, expansion joints, gutter support brackets, gutter spacers, outlet tubes, from manufacturer of the gutters and downspouts.
- B. All accessories to be fabricated from same metal stock and finish as gutter and downspout.
 - 1. Post painting of product will not be approved.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions meet the manufacturer's requirements before starting work.

3.02 INSTALLATION

- A. Verify that other trades are complete before installing the gutter system.
- B. Mounting surfaces shall be straight and secure; substrates shall be of proper width.
- C. Refer to Construction Documents, Shop Drawings, and Manufacturer's installation instructions.
- D. Where applicable, coordinate installation with roof membrane manufacturer's installation instructions.
- E. Observe all appropriate OSHA safety guidelines for this work.

3.03 FIELD QUALITY CONTROL

- A. See Division 01 Quality Control section for field inspection requirements.
- B. Inspection will involve surveillance of work during installation to ascertain compliance with specified requirements.

3.04 CLEANING

- A. Remove all protective plastic surface film immediately after installation.

3.05 PROTECTION

- A. Protect installed work as required by the manufacturer to maintain product performance, design criteria and warranty.

END OF SECTION

SECTION 07 6223.16
CUSTOM BOX GUTTERS AND SMOOTH RECTANGULAR DOWNSPOUTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Fabricated sheet metal items, including gutters and downspouts

1.02 REFERENCE STANDARDS

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

1.03 SUBMITTALS

- A. See Division 01 for submittal procedures.
- B. Product Data: For each type of product specified including components and accessories.
- C. Shop Drawings: Indicate material profile, joining pattern, joining details, fastening methods, flashings, adjacent construction interface, accessories, and dimensions.
- D. Material Samples: Submit two (2) samples, in manufacturer's standard size, illustrating metal finish color.
- E. Fabrication Samples: Submit one (1) sample(s) of gutter downspout elbow offset gutter support bracket hidden hanger/spacer; and 24" on centers.

1.04 QUALITY ASSURANCE

- A. Perform work in accordance with SMACNA requirements and standard details, unless indicated otherwise.
- B. Fabricator Qualifications:
 - 1. Must source metal from specified supplier.
 - 2. Supply required paint warranty.
 - 3. Roll-form round downspout and half round gutter in size, material and metal thickness indicated. Fabrication of said products with metal folder or press break is not acceptable.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. All materials shall arrive in the original sealed and labeled manufacturer's packaging.
- B. Store materials in a dry, protected, well-vented area. The Contractor shall report damaged material within 48 hours of delivery to the delivering carrier and note such damage on the carrier's freight Bill of Lading. Copies of Bill of Lading noting the damage shall be provided to the manufacturer.

1.06 WARRANTY

- A. Warranty: Warranted materials shall be free of defects in material and workmanship. If, after inspection, the manufacturer agrees that materials are defective, the manufacturer shall at their option repair or replace them.
- B. Fabricator or Metal Supplier: Submit Paint Warranty.

PART 2 PRODUCTS

2.01 QUALIFIED MANUFACTURERS

- A. Gutters and Downspouts:
 - 1. Roof Drainage Components & Accessories, Inc (RDCA); www.rdcaa.com; e-mail: sales@rdcaa.com.
 - 2. Substitutions: Proposals for substitution products or suppliers shall be accepted only from bidding contractors a minimum of ten (10) working days before bid due date. The proposed substitution shall meet the Performance Requirements and Quality Assurance Standards of this specification. See Division 01 section on substitutions for additional requirements.

2.02 CUSTOM BOX GUTTER

- A. As part of a complete prefabricated custom drainage system, the manufacturer shall provide a complete custom box gutter system to include the following:

1. Gutter Support Brackets
 - a. All box gutters to be hung using hidden hangers or hidden spacers and gutter support brackets, as per table below.
 - 1) All gutters and gutter support brackets to be fabricated as per drawings.
 - 2) All gutter support brackets are to be installed per table below, complete with 0.125 inch x 1.0 inch 4-sided galvanized or stainless-steel bar, wrapped on all 4 sides with the same metal and color used to fabricate gutter. One longitudinal seam that is not visible after installation is allowed.
 - 3) No post painting of gutter support brackets

GUTTER MOUNTING SPECIFICATIONS - BOX GUTTERS⁽¹⁾

Gutter Girth ⁽²⁾	Material	Gutter Support Bracket			Spacer (Hidden Hanger)		
		Bar Stock Material	Bar Stock Thickness & Width	Maximum Spacing (O.C.)	Spacer Material*	Spacer Thickness & Width	Maximum Spacing (O.C.)
Up through 16"	Steel	Not required	Not required	Not required	Galvanized Steel*	.063" x 1.5" or .125" x 1.0"	24"
Up through 16"	Copper	Not required	Not required	Not required	Stainless Steel	.063" x 1.5" or .125" x 1.0"	24"
Up through 16"	Aluminum	Not required	Not required	Not required	Stainless Steel	.063" x 1.5" or .125" x 1.0"	24"
Up through 16"	Stainless Steel	Not required	Not required	Not required	Stainless Steel	.063" x 1.5" or .125" x 1.0"	24"
16.01 - 24.0"	Steel	Stainless Steel	.125" x 1.0"	36"	Galvanized Steel*	.063" x 1.5" or .125" x 1.0"	36"
16.01 - 24.0"	Copper	Stainless Steel	.125" x 1.0"	36"	Stainless Steel	.063" x 1.5" or .125" x 1.0"	36"
16.01 - 24.0"	Aluminum	Stainless Steel	.125" x 1.0"	36"	Stainless Steel	.063" x 1.5" or .125" x 1.0"	36"
16.01" - 24.0"	Stainless Steel	Stainless Steel	.125" x 1.0"	36"	Stainless Steel	.063" x 1.5" or .125" x 1.0"	36"
24.01" - 30.0"	Steel	Stainless Steel	.125" x 1.0"	30"	Galvanized Steel*	.063" x 1.5" or .125" x 1.0"	30"
24.01" - 30.0"	Copper	Stainless Steel	.125" x 1.0"	30"	Stainless Steel	.063" x 1.5" or .125" x 1.0"	30"
24.01" - 30.0"	Aluminum	Stainless Steel	.125" x 1.0"	30"	Stainless Steel	.063" x 1.5" or .125" x 1.0"	30"
24.01" - 30.0"	Stainless Steel	Stainless Steel	.125" x 1.0"	30"	Stainless Steel	.063" x 1.5" or .125" x 1.0"	30"
30.01" - 35.0"	Steel	Stainless Steel	.125" x 1.0"	24"	Stainless Steel	.063" x 1.5" or .125" x 1.0"	24"
30.01" - 35.0"	Copper	Stainless Steel	.125" x 1.0"	24"	Stainless Steel	.063" x 1.5" or .125" x 1.0"	24"
30.01" - 35.0"	Aluminum	Stainless Steel	.125" x 1.0"	24"	Stainless Steel	.063" x 1.5" or .125" x 1.0"	24"
30.01" - 35.0"	Stainless Steel	Stainless Steel	.125" x 1.0"	24"	Stainless Steel	.063" x 1.5" or .125" x 1.0"	24"
Over 35"	Subject to review of gutter profile and installation detail.						

*Stainless bar may be substituted.

FOOTNOTES:

(1) Values and information provided in this table do not represent any warranty or guarantee of any kind.

(2) Girth equals the sum of the gutter profile dimensions.

1. Connections:
 - a. All gutter to gutter sections to be joined with interior gutter splices, except for a 4-piece expansion joint a minimum of every 50 feet. Metal for splice plates and expansion joints shall be the same metal and paint finish as the gutter.
 - b. Factory fabricated mitered corners required for all gutter corners.
 - c. Connect all gutters and downspouts with factory fabricated outlet tubes.
 - d. Fabricate end caps from the same metal and color as the gutter.
 - e. Stainless steel rivets for aluminum, steel and stainless-steel products with color of rivet head to match gutter, to be used for all joints requiring fasteners. Copper rivets for copper products.
 - f. No component shall be post painted (after fabrication).
2. Gutter:
 - a. Gutter: custom-sized; as shown on drawings.
 - b. Gutter sections shall be 10 ft to 20 ft in length.
 - c. Refer to drawings for metal, metal thickness and color; however, in no case is the metal thickness for gutter, splice plates and mitered corners to be less than listed in this section. (In the event the drawing calls out a thinner material, this list shall supersede the drawing.)
 - d. Gutter Girth*:
 - 1) Up to 16 inches:
 - (a) Steel: 26 gauge.
 - (b) Copper: 16 ounce.
 - (c) Aluminum: 0.032 inches.
 - (d) Stainless Steel: 26 gauge.
 - 2) 16.01 inches to 24 inches:
 - (a) Steel: 24 gauge.
 - (b) Copper: 16 ounce.
 - (c) Aluminum: 0.032 inches.
 - (d) Stainless Steel: 24 gauge.
 - 3) 24.01 inches to 30.0 inches:
 - (a) Steel: 22 gauge.
 - (b) Copper: 20 ounce.
 - (c) Aluminum: 0.050 inches.
 - (d) Stainless Steel: 22 gauge.
 - 4) 30.01 inches to 35 inches:
 - (a) Steel: 22 gauge.
 - (b) Copper: 24 ounce.
 - (c) Aluminum: 0.050 inches.
 - (d) Stainless Steel: 22 gauge.
 - 5) Over 35 inches: Subject to review of gutter profile and installation detail.

* Girth equals the width of the metal prior to forming the gutter.

2.03 CUSTOM SMOOTH, RECTANGULAR DOWNSPOUT, ELBOWS & OFFSETS

- A. As part of a completely prefabricated custom drainage system, the manufacturer shall provide a complete smooth box-style downspout system to include the following:
 1. Width and depth of downspouts, elbows and offsets are custom sized as per drawings.
 2. Refer to drawings for metal, metal thickness and color; however, in no case is the metal thickness for downspouts, elbows and offsets to be less than listed below.

3. Downspout sections shall be 10 to 20 linear feet.
 4. All downspouts shall be connected to gutters using a factory fabricated outlet tube using the same metal and color as used for the downspout.
 5. All downspouts, elbows and offsets must have interlocking acme seam locks.
 6. Provide minimum two (2) factory fabricated, as per drawing, hemmed downspout anchor straps per 10 linear feet of downspout.
 7. Provide factory fabricated elbows and offsets. One-piece offsets required through a 30" horizontal offset distance.
 8. Stainless steel rivets for aluminum, steel and stainless-steel products, with color of rivet head to match downspout, to be used for all joints requiring fasteners. Copper rivets for copper products.
- B. Plain Rectangular Downspout, Elbows and Offsets: Refer to part drawings for metal, metal thickness and color; however, downspout, elbows and offsets must always have a minimum thickness as shown below. (In the event the drawing calls out a thinner material, this list shall supersede the drawing.)
1. Up to 15-inch Girth*:
 - a. Steel: 26 gauge.
 - b. Copper: 16 ounce.
 - c. Aluminum: 0.032 inches.
 - d. Stainless Steel: 26 gauge.
 2. 15.01 inch to 23.0-inch Girth*:
 - a. Steel: 24 gauge.
 - b. Copper: 16 ounce.
 - c. Aluminum: 0.040 inches.
 - d. Stainless Steel: 24 gauge.
 3. 23.01 inch to 47.0-inch Girth*:
 - a. Steel: 22 gauge.
 - b. Copper: 20 ounce
 - c. Aluminum: 0.050 inches.
 - d. Stainless Steel: 22 gauge.
- * Girth equals (2 x width) + (2 x depth)

2.04 EXTERIOR FINISHES

- A. Aluminum:
1. Natural Mill Finish.
 - a. Superior Performance Organic Coating System: Comply with AAMA 2605 for aluminum preparation, pretreatment, primer and finish coat system; provide thermally cured 70-percent PVDF or FEVE fluoropolymer systems.
 - b. Color: As selected from manufacturer's **custom REGAL BLUE** colors.
 2. Clear Anodized Finish: AA-M12C22A41, Class I, clear anodic coating not less than 0.7 mil, 0.0007 inch (0.018 mm) thick.
 3. Color Anodized Finish: AA-M12C22A42/44, Class I, integrally or electrolytically colored anodic coating not less than 0.7 mil, 0.0007 inch (0.018 mm) thick.
 - a. Color: As selected from manufacturer's **[standard] [full] [custom] [_____]** colors.
- B. Galvanized and/or Galvalume Steel:
1. Superior Performance Organic Coating System: Comply with AAMA 2605 for galvanized steel preparation, pretreatment, primer and finish coat system; provide thermally cured 70-percent PVDF or FEVE fluoropolymer systems.
 - a. Color: As selected from manufacturer's **RDCA custom** colors.
- C. Stainless Steel: Mil Finish. **2B**
- D. Copper: Natural Finish.

2.05 FABRICATION

- A. Form sections true to shape, accurate in size, square, and free from distortion or defects.
- B. Form gutters and downspouts in 10' – 20' lengths.
- C. With components requiring a seam, use an interlocking, watertight seam (acme lock), except where otherwise indicated.
- D. Fabricate all downspout, elbows and offsets with interlocking (acme lock) seams, except where otherwise indicated.
- E. All gutter corners to use watertight factory fabricated miters. Same material as gutter fabrication required.
- F. No painting of parts after their fabrication.
- G. Stainless steel rivets for aluminum, steel and stainless-steel products with color of rivet head to match downspout, to be used for all joints requiring fasteners. Copper rivets for copper products.

2.06 ACCESSORIES

- A. Provide all accessories and components, including but not limited to gutter corners, end caps, splice plates, expansion joints, gutter support brackets, gutter spacers, outlet tubes, from manufacturer of the gutters and downspouts.
- B. All accessories to be fabricated from same metal stock and finish as gutter and downspout.
 - 1. Post painting of product will not be approved.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions meet the manufacturer's requirements before starting work.

3.02 INSTALLATION

- A. Verify that other trades are complete before installing the gutter system.
- B. Mounting surfaces shall be straight and secure; substrates shall be of proper width.
- C. Refer to Construction Documents, Shop Drawings, and Manufacturer's installation instructions.
- D. Where applicable, coordinate installation with roof membrane manufacturer's installation instructions.
- E. Observe all appropriate OSHA safety guidelines for this work.

3.03 FIELD QUALITY CONTROL

- A. See Division 01 Quality Control section for field inspection requirements.
- B. Inspection will involve surveillance of work during installation to ascertain compliance with specified requirements.

3.04 CLEANING

- A. Remove all protective plastic surface film immediately after installation.

3.05 PROTECTION

- A. Protect installed work as required by the manufacturer to maintain product performance, design criteria and warranty.

END OF SECTION

SECTION 07 9200 JOINT SEALERS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes joint sealants for the following applications:
 - 1. Exterior joints in vertical surfaces and horizontal non-traffic surfaces.
 - 2. Interior joints in the following vertical surfaces and horizontal non-traffic surfaces:
 - a. Perimeter joints of exterior openings.
 - b. Perimeter joints between interior wall surfaces and frames of windows.
 - c. Other joints as indicated.

1.2 DEFINITIONS

- A. Agencies and the abbreviations used to reference them include the following:
 - 1. ASTM - American Standards for Testing Materials.
 - 2. FS - Federal Specification.
 - 3. UL - Underwriters Laboratory.

1.3 SUBMITTALS

- A. Product Data: For each joint-sealant product.
- B. Warranties: Special warranties specified in this Section.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.
- B. Codes, Standards & Regulations: Work, including materials and installation, shall be in strict accordance with the following codes.
 - 1. FS TT-S-00230C: Sealing Compound; Elastomeric Type, Single Component.
 - 2. FS TT-S-001543A: Sealing Compound; Silicone Rubber Base.
 - 3. UL 263: Fire Tests of Building Construction and Materials.

1.5 PROJECT CONDITIONS

- A. Do not proceed with installation of joint sealants under the following conditions:
 - 1. When ambient and substrate temperature conditions are outside limits permitted by joint sealant manufacturer or are below 40 degrees F.
 - 2. When joint substrates are wet.

3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
4. Contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.6 WARRANTY

- A. Special Installer's Warranty: Installer's standard form in which Installer agrees to repair or replace elastomeric joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Two years from date of acceptance of complete project by the authority.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer, based on testing and field experience.
- B. Colors of Exposed Joint Sealants: As selected by The Authority from manufacturer's full range.

2.2 ELASTOMERIC JOINT SEALANTS

- A. Elastomeric Sealants: Comply with ASTM C920 and other requirements indicated for each liquid-applied chemically curing sealant specified, including those referencing ASTM C920 classifications for type, grade, class, and uses related to exposure and joint substrates.
- B. Type: Single-component, low-modulus, neutral-cure silicone sealant for general glazing and above-grade weathersealing for joints between Masonry or Siding to Fiberglass Window Frames.
 1. Type and Grade: S (single component) and NS (non-sag).
 2. Class: 50.
 3. NST: Non-staining technology.
 4. Uses Related to exposure: T (traffic) and NT (non-traffic)
 5. Uses Related to Joint Substrates: G, M, A, and O.
 6. Federal Specification TT-S001543 A, TT-S00230C Class A.
 7. Mold and mildew resistant.
 8. Products: Subject to compliance with requirements, provide one of the following:
 - a. Pecora Corporation; 898NST.
 - b. Dow Corning 991 Silicone.
 - c. GE SCS9000 SilPruf NB non-staining silicone.

2.3 LATEX JOINT SEALANTS

- A. Latex Joint Sealant: Acrylic terpolymer latex solvent-based, thermo-plastic, solids not less than 95 percent acrylic, paintable. Comply with performance requirements of either ASTM C-920 Type S, Class 12-1/2, Grade NS; or FS TT-S-0023C, Class B, Type Non-sag.
 - 1. Location: Interior vertical and horizontal joints. Do NOT use for traffic joints.
 - 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. BASF Building Systems.
 - b. Pecora Corporation, AC-20.
 - c. Tremco Incorporated, Tremplex 834.

2.4 JOINT-SEALANT BACKING

- A. General: Provide sealant backings of material and type that are non-staining, are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Cylindrical Sealant Backings: ASTM C 1330, Type O, open-cell material and non-off-gassing as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

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 pre-construction joint-sealant-substrate tests and field tests.
 - 1. Provide primer at locations where PVC simulated wood trim is installed.
- 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.

PART 3 - EXECUTION

3.1 EXAMINATION

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

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, blast cleaning, 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.
 3. Remove laitance and form-release agents from concrete.
 4. Clean nonporous 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: Metal.
- B. Joint Priming: Prime joint substrates were recommended in writing by joint-sealant manufacturer. Apply primer to comply with manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

3.3 INSTALLATION OF JOINT SEALANTS

- A. 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 type 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 edges 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 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.
- E. Tooling of Non-sag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified 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 configuration per Figure SA in ASTM C1193, unless otherwise indicated.

END OF SECTION

DIVISION 08

SECTION 08 1113

HOLLOW METAL DOORS AND FRAMES

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Hollow Metal doors and frames.
- B. Related Sections:
 - 1. Division 01: Administrative, procedural, and temporary work requirements.
 - 2. Section 08 7100 - Door Hardware.
 - 3. Section 08 8000 - Glazing.

1.2 REFERENCES

- A. American National Standards Institute (ANSI)
 - 1. A250.8 - Recommended Specifications for Standard Steel Doors and Frames.
 - 2. A250.11 - Recommended Erection Instructions for Steel Frames.
- B. ASTM International (ASTM):
 - 1. A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
 - 2. A924 - Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
 - 3. A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
 - 4. E413 - Classification for Rating Sound Insulation.
- C. National Fire Protection Association (NFPA) 80 - Standard for Fire Doors and Fire Windows.
- D. Underwriters Laboratories (UL):
 - 1. 10B - Standard for Fire Tests of Door Assemblies.
 - 2. 10C - Standard for Positive Pressure Fire Tests of Door Assemblies.

1.3 SUBMITTALS

- A. Submittals for Review:
 - 1. Shop Drawings: Show locations, elevations, dimensions, model designations, fire ratings, preparation for hardware, and anchoring details.
 - 2. Product Data: Show elevations, dimensions, gages of metal, hardware reinforcing gages and locations, and anchor types.
- B. Quality Control Submittals:
 - 1. Certificates of Compliance: Certification that doors and frames comply with specified code requirements.

1.4 QUALITY ASSURANCE

- A. Doors: ANSI A250.8.
 - 1. Grade: II - Heavy Duty.
 - 2. Model: 1A - Full Flush
 - 3. Exterior doors: Minimum R value of 12.0.

- B. Frames: ANSI A250.8, Grade II - Heavy Duty.
- C. Fire Door and Frame Construction: Conform to UL [10B.] [10C.]
- D. Installed Fire Rated Door and Frame Assemblies: Conform to NFPA 80.
- E. Acoustic Door and Frame Assemblies: Minimum STC rating of 41, measured in accordance with ASTM E413. With fiberglass core.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Ship door frames with removable angle spreader; do not remove until frame is installed.
- B. Store doors upright in protected, dry area, off ground or floor, with at least 1/4 inch space between individual units.
- C. Do not cover with non-vented coverings that create excessive humidity.
- D. Remove wet coverings immediately.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers:
 - 1. ~~Amweld Building Products LLC. (www.amweld.com)~~ **NOT USED**
 - 2. Ceco Door Products. (www.cecodoor.com)
 - 3. Curries Company. (www.curries.com)
 - 4. ~~Kewanee Corp. (www.kewaneeecorp.com)~~ **NOT USED**
 - 5. Pioneer Industries, Inc. (www.pioneerindustries.com)
 - 6. Steelcraft. (www.steelcraft.com)
- B. Substitutions: Not permitted.

2.2 MATERIALS

- A. Steel Sheet:
 - 1. ASTM A1008/1008M, cold rolled.
- B. Door Core: Vertical steel stiffeners.

2.3 ACCESSORIES

- A. Primer: electro-statically applied prime base code.

2.4 FABRICATION

- A. Fabricate doors and frames in accordance with ANSI A250.8.
- B. Fabricate exterior doors and frames from galvanized steel sheet.
- C. Doors:
 - 1. Fabricate from minimum 18 gage sheets.
 - 2. Close top and bottom edges of doors with steel channel, minimum 16 gage, extending full width of door, and spot welded to both faces, with top channel flush and bottom channel recessed.
 - 3. Fill voids between vertical steel stiffeners with fiberglass insulation.

- D. Frames:
 - 1. Fabricate from minimum 18 gage sheets.
 - 2. Provide self aligning tabs and slots to hold corners in alignment.
- E. Accurately form to required sizes and profiles.
- F. Grind and dress exposed welds to form smooth, flush surfaces.
- G. Do not use metallic filler to conceal manufacturing defects.
- H. Fabricate with internal reinforcement for hardware specified in Section 08 7100; weld in place.

2.5 FINISHES

- A. Apply custom color to be selected from manufacturer's standards.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install doors and frames in accordance with ANSI A250.11.
- B. Set plumb and level.
- C. Secure to adjacent construction using fastener type best suited to application.
- D. Install hardware in accordance with Section 08 7100.

3.2 ADJUSTING

- A. Touch up minor scratches and abrasions in [primer paint] [baked enamel] to match factory finish.

END OF SECTION

SECTION 08 7100

DOOR HARDWARE

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Hardware for steel doors.
 - 2. Hardware for other sections referencing this section.
 - 3. Note: All doors will have deadbolt key locks.

1.2 REFERENCES

- A. American National Standards Institute/Builders Hardware Manufacturers Association (ANSI/BHMA):
 - 1. A156.1 - Butts and Hinges.
 - 2. A156.2 - Bored and Pre-assembled Locks and Latches.
 - 3. A156.3 - Exit Devices.
 - 4. A156.4 - Door Controls - Closers.
 - 5. A156.5 - Auxiliary Locks and Associated Products.
 - 6. A156.13 - Mortise Locks and Latches.
 - 7. A156.18 - Materials and Finishes.
 - 8. A156.26 - Continuous Hinges.
 - 9. A156.31 - Electric Strikes.
- B. National Fire Protection Association (NFPA):
 - 1. 80 - Standard for Fire Doors and Windows.

1.3 SUBMITTALS

- A. Submittals for Review:
 - 1. Shop Drawings: Schedule hardware by door type and location; show door size, hand, thickness, edge bevel, hardware components and quantities, keying, and finishes.
 - 2. Product Data: Manufacturer's descriptive data for each component.
- B. Closeout Submittal:
 - 1. Copy of approved hardware schedule.
 - 2. Keying list.
 - 3. Keys; tag with mark corresponding to keying schedule.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Minimum 5 years documented experience in work of this Section.
- B. Provide hardware labeled by recognized independent testing laboratory and meeting requirements of NFPA 80 for fire rated doors.
- C. Provide smoke gasketing at fire rated doors in accordance with NFPA 105.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Pack hardware items separately, with fasteners, installation instructions, and templates.
- B. Mark containers with item number corresponding to hardware schedule.

1.6 WARRANTIES

- A. Furnish manufacturer's 2 year warranty for locksets and latch sets.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers - Butt Hinges:
1. ~~Bommer Industries, Inc. (www.bommer.com)~~ **Bommer Not used**
 2. Hager Companies. (www.hagerco.com)
 3. McKinney Products Co. (www.mckinneyhinge.com)
 4. ~~Stanley Hardware. (www.stanleyworks.com)~~ **Stanleyworks Not used**
- B. Acceptable Manufacturers - Continuous Hinges:
1. Hager Companies. (www.hagerco.com)
 2. McKinney Products Co. (www.mckinneyhinge.com)
 3. Pemko Manufacturing Co. (www.pemko.com)
 4. ~~Stanley Hardware. (www.stanleyhardware.com)~~ **Stanleyworks Not used**
- C. Acceptable Manufacturers - Locksets, Latchsets, Deadbolts, and Cylinders:
1. Best Access Systems. (www.bestaccess.com)
 2. ~~Corbin Russwin Architectural Hardware. (www.corbin-russwin.com)~~ **Not used**
 3. Schlage Lock Co. (www.schlage.com)
 4. Sargent Mfg. (www.sargentlock.com)
 5. Yale Security, Inc. (www.yalelocks.com)
- D. Acceptable Manufacturers - Closers:
1. ~~Corbin Russwin Architectural Hardware. (www.corbin-russwin.com)~~ **Not used**
 2. Dorma Door Controls, Ltd. (www.dorma-usa.com)
 3. LCN Closers. (www.lcnclosers.com)
 4. Sargent Mfg. (www.sargentlock.com)
 5. Yale Security, Inc. (www.yalelocks.com)
- E. Acceptable Manufacturers - Exit Devices:
1. ~~Corbin Russwin Architectural Hardware. (www.corbin-russwin.com)~~ **Not used**
 2. Sargent Mfg. (www.sargentlock.com)
 3. Von Duprin. (www.vonduprin.com)
 4. Yale Security, Inc. (www.yalelocks.com)
- F. Substitutions: Not permitted.

2.2 MANUFACTURED UNITS

- A. Commercial Hinges:
1. Description: ANSI / BHMA A156.1, Commercial door hinge, ball bearing.
 2. Exterior out swinging doors: Provide set screw in barrel making hinge non-removable when door is closed.
 3. Weight: 0.495 weight.
 4. Gauge: 0.134
 5. Handing: Reversible.
 6. Size: 4.5" w x 4.5" h inches.
 7. Knuckles: 5
 8. Number of screw holes: 8

- B. Locksets, Latch sets, Deadbolts, and Cylinders:
 - 1. Locksets and latch sets:
 - a. Type: ANSI/BHMA A156.13, Grade 1 mortise, lever handles.
 - b. Lever design: To be selected from manufacturer's full range of selections.
 - 2. Keys: Solid brass or nickel silver.
 - 3. Keying:
 - a. Construction key locks.
 - b. Grand Master key locks in one set. To existing master key system.
 - c. Key alike, cross key, or otherwise key as directed by Owner.
 - d. Provide four keys for each lock and 6 master keys for each master key system.
 - e. Inscribe keys with lock manufacturer [and notation DO NOT DUPLICATE.
 - f. Provide 1.25 inch wide bow surface for access by the physically handicapped.

- C. Door Stops: Floor mounted, aluminum housing with resilient bumper.

2.3 FINISHES

- A. Finishes: To ANSI/BHMA A156.18.

Hinges at Fire-Rated Doors: Finish No. 652, satin chrome plated.

- B. Thresholds and Door Seal Housings: Clear anodized.
- C. Other: Finish No. 626, satin chrome plated.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install hardware in accordance with approved hardware schedule and manufacturer's instructions.
- B. Install mortise items flush with adjacent surfaces.
- C. Install Locksets, closers, and trim after finish painting.
- D. Set thresholds in mastic and secure.
- E. Install kick plates on restroom doors entry side.
- F. Mount closers so that closers and closer arms are not visible on corridor or public side of doors or on exterior of building.
- G. Mounting Heights - Finished Floor to Center Line of:
 - 1. Locksets: 38 inches.
 - 2. Push and pull plates: 42 inches.
 - 3. Dead locks: 48 inches.
 - 4. Push pad exit devices: 42 inches.
 - 5. Cross bar exit devices: 38 inches.
 - 6. Top hinge: Maximum 10 inches from frame head.
 - 7. Bottom hinge: Maximum 12-1/2 inches from floor.
 - 8. Intermediate hinges: Equally spaced.

3.2 PROTECTION

- A. Remove or protect hardware until painting is completed.

3.3 ADJUSTING

- A. Test and adjust hardware for quiet, smooth operation, free from binding and rattling.
- B. Adjust doors to operate with maximum opening forces in accordance with applicable accessibility code as follows:
 - 1. Interior fire-rated doors: 15.0 pounds.

3.4 SCHEDULE

SET NO.	QUANTITY	DESCRIPTION
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END OF SECTION

DIVISION 09

SECTION 09 2900 GYPSUM BOARD

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following: Interior gypsum board.
- B. Related Sections include the following:
 - 1. Section 061053 "Miscellaneous Carpentry" for non-structural framing and suspension systems that support gypsum board panels.

1.2 ACTION SUBMITTALS

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

1.3 QUALITY ASSURANCE

- 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. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

1.4 STORAGE AND HANDLING

- A. Store materials inside under cover and keep them dry and protected against damage from weather, condensation, direct sunlight, construction traffic, and other causes. Stack panels flat to prevent sagging.

1.5 PROJECT CONDITIONS

- A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.
- B. Do not install interior products until installation areas are enclosed and conditioned.
- C. Do not install panels that are wet, those that are moisture damaged, and those that are 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 INTERIOR GYPSUM BOARD

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. CertainTeed Gypsum, Inc.
 - 2. G-P Gypsum.
 - 3. Lafarge North America Inc.
 - 4. National Gypsum Company.
 - 5. USG Corporation.
- B. Abuse-Resistant Type: ASTM C 1629/C 1629M, Level 2. Manufactured to produce greater resistance to surface indentation, through-penetration (impact resistance), and abrasion than standard, regular-type and Type X gypsum board.
 - 1. Thickness: 5/8 inch (12.7 mm).
 - 2. Long Edges: Tapered.

2.2 TRIM ACCESSORIES

- A. Trim: ASTM C 1047.
 - 1. Material: Hot-dip galvanized steel sheet 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.

2.3 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C 475/C 475M.
- B. Joint Tape For Interior Gypsum Wallboard: Paper.
- C. Joint Compound for Interior Gypsum Wallboard: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.
 - 1. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound.
 - a. Use setting-type compound for installing paper-faced metal trim accessories.
 - 2. Fill Coat: For second coat, use setting-type, sandable topping compound.
 - 3. Finish Coat: For third coat, use setting-type, sandable topping compound.
 - 4. Skim Coat: For final coat of Level 5 finish, use setting-type, sandable topping compound or high-build interior coating product designed for application by airless sprayer and to be used instead of skim coat to produce Level 5 finish.

2.4 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.
- 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 thick.

PART 3 - EXECUTION

3.1 APPLYING AND FINISHING PANELS, GENERAL

- A. Comply with ASTM C 840.
- B. 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.
- C. 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.
- D. Form control and expansion joints with space between edges of adjoining gypsum panels.
- E. 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-wide joints to install sealant.
- F. Attachment to Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

3.2 APPLYING INTERIOR GYPSUM BOARD

- A. Install interior gypsum board in the following locations:
 - 1. Abuse-Resistant Type: Vertical surfaces, unless otherwise indicated.
 - 2. Type X: Where required for fire-resistance-rated assembly.
- B. Single-Layer Application:
 - 1. On ceilings, apply gypsum panels vertically (parallel to framing), horizontally (perpendicular to framing), or required by fire-resistance-rated assembly, and minimize end joints.
 - 2. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

3.3 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. Install joints on both sides above framed door openings at locations where ceiling height is greater than 8-feet.
- C. Trim: Install in the following locations:
 - 1. Cornerbead: Use at outside corners, unless otherwise indicated.
 - 2. Bullnose Bead: Use at outside corners where indicated.
 - 3. LC-Bead: Use at exposed panel edges.
 - 4. L-Bead: Use where indicated.

3.4 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 those with trim having flanges not intended for tape.
- D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:
 - 1. Level 4: At panel surfaces that will be exposed to view, unless otherwise indicated. Including surfaces scheduled to receive ceiling to wall covering.
 - a. Primer and its application to surfaces are specified in other Division 09 Sections.
 - 2. Level 5: Not used unless indicated on Drawings.

END OF SECTION 092900

SECTION 09 9100 INTERIOR PAINTING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes surface preparation and field painting of, but not limited to, the following exposed interior items and surfaces.
 - 1. Gypsum surfaces surrounding windows.
 - 2. Pre-primed surfaces.
- B. Surface preparation, priming, and finish coats specified in this Section are in addition to shop priming and surface treatment specified in other Sections.
- C. Paint exposed surfaces, except where these Specifications indicate that the surface or material is not to be painted or is to remain natural. If an item or a surface is not specifically mentioned, paint the item, or surface the same as similar adjacent materials or surfaces. If a color of finish is not indicated, The Authority will select from standard colors and finishes available.
 - 1. Painting includes field painting of exposed bare and covered pipes and ducts (including color coding), hangers, exposed steel and iron supports, and surfaces of mechanical and electrical equipment that do not have a factory-applied final finish.
- D. Do not paint prefinished items, concealed surfaces, finished metal surfaces, operating parts, and labels.
 - 1. Prefinished items include the following factory-finished components:
 - a. Finished mechanical and electrical equipment.
 - b. Light fixtures.
 - 2. Finished metal surfaces include the following:
 - a. Anodized aluminum.
 - b. Stainless steel.
 - c. Chromium plate.
 - d. Copper and copper alloys.
 - e. Bronze and brass.
 - 3. Operating parts include moving parts of operating equipment
 - 4. Labels: Do not paint over UL, FMG, or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.

1.2 DEFINITIONS

- A. Agencies, and the abbreviations used to reference them, include the following:
 - 1. ASTM - American Standards for Testing Materials.
 - 2. FM - Factory Mutual.
 - 3. SSPC - Steel Structures Painting Council.

B. Standard coating terms defined in ASTM D 16 apply to this Section.

1. Flat: A lusterless or matte finish with a gloss range below 15 when measured at an 85-degree meter.
2. Eggshell: Low-sheen finish with a gloss range between 20 and 35 when measured at a 60-degree meter.
3. Semi Gloss: Medium-sheen finish with a gloss range between 35 and 70 when measured at a 60-degree meter.
4. Gloss: High-sheen finish with a gloss range more than 70 when measured at a 60-degree meter.

1.3 SUBMITTALS

A. Product Data:

1. Material List: Indicate each material and cross-reference specific coating, finish system, and application. Identify each material by highlighting the manufacturer's catalog number and general classification.
2. Manufacturer's Information: Manufacturer's technical information, including MSDS label analysis and instructions for handling, storing, and applying each coating material.
3. Color chart with manufacturer's full range of standard colors

1.4 QUALITY ASSURANCE

- A. Applicator Qualifications: A firm or individual experienced in applying paints and coatings similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance.
- B. Source Limitations: Obtain block fillers and primers for each coating system from the same manufacturer as the finish coats. Products shall not contain TCLP metals and PCB's.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Project site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label and the following information:

1. Product name or title of material.
2. Product description (generic classification or binder type).
3. Manufacturer's stock number and date of manufacture.
4. Contents by volume, for pigment and vehicle constituents.
5. Thinning instructions.
6. Application instructions.
7. Color name and number.
8. VOC content.

B. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45 degrees F. Maintain storage containers in a clean condition, free of foreign materials and residue. The Authority requires additional safety controls and health rules for on-site service for flammable material storage.

1. Protect from freezing. Keep storage area neat and orderly. Remove oily rags and waste daily.

1.6 PROJECT CONDITIONS

- A. Apply waterborne paints only when temperatures of surfaces to be painted and surrounding air are between 50 and 90 degrees F.
- B. Do not apply paint in snow, rain, fog, or mist; or when relative humidity exceeds 85 percent; or at temperatures less than 5 degrees F above the dew point; or to damp or wet surfaces.
 - 1. Painting may continue during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature limits specified by manufacturer during application and drying periods.

PART 2 - PRODUCTS

2.1 PAINT MATERIALS, GENERAL

- A. Material Compatibility: Provide block fillers, primers, and finish-coat materials that are compatible with one another and with the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing-and field experience.
- B. Material Quality: Provide manufacturer's best-quality paint material of the various coating types specified that are factory formulated and recommended by manufacturer for application indicated. Paint-material containers not displaying manufacturer's product identification will not be acceptable.
 - 1. Proprietary Names: Use of manufacturer's proprietary product names to designate colors or materials is intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers unless an approval request is submitted and approved by The Authority. Furnish manufacturer's material data MSDS and certificates of performance for proposed substitutions.
- C. Colors: As selected by Architect from manufacturer's full range of color chips.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements for paint application. Comply with procedures specified in PDCA P4.
 - 1. Proceed with paint application only after unsatisfactory conditions have been corrected and surfaces receiving paint are thoroughly dry.
 - 2. Start of painting will be construed as Applicator's acceptance of surfaces and conditions within a particular area.
- B. Coordination of Work: Review other Sections in which primers are provided to ensure compatibility of the total system for various substrates. On request, furnish information on characteristics of finish materials to ensure use of compatible primers.
 - 1. Notify the Authority about anticipated problems when using the materials specified over substrates primed by others.

3.2 PREPARATION

- A. General: Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items already installed that are not to be painted. If removal is impractical or impossible because of size or weight of the item, provide surface-applied protection before surface preparation and painting.
1. After completing painting operations in each space or area, reinstall items removed using workers skilled in the trades involved.
- B. Cleaning: Before applying paint or other surface treatments, clean substrates of substances that could impair bond of the various coatings. Remove oil and grease before cleaning.
1. Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.
- C. Surface Preparation: Clean and prepare surfaces to be painted according to manufacturers written instructions for each particular substrate condition and as specified.
1. Provide barrier coats over incompatible primers or remove and re-prime.
 2. Ferrous Metals: Clean ungalvanized ferrous-metal surfaces that have not been shop coated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with SSPC's recommendations.
 - a. Treat bare and sandblasted or pickled clean metal with a metal treatment wash coat before priming.
 - b. Touch up bare areas and shop-applied prime coats that have been damaged. Wire-brush; clean with solvents recommended by paint manufacturer, and touch up with same primer as the shop coat.
- D. Material Preparation: Mix and prepare paint materials according to manufacturers written instructions.
1. Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.
 2. Stir material before application to produce a mixture of uniform density. Stir as required during application. Do not stir surface film into material. If necessary, remove surface film and strain material before using.
 3. Use only thinners approved by paint manufacturer and only within recommended limits.
- E. Surface Preparation Schedule:

NO.	SURFACE	SURFACE PREPARATION
SP-11	Gypsum Board Surfaces	Fill minor defects with filler compound and sand smooth. Spot prime defects after repair.
SP-13	Interior Wood (or wood products)	Wipe off dust and grit prior to priming. Seal knots, pitch streaks and sappy sections with sealer. Fill nail holes and cracks after primer has dried; sand between coats.

3.3 APPLICATION

- A. General: Apply paint according to manufacturer's written instructions. Use applicators and techniques best suited for substrate and type of material being applied.
1. Paint colors, surface treatments, and finishes are indicated in the paint schedules.
 2. Do not paint over dirt, rust, scale; grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.
 3. Provide finish coats that are compatible with primers used.
 4. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, grilles, convector covers, covers for finned-tube radiation, and similar components are in place. Extend coatings in these areas, as required, to maintain system integrity and provide desired protection.
 5. Finish exterior doors on tops, bottoms, and side edges the same as exterior faces.
 6. Sand lightly between each succeeding enamel or varnish coat.
- B. Scheduling Painting: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.
1. The number of coats and film thickness required are the same regardless of application method. Do not apply succeeding coats until previous coat has cured as recommended by manufacturer. If sanding is required to produce a smooth, even surface according to manufacturer's written instructions, sand between applications.
 2. Omit primer over metal surfaces that have been shop primed and touch-up painted.
 3. If undercoats, stains, or other conditions show through final coat of paint, apply additional coats until paint film is of uniform finish, color, and appearance. Give special attention to ensure that edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.
 4. Allow sufficient time between successive coats to permit proper drying. Do not re-coat surfaces until paint has dried to where it feels firm, and does not deform or feel sticky under moderate thumb pressure, and until application of another coat of paint does not cause undercoat to lift or lose adhesion.
- C. Application Procedures: Apply paints and coatings by brush, roller, spray, or other applicators according to manufacturer's written instructions.
- D. Minimum Coating Thickness: Apply paint materials no thinner than manufacturer's recommended spreading rate to achieve dry film thickness indicated. Provide total dry film thickness of the entire system as recommended by manufacturer.
- E. Electrical items to be painted include, but are not limited to, the following:
1. Panel boards.
 2. Electrical equipment that is indicated to have a factory-primed finish for field painting.
- F. Prime Coats: Before applying finish coats, apply a prime coat, as recommended by manufacturer, to material that is required to be painted or finished and that has not been prime coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no bum-through or other defects due to insufficient sealing.
- G. Pigmented (Opaque) Finishes: Completely cover surfaces as necessary to provide a smooth, opaque surface of uniform (mish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable.

- H. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not complying with requirements.

3.4 PAINTING & COATING SYSTEMS

- A. General: Work with Painting Schedule for number of coats.

SYSTEM	MATERIAL & CONDITION	SURFACE PREP	PRIMER COAT	INTERMEDIATE COAT	FINISH COAT
G1	Gypsum Board Interior Normal Service	SP-11	Acrylic Latex 1 coat @ 1.5-1.9 MDF per coat Color: White	N/A	Acrylic Latex 2 coats @ 1.4.-1.7 MDF per coat Color: Per Painting Schedule
W1	Wood or Wood Product, Interior Normal Surface	SP-13	Modified Alkyd 1 coat @ 2.0-2.6 MDF per coat Color: White	N/A	Styrene Acrylic Latex 1 coat@ 1.4-1.7 MDF per coat Color: Per Painting Schedule

3.5 CLEANING

- A. Cleanup: At the end of each workday, remove empty cans, rags, rubbish, and other discarded paint materials from Project site.

3.6 PROTECTION

- A. Protect work of other trades, whether being painted or not, against damage from painting. Correct damage by cleaning, repairing or replacing, and repainting, as approved by The Authority.
- B. Provide "Wet Paint" signs to protect newly painted finishes. After completing painting operations, remove temporary protective wrappings provided by others to protect their work.
1. After work of other trades is complete, touch up and restore damaged or defaced painted surfaces. Comply with procedures specified in PDCA PI.

END OF SECTION 099100

DIVISION 10

Section 10 1400

Signage

Cast Flat Cut Stainless Steel Letters

GENERAL

1.1 Summary

1. **Scope:** Provide exterior cast flat cut stainless steel letters with flush stud mounting.
2. **Related Sections:** Section 04 2200 (Concrete Unit Masonry).

1.2 Submittals

1. **Product Data:** Submit manufacturer technical data sheets and installation instructions.
2. **Shop Drawings:** Show letter dimensions, font style, spacing, and stud locations.
3. **Samples:** Submit full-size sample letter showing specified painted finish on stainless steel.
4. **Color Samples:** Submit physical paint draw-downs of custom green for Architect selection and approval.
5. **Mounting Template:** Provide full-size paper template showing exact drill hole positions.

1.3 Quality Assurance

1. **Manufacturer Qualifications:** Minimum 5 years experience manufacturing cast metal signage.
2. **Regulatory Requirements:** Comply with ADA accessibility guidelines where applicable.

1.4 Warranty

1. **Special Warranty:** Submit a written warranty signed by the manufacturer and installer.
2. **Warranty Period:** 5 years from the date of Substantial Completion.
3. **Coverage:** Guarantee against defects in materials and workmanship, including cracking, peeling, chalking, fading, or loss of adhesion of the custom paint finish.

Part 2 - Products

2.1 Manufacturers

1. **Acceptable Manufacturers:** Gemini Sign Products, Matthews International, or approved equal.

2.2 Materials

1. **Metal Type:** Stainless Steel alloy suited for exterior environmental exposure.
2. **Manufacturing Process:** Cast metal with flat cut face profiles.
3. **Letter Height:** 12 inches.
4. **Letter Depth:** 1 inch.
5. **Font Style:** Roff Font.
6. **Finish:** Exterior-grade custom paint finish to match glazed tile and column green, as selected by Architect.

2.3 Mounting Hardware

1. **Mounting Type:** Flush stud mount via embedded pins.
2. **Pins/Studs:** Threaded stainless steel pins, minimum 1/4-20 gauge, cut to lengths suitable for complete structural embedment within the glazed block face and masonry core.
3. **Adhesive:** High-strength, exterior-grade, non-staining structural epoxy or polyester resin chemical anchoring adhesive specifically formulated for bonding stainless steel pins to dense, vitrified surfaces and masonry cores.

Part 3 - Execution

3.1 Examination

- **Site Conditions:** Verify exterior glazed concrete block wall surface is plumb, clean, and dry.
- **Substrate Integrity:** Inspect glazed faces for existing cracks or structural damage prior to drilling.
- **Notification:** Report defects in writing; do not proceed until corrected.

3.2 Installation

1. **Preparation:** Apply full-size paper mounting template securely to the glazed concrete block surface.
2. **Drilling:** Use a diamond-tipped core bit or high-speed carbide masonry bit to drill through the vitrified glaze without spalling, cracking, or chipping the tile face.
3. **Hole Preparation:** Drill to the specified manufacturer depth for full pin embedment. Clean holes thoroughly with a nylon brush and compressed air to remove all masonry dust and slurry.

4. **Hardware Insertion:** Thread pins into the back of cast letters until flush.
5. **Securing:** Inject structural chemical anchoring adhesive into the back of the cleaned holes. Insert the letter pins firmly until the back of the characters sit completely flush against the glazed tile face.
6. **Alignment:** Maintain level alignment and uniform spacing using the template while adhesive cures.

3.3 Cleaning Protocols

1. **Adhesive Removal:** Wipe away excess installation adhesive or squeezed-out epoxy immediately using manufacturer-approved solvents before the compound sets.
2. **Debris Removal:** Clean up all masonry dust, drilling chips, and template remnants from the site daily.
3. **Surface Wash:** Wash painted letter surfaces using a clean, soft cloth and a mild soap-and-water solution.
4. **Prohibited Items:** Do not use abrasive pads, wire brushes, steel wool, or harsh acid-based chemical cleaners.
5. **Rinsing:** Rinse thoroughly with clean water and dry with a soft, lint-free cloth to prevent spotting.

3.4 Final Inspection

1. **Alignment Check:** Inspect letters from a distance to verify visual leveling, uniform tracking, and proper font kerning.
2. **Stability Verification:** Gently test each character manually to ensure a completely rigid, flush fit against the glazed tile with zero rotational play in the embedded pins.
3. **Finish Review:** Examine painted surfaces under natural daylight for scratches, nicks, or uneven color coats.
4. **Touch-up:** Repair minor field blemishes using factory-supplied touch-up paint matching the approved custom green.
5. **Sign-off:** Replace any letters that show uncorrectable visual or structural defects prior to final project acceptance.

To ensure this document is completely finalized for your construction package, let me know if you would like to:

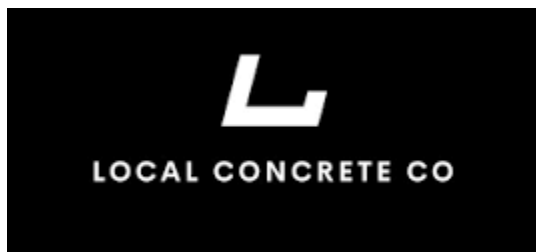
1. Consolidate everything into a **clean copy-paste text block**?
2. Specify a **particular epoxy manufacturer**, Hilti, Simpson Strong-Tie
3. Add any notes on **ambient temperature limits** required for curing the embedded pin adhesive?



1 site

- Concrete Anchor Installation Guide: Tapcons vs Wedge Anchors

Jan 25, 2026 — Clean the hole thoroughly. Blow out all dust with compressed air, then brush the hole with a nylon bore brush, then blow again. Ac...



www.localconcretecontractor.com

JB Weld , 40 degree F mi

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Section 10 14 00 - Signage (Cast Flat Cut Stainless Steel Letters)

Part 1 - General

Signage

10 1400-4

HACP NVH Family Recreational Area
March 2023

Cast Flat Cut Stainless Steel Letters

1.1 Summary

* **Scope**: Provide exterior cast flat cut stainless steel letters with flush stud mounting.

* **Related Sections**: Section 04 22 00 (Concrete Unit Masonry).

1.2 Submittals

* **Product Data**: Submit manufacturer technical data sheets and installation instructions.

* **Shop Drawings**: Show letter dimensions, font style, spacing, and stud locations.

* **Samples**: Submit full-size sample letter showing specified painted finish on stainless steel.

* **Color Samples**: Submit physical paint draw-downs of custom green for Architect selection and approval.

* **Mounting Template**: Provide full-size paper template showing exact drill hole positions.

1.3 Quality Assurance

* **Manufacturer Qualifications**: Minimum 5 years experience manufacturing cast metal signage.

* **Regulatory Requirements**: Comply with ADA accessibility guidelines where applicable.

1.4 Warranty

* **Special Warranty**: Submit a written warranty signed by the manufacturer and installer.

* **Warranty Period**: 5 years from the date of Substantial Completion.

* **Coverage**: Guarantee against defects in materials and workmanship, including cracking, peeling, chalking, fading, or loss of adhesion of the custom paint finish.

Part 2 - Products

2.1 Manufacturers

* **Acceptable Manufacturers**:

Gemini Sign Products, Matthews International, or approved equal.

2.2 Materials

* **Metal Type**:

Stainless Steel alloy suited for exterior environmental exposure.

* **Manufacturing Process**:

Cast metal with flat cut face profiles.

* **Letter Height**:

12 inches.

* **Letter Depth**:

1 inch.

* **Font Style**:

Roff Font.

* **Finish**:

Exterior-grade custom paint finish to match glazed tile and column green, as selected by Architect.

2.3 Mounting Hardware

* **Mounting Type**:

Flush stud mount via embedded pins.

* **Pins/Studs**:

Threaded stainless steel pins, minimum 1/4-20 gauge, cut to lengths suitable for complete structural embedment within the glazed block face and masonry core.

* **Adhesive**:

J-B Weld high-strength exterior-grade structural epoxy compound.

Part 3 - Execution

3.1 Examination

* **Site Conditions**:

Verify exterior glazed concrete block wall surface is plumb, clean, and dry.

* **Environmental Constraints**:

Do not proceed with adhesive application if ambient or substrate temperatures are below 40°F (4.4°C).

* **Substrate Integrity***: Inspect glazed faces for existing cracks or structural damage prior to drilling.

* **Notification***: Report defects in writing; do not proceed until corrected.

3.2 Installation

* **Preparation***: Apply full-size paper mounting template securely to the glazed concrete block surface.

* **Drilling***: Use a diamond-tipped core bit or high-speed carbide masonry bit to drill through the vitrified glaze without spalling, cracking, or chipping the tile face.

* **Hole Preparation***: Drill to the specified manufacturer depth for full pin embedment. Clean holes thoroughly with a nylon brush and compressed air to remove all masonry dust and slurry.

* **Hardware Insertion***: Thread pins into the back of cast letters until flush.

* **Securing***: Mix and apply J-B Weld epoxy per manufacturer instructions. Inject adhesive into the back of the cleaned holes. Insert the letter pins firmly until the back of the characters sit completely flush against the glazed tile face.

* **Alignment***: Maintain level alignment and uniform spacing using the template while adhesive cures.

3.3 Cleaning Protocols

* **Adhesive Removal***: Wipe away excess installation adhesive or squeezed-out epoxy immediately using manufacturer-approved solvents before the compound sets.

* **Debris Removal***: Clean up all masonry dust, drilling chips, and template remnants from the site daily.

* **Surface Wash***: Wash painted letter surfaces using a clean, soft cloth and a mild soap-and-water solution.

* **Prohibited Items***: Do not use abrasive pads, wire brushes, steel wool, or harsh acid-based chemical cleaners.

* **Rinsing***: Rinse thoroughly with clean water and dry with a soft, lint-free cloth to prevent spotting.

3.4 Final Inspection

* **Alignment Check**: Inspect letters from a distance to verify visual leveling, uniform tracking, and proper font kerning.

* **Stability Verification**: Gently test each character manually to ensure a completely rigid, flush fit against the glazed tile with zero rotational play in the embedded pins.

* **Finish Review**: Examine painted surfaces under natural daylight for scratches, nicks, or uneven color coats.

* **Touch-up**: Repair minor field blemishes using factory-supplied touch-up paint matching the approved custom green.

* **Sign-off**: Replace any letters that show uncorrectable visual or structural defects prior to final project acceptance.

Use code with caution.

To complete your final construction documentation packet, let me know if you would like me to:

1. Generate a standard **Submittal Cover Sheet** detailing these parameters?
2. Provide a **Schedule of Signage** table to track multiple locations on the project?
3. Add language defining **allowable tolerances** for alignment (e.g., 1/16" plumb/level deviation)?

Please place inCSI Format

Below is the finalized specification properly structured into the official MasterFormat 3-Part CSI (Construction Specifications Institute) layout, complete with the standard section numbering, article titles, and paragraph breaks. [1]

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SECTION 10 14 00 - SIGNAGE

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Exterior cast flat cut stainless steel dimensional letters with flush stud mounting.

Signage	10 1400-8	HACP NVH Family Recreational Area
Cast Flat Cut Stainless Steel Letters		March 2023

B. Related Requirements:

1. Section 04 22 00 - Concrete Unit Masonry (Glazed concrete block and tile substrates).

1.02 REFERENCES

- A. American with Disabilities Act (ADA) - Accessibility Guidelines for Buildings and Facilities.

1.03 SUBMITTALS

A. Product Data: Submit manufacturer's technical data sheets, product specifications, and installation instructions for letters and finish systems.

B. Shop Drawings: Include plans, elevations, and large-scale details. Show letter dimensions, materials, finishes, font style, spacing, and precise stud locations.

C. Samples for Verification:

1. Submit one (1) full-size sample letter showing specified cast metal composition and structural cross-section.

2. Submit physical paint draw-down samples on stainless steel backing of the custom green color for Architect selection and approval.

D. Mounting Templates: Provide full-size paper templates showing exact drill hole positions, spacing, and structural alignment guides.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm specializing in manufacturing the products specified in this section with a minimum of five (5) years of documented experience.

B. Installer Qualifications: A firm experienced in performing work of this section that has specialized in installation of architectural signage.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in manufacturer's original, unopened packaging with labels intact.

B. Store materials in a clean, dry, protected area to prevent damage, scratching, or marring of finished surfaces.

1.06 FIELD CONDITIONS

A. Environmental Limitations: Do not proceed with epoxy adhesive application if ambient air temperatures or masonry substrate temperatures are below 40°F (4.4°C).

1.07 WARRANTY

A. Special Project Warranty: Submit a written warranty signed by the manufacturer and installer agreeing to repair or replace components that fail in materials or workmanship within the specified warranty period.

B. Warranty Period: Five (5) years from date of Substantial Completion.

C. Failures include, but are not limited to: structural failure of castings, failure of anchoring hardware, or finish degradation such as cracking, peeling, blistering, chalking, fading, or loss of adhesion of the custom paint finish.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Acceptable Manufacturers:

1. Gemini Sign Products.
2. Matthews International.
3. Or approved equal.

2.02 MATERIALS AND LETTERS

A. Metal Type: Stainless steel alloy formulated for exterior environmental exposure and corrosion resistance.

B. Manufacturing Process: Cast metal construction with flat cut face profiles and integrated rear mounting bosses.

C. Letter Parameters:

1. Height: 12 inches.

2. Depth: 1 inch.

3. Font Style: Roff Font.

D. Finish: Exterior-grade custom paint finish formulated to match glazed tile and column green. Color to be selected and approved by Architect.

2.03 ACCESSORIES

A. Fasteners: Threaded stainless steel pins, minimum 1/4-20 gauge. Cut pins to lengths required for complete structural embedment within the concrete glazed tile face and masonry core block.

B. Adhesive: J-B Weld high-strength exterior-grade structural epoxy compound.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Site Conditions: Verify that the exterior glazed concrete tile wall surface is plumb, clean, dry, and structurally ready to receive signage.

B. Substrate Integrity: Inspect glazed masonry faces for existing structural cracks, defects, or loose blocks prior to commencing work.

C. Notification: Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Templates: Apply the full-size paper mounting template securely to the glazed concrete block surface, ensuring absolute level and correct vertical positioning.

3.03 INSTALLATION

A. Drilling:

1. Use diamond-tipped core bits or high-speed carbide masonry bits to drill holes through the vitrified glaze layer.

2. Execute drilling without spalling, cracking, or chipping the decorative glazed tile face.

3. Drill holes to the depth specified by the manufacturer for full pin embedment.

B. Hole Preparation: Thoroughly clean all drilled holes using a stiff nylon brush and oil-free compressed air to remove all masonry dust, slurry, and debris.

C. Pin Attachment: Thread the stainless steel pins into the rear mounting bosses of the cast letters until completely flush.

D. Securing Letters:

1. Mix and prepare the J-B Weld structural epoxy compound in strict accordance with the manufacturer's printed instructions.

2. Inject the mixed epoxy adhesive into the back of the cleaned masonry holes.

3. Firmly insert the letter pins into the holes until the back edges of the characters sit completely flush against the glazed tile face.

E. Alignment: Maintain level horizontal alignment and uniform character tracking utilizing the template guides while the adhesive cures.

3.04 CLEANING PROTOCOLS

A. Excess Adhesive: Wipe away excess installation adhesive or squeezed-out epoxy immediately from the glazed tile and letter edges using manufacturer-approved solvents before the compound sets.

B. Waste Removal: Clean up all masonry dust, drilling chips, and paper template remnants from the construction site on a daily basis.

C. Surface Washing: Wash all painted letter surfaces using a clean, soft cloth and a mild, non-abrasive soap-and-water solution.

D. Prohibited Actions: Do not use abrasive pads, wire brushes, steel wool, or harsh acid-based chemical cleaners that could damage the paint or glaze.

E. Rinsing: Rinse thoroughly with clean water and dry using a soft, lint-free cloth to prevent spotting or streaking.

3.05 FINAL INSPECTION AND QUALITY CONTROL

A. Alignment Check: Inspect letters from a standard viewing distance to verify visual leveling, uniform tracking, and proper font kerning.

B. Stability Verification: Manually test each individual character to ensure a completely rigid, unyielding flush fit against the glazed tile with zero rotational play in the embedded pins.

C. Finish Review: Examine all painted surfaces under natural daylight conditions to ensure absence of scratches, nicks, holidays, or uneven color coats.

D. Touch-up: Repair minor field blemishes using factory-supplied touch-up paint matching the approved custom green color.

E. Rejection: Remove and replace any letters showing uncorrectable visual or structural defects prior to final project acceptance by the Owner.

Use code with caution.

To wrap up this technical section, let me know if you would like me to:

- Draft **Section 04 22 00 coordination notes** for the masonry team so they don't use incompatible sealers?
- Outline the exact **submittal review workflow** for the Architect's paint samples?
- Establish **allowable tolerances** for alignment deviations (e.g., maximum 1/16 inch)?

1 site

- Construction Specifications

A complete specification will be divided into "spec sections," that are defined by CSI (Construction Specifications Institute) '

SECTION 10 21 13
TOILET COMPARTMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Solid Color Reinforced Composite (SCRC) Substrate: (Bobrick Sierra Series).
 - 1. Toilet partitions.
 - 2. Urinal privacy screens.
 - 3. Dressing compartments.
 - 4. Shower dividers.
- B. Compact Laminate (CL/Solid Phenolic), Moisture Resistant Substrate: (Bobrick Dura Line Series).
 - 1. Toilet partitions.
 - 2. Urinal privacy screens.
 - 3. Dressing compartments.
 - 4. Shower dividers.
- C. High Pressure Laminate (HPL) with Particle Board Substrate (Bobrick Designer Series).
 - 1. Toilet partitions.
 - 2. Urinal privacy screens.
 - 3. Dressing compartments.
- D. High Pressure Laminate (HPL) with Particle Board Substrate (Bobrick Metro Series).
 - 1. Toilet partitions.
 - 2. Urinal privacy screens.
 - 3. Dressing compartments.

1.2 RELATED SECTIONS

- A. Section 05 50 00 - Metal Fabrications.
- B. Section 06 10 00 - Rough Carpentry.
- C. Section 09 25 23 - Lime Based Plastering.
- D. Section 09 33 00 - Conductive Tiling.
- E. Section 09 51 23 - Acoustical Tile Ceilings.
- F. Section 10 28 13.19 - Healthcare Toilet Accessories.
- G. Section 10 28 13.19 - Healthcare Toilet Accessories.

1.3 SUBMITTALS

- A. Submit under provisions of Section 01 30 00 - Administrative Requirements.

- B. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation methods.
- C. USGBC LEED Submittals:
 - 1. For Bobrick Metro Series, Designer Series and Dura Line Series: Materials and Resource Credits MR4.1 and MR4.2 - Recycled Content; submit manufacturer's calculation of value of recycled content for specified products, calculated in accordance with USGBC LEED certification requirements.
 - 2. For Bobrick Metro Series and Designer Series: Materials and Resource Credit MR6 - Rapidly Renewable Materials; submit manufacturers certification that products contain raw materials that are derived from plants that are harvested within a 10 year cycle or shorter.
 - 3. For Bobrick Sierra Series: Indoor Environmental Quality Credit IEQ 4 - No Added Urea Formaldehyde; submit manufacturer's certification that composite and Agri-fiber products contain no added urea-formaldehyde resins and that laminating used to fabricate on-site and shop-applied composite wood and Agri fiber contain no added urea-formaldehyde resins.
 - 4. For Bobrick Sierra Series: Indoor Environmental Quality Credit IEQ 4 for Schools; submit manufacturer's certification that products 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."
- D. USA Certificate of Origin: Manufacturer shall supply with first submittal, an example of their Certificate of Origin declaring toilet compartments are wholly manufactured and assembled specifically in the United States, including city and state locations. A notarized Certificate of Origin shall be provided with closeout documents.
- E. Shop Drawings: Submit manufacturer's shop drawings for each product specified, including the following:
 - 1. Plans, elevations, details of construction and attachment to adjacent construction.
 - 2. Show anchorage locations and accessory items.
 - 3. Verify dimensions with field measurements prior to final production of toilet compartments.
- F. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.
- G. Verification Samples: For each finish product specified, two samples, minimum size 6 inches (150 mm) square representing actual product, color, and patterns.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Minimum 10 year experience manufacturing similar products.
- B. Installer Qualifications: Minimum 2 year experience installing similar products.
- C. Single Source Requirements: To the greatest extent possible provide products from a single manufacturer.
- D. Accessibility Requirements: Comply with requirements applicable in the jurisdiction of the project, including but not limited to ADA and ICC/ANSI A117.1 requirements as applicable.
- E. Mock-Up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship.

1. Finish areas designated by Architect.
2. Do not proceed with remaining work until workmanship is approved by Architect.
3. Refinish mock-up area as required to produce acceptable work.

1.5 PRE-INSTALLATION MEETINGS

- A. Convene minimum two weeks prior to starting work of this section.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store products in manufacturer's unopened packaging bearing the brand name and manufacturer's identification until ready for installation.
- B. Handling: Handle materials to avoid damage.

1.7 PROJECT CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's recommended limits.

1.8 SEQUENCING

- A. Ensure that products of this section are supplied to affected trades in time to prevent interruption of construction progress.

1.9 WARRANTY

- A. Manufacturer's Warranty (Sierra Series and Dura Line Series): Manufacturer's standard 25 year limited warranty for panels, doors, and stiles against breakage, corrosion, delamination, and defects in factory workmanship. Manufacturer's standard 1 year guarantee against defects in material and workmanship for stainless steel door hardware and mounting brackets.
- B. Manufacturer's Warranty (Designer Series and Metro Series): Manufacturer's standard 2 year warranty for materials and workmanship.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturer: Bobrick Washroom Equipment, Inc., which is located at: 6901 Tujunga Ave.; North Hollywood, CA 91605-6213; Tel: 818-764-1000; Fax: 818-765-2700; Email: info@bobrick.com; Web: www.bobrick.com
- B. Basis of Design Products: Based on the quality and performance requirements of the project, specifications are based solely on the products of Bobrick Washroom Equipment, Inc. www.bobrick.com. Location of manufacturing shall be the United States.
- C. Substitutions: The Architect will consider products of comparable manufacturers as a substitution, pending the Contractor's submission of adequate documentation of the substitution in accordance with procedures in Division 1 of the Project Manual. Documentation shall include a list of five similar projects of equivalent size where products have been installed for a minimum of two years, and manufacturer's certification that products are fabricated in the United States.
- D. Requests for substitutions will be considered in accordance with provisions of Section 01 60 00 - Product Requirements.

2.2 SOLID COLOR REINFORCED COMPOSITE (SCRC) SUBSTRATE (Sierra Series)

A. Solid Color Reinforced Composite (SCRC) Toilet Partitions: Bobrick Sierra Series.

1. Design Type:
 - a. Standard Height.
 - 1) Door/Panel Height: 58 inches (147 cm).
 - 2) Floor Clearance: 12 inches (30 cm).
 - b. Maximum Height.
 - 1) Door/Panel Height: 71-3/4 inches (182 cm).
 - 2) Floor Clearance: 4-1/2" inches (11 cm).
2. Privacy Style Partitions: No sight lines with gap-free interlocking doors and stiles routed 0.300 inches (7.6 mm) from the edge to allow for 0.175 inch (4.4 mm) overlap to prevent line-of-sight into the toilet compartment. Privacy strips fastened or adhered onto the partition material are not acceptable.
3. Mounting:
 - a. Floor-mounted.
 - 1) Stile Standard Height: 69 inches (175 cm)
 - 2) Stile Maximum Height: 75-3/16 inches (191 cm).
 - b. Floor-mounted, overhead-braced with extruded anodized aluminum headrails, 0.065 inch (1.65 mm) thick with anti-grip profile.
 - 1) Stile Maximum Height: 83 inches (211 cm).
 - c. Floor-to-ceiling.
 - 1) Stile Height: As required, 10 feet 0 inches (305 cm) maximum.
 - d. Ceiling-hung.
 - 1) Stile Height: 8 feet 0 inches (244 cm) or as required 10 feet 0 inches (305 cm) maximum.

B. Solid Color Reinforced Composite (SCRC) Urinal Screens: Bobrick Sierra Series.

1. Mounting Configuration:
 - a. Floor-to-ceiling.
 - 1) Screen Height: 58 inches (178 cm) with floor clearance: 12 inches (30 cm).
 - 2) Stile Height: As required up to 10 feet 0 inches (305 cm) maximum.
 - b. Floor-to-ceiling maximum privacy.
 - 1) Screen Height: 72 inches (183 cm) with floor clearance: 4-1/2 inches (11 cm).
 - 2) Stile Height: As required up to 10 feet 0 inches (305 cm) maximum.
 - c. Post-to-ceiling.
 - 1) Screen Height: 58 inches (178 cm).
 - 2) Floor Clearance: 12 inches (30 cm).
 - 3) Post Height: Up to 10 feet 0 inches (305 cm) maximum.
 - d. Post-to-ceiling maximum privacy.
 - 1) Screen Height: 72 inches (183 cm).
 - 2) Floor Clearance: 4-1/2 inches (11 cm).
 - 3) Post Height: Up to 10 feet 0 inches (305 cm) maximum.
 - e. Floor-anchored standard height
 - 1) Screen Standard Height: 58 inches (178 cm) with floor clearance: 12 inches (30 cm)
 - 2) Stile Standard Height: 69 inches (175 cm)
 - f. Floor-anchored maximum height
 - 1) Screen Standard Height: 71-3/4 inches (182 cm) with floor clearance: 4-1/2 inches (11 cm)
 - 2) Stile Standard Height: 75-3/16 inches (191 cm)
 - g. Wall-hung.
 - 1) Screen Height: 42 inches (107 cm) with 18 inches (46 cm) floor

- clearance.
 - 2) Screen Height: 48 inches (122 cm) with 12 inches (30 cm) floor clearance.
- C. Solid Color Reinforced Composite (SCRC) Dressing Compartments and/or Shower Dividers: Bobrick Sierra Series.
 1. Design Type:
 - a. Standard Height.
 - 1) Door/Panel Height: 58 inches (178 cm).
 - 2) Floor Clearance: 12 inches (30 cm).
 - b. Maximum Height.
 - 1) Door/Panel Height: 71-3/4 inches (182 cm).
 - 2) Floor Clearance: 4-1/2 inches (11 cm).
 2. Privacy Style Partitions: No sight lines with gap-free interlocking doors and stiles routed 0.300 inches (7.6 mm) from the edge to allow 0.175 inch (4.4 mm) overlap to prevent line-of-sight into the toilet compartment. Privacy strips fastened or adhered onto the partition material are not acceptable.
 3. Mounting Configuration:
 - a. Floor-mounted, overhead-braced with extruded anodized aluminum headrails, 0.065 inch (1.65 mm) thick with anti-grip profile and integral curtain tracks and hooks for compartments without doors.
 - 1) Bobrick vinyl curtains.
 - 2) Stile Height: 83 inches (211 cm).
- D. Materials: Solid color reinforced composite (SCRC) material for stiles, panels, doors, and screens with Bobrick Graffiti-off coating, thermo-set and integrally fused into homogeneous piece; high density polyethylene (HDPE), high density polypropylene not acceptable.
 1. Composition: Dyes, organic fibrous material, and polycarbonate/phenolic resins.
 2. Surface Treatment: Non-ghosting, graffiti resistant surface integrally bonded to core through a manufacturing steps requiring thermal and mechanical pressure.
 3. Edges: Same color as the surface.
 4. Color:
 - a. As selected by Architect from manufacturer's standard Sierra Series range.
 - b. As indicated on Drawings.
 - c. SC01 Golden Khaki.
 - d. SC02 Desert Beige.
 - e. SC03 Terra-Cotta.
 - f. SC04 Forest Green.
 5. Acceptable SCRC Products: Or manufacturer approved equal.
 - a. Ultimate Corian System by Shower Shapes.
 - b. Wilson Art Gibraltar Material.
 - c. Wilson Art Earth Stone Material.
- E. Performance Requirements:
 1. Graffiti Resistance (ASTM D 6578): Passed cleanability test; 5 staining agents.
 2. Scratch Resistance (ASTM D 2197): Maximum load value exceeds 10 kilograms.
 3. Impact Resistance (ASTM D 2794): Maximum impact force exceeds 30 inch-pounds.
 4. Smoke Developed Index (ASTM E 84): Less than 450.
 5. Flame Spread Index (ASTM E 84): Less than 75.
 6. National Fire Protection Association/International Building Code Interior Wall and Ceiling Finish: Class B.
 7. Uniform Building Code: Class II.
- F. Finished Thickness:
 1. Stiles and Doors: 3/4 inch (19 mm).
 2. Panels and Screens: 1/2 inch (13 mm).

- G. Stiles: Floor-anchored stiles furnished with expansion shields and threaded rods.
 - 1. Leveling Devices: 7 gauge, 3/16 inches (5 mm) thick, corrosion-resistant, chromate-treated, double zinc-plated steel angle leveling bar bolted to stile; furnished with 3/8 inch (10 mm) diameter threaded rods, hex nuts, lock washers, flat washers, spacer sleeves, expansion anchors, and shoe retainers.
 - 2. Stile Shoes: One-piece, 22 gauge (0.8 mm), 18-8, Type 304 stainless steel, 4 inch (102 mm) height; tops with 90 degree return to stile. One-piece shoe capable of adapting to 3/4 inch (19 mm) or 1 inch (25 mm) stile thickness and capable of being fastened (by clip) to stiles starting at wall line.
- H. Wall Posts: Pre-drilled for door hardware, 18-8, Type 304, 16 gauge (1.6 mm) stainless steel with satin finish; 1 inch (25 mm) x 1-1/2 inches (38 mm) x 58 inches high (1473 mm).
- I. Anchors: Expansion shields and threaded rods at floor connections as applicable. Threaded rods secured to supports above ceiling as applicable. Supports above ceiling furnished and installed as Work of Section 05 50 00 - Metal Fabrications.
- J. Hardware: Chrome-plated "Zamak", aluminum, extruded plastic hardware not acceptable.
 - 1. Compliance: Operating force of less than 5 lbs. (2.25 kg).
 - 2. Emergency Access: Hinges, door latch allow door to be lifted over keeper from outside compartment on in-swing doors.
 - 3. Materials: 18-8, Type 304, heavy-gauge stainless steel with satin finish.
 - 4. Doorstops: Prevents in swinging doors from swinging out beyond stile; on out-swing doors, doorstop prevents door from swinging in beyond stile.
 - 5. Fastening: Hardware secured to door and stile by through-bolted, theft-resistant, pin - in-head Torx stainless steel machine screws into factory-installed, threaded brass inserts. Fasteners secured directly into core not acceptable.
 - a. Threaded Brass Inserts: Factory-installed; withstand direct pull force exceeding 1500 lbs. (680 kg) per insert.
 - 6. Clothes Hooks: Projecting no more than 1-1/8 inch (29 mm) from face of door.
 - 7. Door Latch: Track of door latch prevents inswing doors from swinging out beyond stile; on out-swing doors, door keeper prevents door from swinging in beyond stile; 16 gauge (1.6 mm) sliding door latch, 14 gauge (2 mm) keeper.
 - 8. Locking: Door locked from inside by sliding door latch into keeper.
 - 9. Hinge Type:
 - a. Standard.
 - 1) Balanced, with field-adjustable cam to permit door to be fully closed or partially open when compartment is unoccupied.
 - b. Full-Height Institutional Hinge.
 - 1) Hinges: 16 gauge (1.6 mm) stainless steel, self-closing, 3 section hinges.
 - 10. Mounting Brackets:
 - a. Standard Concealed.
 - 1) Mounting Brackets: Mounted inside compartment; exposed brackets on exterior of compartment not acceptable with the exception of out-swing doors.
 - b. Full-Height.
 - 1) Mounting Brackets: 18 gauge (1.2 mm) stainless steel and extend full height of panel.
 - 2) U-Channels: Secure panels to stiles.
 - 3) Angle Brackets: Secure stiles-to-walls and panels to walls.

2.3 COMPACT LAMINATE (SOLID PHENOLIC), MOISTURE RESISTANT SUBSTRATE (Dura Line Series)

- A. Compact Laminate (Solid Phenolic) Toilet Partitions: Bobrick Dura Line Series.
 - 1. Design Type::

- a. Standard Height.
 - 1) Door/Panel Height: 58 inches (147 cm).
 - 2) Floor Clearance: 12 inches (30 cm).
 - b. Maximum Height.
 - 1) Door/Panel Height: 71-3/4 inches (182 cm).
 - 2) Floor Clearance: 4-1/2 inches (11 cm).
 - c. Extended Height (available in gap-less, full-height institutional hardware at the panel; overhead braced and floor to ceiling configurations only).
 - 1) Door/Panel Height: 96 inches (244 cm).
 - 2) Floor Clearance: 1 inch (3 cm).
 - 2. Privacy Style Partitions: No sight lines with gap-free interlocking doors and stiles routed 0.300 inches (7.6 mm) from the edge to allow 0.175 inch (4.4 mm) overlap to prevent line-of-sight into the toilet compartment. Privacy strips fastened or adhered onto the partition material are not acceptable.
 - 3. Mounting Configuration:
 - a. Floor-mounted.
 - 1) Stile Standard Height: 69 inches (175 cm);
 - 2) Maximum Height: 75-3/16 inches (191 cm).
 - b. Floor-mounted, overhead-braced with anodized aluminum head-rails, 0.065 inch (1.65 mm) thick with anti-grip profile.
 - 1) Stile Maximum Height: 83 inches (211 cm);
 - 2) Extended Height: 97 3/4 inches (248 cm).
 - c. Floor-to-ceiling.
 - 1) Stile Standard Height: As required, 10 feet 0 inches (305 cm) maximum.
 - d. Ceiling-hung.
 - 1) Stile Standard Height: 8 feet 0 inches (244 cm), or as required 10 feet 0 inches (305 cm) maximum.
- B. Compact Laminate (Solid Phenolic) Urinal Screens: Bobrick Dura Line Series.
- 1. Mounting Configuration:
 - a. Floor-anchored standard height
 - 1) Screen Standard Height: 58 inches (178 cm) with floor clearance: 12 inches (30 cm).
 - 2) Stile Standard Height: 69 inches (175 cm);
 - b. Floor-anchored maximum height
 - 1) Screen Standard Height: 71-3/4 inches (182 cm) with floor clearance: 4-1/2" inches (11 cm).
 - 2) Stile Maximum Height: 75-3/16 inches (191 cm).
 - c. Floor-to-ceiling.
 - 1) Screen Height: 58 inches (178 cm) with floor clearance: 12 inches (30 cm).
 - 2) Stile Height: As required up to 10 feet 0 inches (305 cm) maximum.
 - d. Floor-to-ceiling maximum privacy.
 - 1) Screen Height: 71-3/4 inches (182 cm) with floor clearance: 4-1/2 inches (11 cm).
 - 2) Stile Height: As required up to 10 feet 0 inches (305 cm) maximum.
 - e. Post-to-ceiling.
 - 1) Screen Height: 58 inches (178 cm).
 - 2) Floor Clearance: 12 inches (30 cm).
 - 3) Post Height: Up to 10 feet 0 inches (305 cm) maximum.
 - f. Post-to-ceiling maximum privacy.
 - 1) Screen Height: 71-3/4 inches (182 cm).
 - 2) Floor Clearance: 4-1/2 inches (11 cm).
 - 3) Post Height: Up to 10 feet 0 inches (305 cm) maximum.
 - g. Wall-hung.
 - 1) Screen Height: 42 inches (107 cm) with 18 inches (46 cm) floor

clearance.

- 2) Screen Height: 48 inches (122 cm) with 12 inches (30 cm) floor clearance.

C. Compact Laminate (Solid Phenolic) Dressing Compartments and/or Shower Dividers: Bobrick Dura Line Series.

1. Design Type:
 - a. Standard Height.
 - 1) Door/Panel Height: 58 inches (178 cm).
 - 2) Floor Clearance: 12 inches (30 cm).
 - b. Maximum Height.
 - 1) Door/Panel Height: 71-3/4 inches (182 cm).
 - 2) Floor Clearance: 4-1/2 inches (11 cm).
 - 3) Panels: Up to 71-3/4 inches (182 cm) wide, one piece. Splice or two panels joined by bracket not acceptable.
2. Privacy Style Partitions: No sight lines with gap-free interlocking doors and stiles routed 0.300 inches (7.6 mm) from the edge to allow 0.175 inch (4.4 mm) overlap to prevent line-of-sight into the toilet compartment. Privacy strips fastened or adhered onto the partition material are not acceptable.
3. Mounting Configuration:
 - a. Floor-mounted, overhead-braced with extruded anodized aluminum head rails, 0.065 inch (1.65 mm) thick with anti-grip profile and integral curtain tracks and hooks for compartments without doors.
 - 1) Bobrick vinyl curtains.
 - 2) Stile Height: 83 inches (211 cm).

D. Materials: Solidly fused plastic laminate with matte-finish melamine surfaces; integrally bonded colored face sheets and black phenolic-resin core.

E. Edges: Black; brown edges not acceptable.

F. Color:

1. As selected by Architect from manufacturer's standard Dura Line Series Compact Grade Laminate color range.
2. As indicated on Drawings.
3. Other color as selected by architect based on Manufacturer's range and confirmed by local Manufacturer Representative.

G. Fire Resistance:

1. National Fire Protection Association/International Building Code Interior Wall and Ceiling Finish: Class B / Uniform Building Code: Class II.
 - a. Flame Spread Index (ASTM E 84): 30 for panels and stiles.
 - b. Smoke Developed Index (ASTM E 84): 55 for panels, 20 for stiles.
2. National Fire Protection Association/International Building Code Interior Wall and Ceiling Finish: Class A / Uniform Building Code: Class I.
 - a. Flame Spread Index (ASTM E 84): 15-25 for panels, stiles and doors.
 - b. Smoke Developed Index (ASTM E 84): 25 - 105 for panels, 20-90 for stiles.

H. Finished Thickness:

1. Stiles and Doors: 3/4 inch (19 mm).
2. Panels and Screens: 1/2 inch (13 mm).

I. Stiles: Floor-anchored stiles furnished with expansion shields and threaded rods.

1. Leveling Devices: 7 gauge, 3/16 inches (5 mm) thick, corrosion-resistant, chromate-treated, double zinc-plated steel angle leveling bar bolted to stile; furnished with 3/8 inch (10 mm) diameter threaded rods, hex nuts, lock washers, flat washers, spacer

- sleeves, expansion anchors, and shoe retainers.
- 2. Stile Shoes: One-piece, 22 gauge (0.8 mm), 18-8, Type 304 stainless steel, 4 inch (102 mm) height; tops with 90 degree return to stile. One-piece shoe capable of adapting to 3/4 inch (19 mm) or 1 inch (25 mm) stile thickness and capable of being fastened (by clip) to stiles starting at wall line.
- J. Wall Posts: Pre-drilled for door hardware, 18-8, Type 304, 16 gauge (1.6 mm) stainless steel with satin finish; 1 inch (25 mm) x 1-1/2 inches (38 mm) x 58 inches high (1473 mm).
- K. Anchors: Expansion shields and threaded rods at floor connections as applicable. Threaded rods secured to supports above ceiling as applicable. Supports above ceiling furnished and installed as Work of Section 05 50 00 - Metal Fabrications.
- L. Hardware:
 - 1. Compliance: Operating force of less than 5 lbs. (2.25 kg).
 - 2. Emergency Access: Hinges, latch allow door to be lifted over keeper from outside compartment on ins-wing doors.
 - 3. Materials: 18-8, Type 304, heavy-gauge stainless steel with satin finish.
 - 4. Doorstops: Prevents in swinging doors from swinging out beyond stile; on out-swing doors, doorstop prevents door from swinging in beyond stile.
 - 5. Fastening: Hardware is secured to door and stile with pin-in-head Torx stainless steel machine screws. Hinges, latch and optional door stops secured to door with pin-in - head Trox stainless steel machine screws into factory-installed, threaded brass inserts. Fasteners for hinges latch and optional door stops secured directly into core not acceptable.
 - a. Threaded Brass Inserts: Factory-installed; withstand direct pull force exceeding 1500 lbs. (680 kg) per insert.
 - 6. Clothes Hooks: Projecting no more than 1-1/8 inch (29 mm) from face of door.
 - 7. Door Latch: Track of door latch prevents inswing doors from swinging out beyond stile; on out-swing doors, door keeper prevents door from swinging in beyond stile; 16 gauge (1.6 mm) sliding door latch, 14 gauge (2 mm) keeper.
 - 8. Locking: Door locked from inside by sliding door latch into keeper.
 - 9. Hinge Type:
 - a. Standard.
 - 1) Balanced, with field-adjustable cam to permit door to be fully closed or partially open when compartment is unoccupied.
 - b. Full-Height Institutional Hinge.
 - 1) Hinges: 16 gauge (1.6 mm) stainless steel, self-closing, 3 section hinges.
 - 10. Mounting Brackets:
 - a. Standard concealed.
 - 1) Mounting Brackets: Mounted inside compartment; exposed brackets on exterior of compartment not acceptable with the exception of outswing doors.
 - b. Full-Height.
 - 1) Mounting Brackets: 18 gauge (1.2 mm) stainless steel and extend full height of panel.
 - 2) U-Channels: Secure panels to stiles.
 - 3) Angle Brackets: Secure stiles-to-walls and panels to walls.

2.4 HIGH PRESSURE LAMINATE WITH PARTICLE BOARD SUBSTRATE (Bobrick Designer Series)

- A. High Pressure Laminate Toilet Partitions:
 - 1. Design Type:
 - a. Standard Height.
 - 1) Door/Panel Height: 58 inches (147 cm).
 - 2) Floor Clearance: 12 inches (30 cm).

- Maximum Height.
 - 1) Door/Panel Height: 71-3/4 inches (182 cm).
 - 2) Floor Clearance: 4-1/2 inches (11 cm).
- 2. Mounting Configuration:
 - a. Floor-mounted.
 - 1) Stile Standard Height: 69 inches (175 cm)
 - 2) Maximum Height: 75-3/16 inches (191 cm).
 - b. Floor-mounted, overhead-braced with extruded anodized aluminum head-rails, 0.065 inch (1.65 mm) thick with anti-grip profile.
 - 1) Stile Height: 83 inches (211 cm).
 - c. Floor-to-ceiling.
 - 1) Stile Standard Height: As required, 10 feet 0 inches (305 cm) maximum
 - d. Ceiling-hung.
 - 1) Stile Height: 8 feet 0 inches (244 cm) or as required 10 feet 0 inches (305 cm) maximum.
- B. High Pressure Laminate Urinal Screens:
 - 1. Mounting Configuration:
 - a. Floor-to-ceiling.
 - 1) Screen Height: 58 inches (178 cm) with floor clearance: 12 inches (30 cm).
 - 2) Stile Height: As required up to 10 feet 0 inches (305 cm) maximum.
 - b. Floor-to-ceiling maximum privacy.
 - 1) Screen Height: 71-3/4 inches (182 cm) with floor clearance: 4-1/2 inches (11 cm).
 - 2) Stile Height: As required up to 10 feet 0 inches (305 cm) maximum.
 - c. Post-to-ceiling.
 - 1) Screen Height: 58 inches (178 cm).
 - 2) Floor Clearance: 12 inches (30 cm).
 - 3) Post Height: Up to 10 feet 0 inches (305 cm) maximum.
 - d. Post-to-ceiling maximum privacy.
 - 1) Screen Height: 71-3/4 inches (182 cm).
 - 2) Floor Clearance: 4-1/2 inches (11 cm).
 - 3) Post Height: Up to 10 feet 0 inches (305 cm) maximum.
 - e. Floor-anchored standard height.
 - 1) Screen Standard Height: 58 inches (178 cm) with floor clearance: 12 inches (30 cm)
 - 2) Stile Standard Height: 69 inches (175 cm)
 - f. Floor-anchored maximum height.
 - 1) Screen Standard Height: 71-3/4 inches (182 cm) with floor clearance: 4-1/2 inches (11 cm)
 - 2) Stile Maximum Height: 75-3/16 inches (191 cm)
 - g. Wall-hung.
 - 1) Screen Height: 42 inches (107 cm) with 18 inches (46 cm) floor clearance.
 - 2) Screen Height: 48 inches (122 cm) with 12 inches (30 cm) floor clearance.
- C. High Pressure Laminate Dressing Compartments:
 - 1. Design Type:
 - a. Standard Height.
 - 1) Door/Panel Height: 58 inches (178 cm).
 - 2) Floor Clearance: 12 inches (30 cm).
 - b. Maximum Height.
 - 1) Door/Panel Height: 71-3/4 inches (182 cm).
 - 2) Floor Clearance: 4-1/2 inches (11 cm).

2. Mounting Configuration:
 - a. Floor-mounted, overhead-braced with extruded anodized aluminum head-rails, 0.065 inch (1.65 mm) thick with anti-grip profile and integral curtain tracks and hooks for compartments without doors.
 - 1) Bobrick vinyl curtains.
 - 2) Stile Height: 83 inches (211 cm).
- D. Finished Thickness: 1 inch (25 mm) for stiles, doors, screens and panels.
- E. Materials: 3-ply, stiles, panels, doors, and screens.
 1. Cores: 45 lb (20.4 kg) density, industrial grade, resin-impregnated, particle board.
 2. Surfaces: High-pressure laminated plastic NEMA LDS-1985 minimum thickness 0.050 inch (1.33 mm) with matte finish.
 3. Fabrication: Bonded high-pressure plastic laminate to core material with adhesive specially formulated to prevent delamination. Edges bonded prior to bonding face sheets. Splices or joints in faces or edges are not acceptable except in the case of laminate material limitations.
 4. Color:
 - a. As selected by Architect from manufacturer's standard High Pressure Laminate range.
 - b. As indicated on Drawings.
 - c. As selected by Architect from manufacturer's 10 Day Rapid Response Designer Series range.
- F. Fire Resistance:
 1. National Fire Protection Association/International Building Code Interior Wall and Ceiling Finish: Class B / Uniform Building Code: Class II.
 - a. Flame Spread Index (ASTM E 84): 60 for panels and stiles.
 - b. Smoke Developed Index (ASTM E 84): 265 for panels and stiles.
- G. Stiles: Floor-anchored stiles furnished with expansion shields and threaded rods.
 1. Leveling Devices: 3/8 inch x 7/8 inch (10 mm x 22 mm) steel bar welded to 11 gauge (3 mm) steel-reinforcing core; chromate-treated and double zinc-plated; welded to sheet-steel core of stiles.
 2. Stile Shoes: One-piece, 22 gauge (0.8 mm), 18-8, Type 304 stainless steel, 4 inch (102 mm) height; tops with 90 degree return to stile. One-piece shoe capable of adapting to 3/4 inch (19 mm) or 1 inch (25 mm) stile thickness and capable of being fastened (by clip) to stiles starting at wall line.
- H. Wall Posts: Pre-drilled for door hardware, 18-8, Type 304, 16 gauge (1.6 mm) stainless steel with satin finish; 1 inch (25 mm) x 1-1/2 inches (38 mm) x 58 inches high (1473 mm).
- I. Anchors: Expansion shields and threaded rods at floor connections as applicable. Threaded rods secured to supports above ceiling as applicable. Supports above ceiling furnished and installed as Work of Section 05 50 00 - Metal Fabrications.
- J. Hardware:
 1. Compliance: Operating force of less than 5 lbs. (2.25 kg).
 2. Emergency Access: Hinges, latch allow door to be lifted over keeper from outside compartment on inswing doors.
 3. Materials: Stainless Steel 18-8, Type 304, heavy-gauge stainless steel with satin finish.
 4. Fastening: Hardware secured to door and stile by theft-resistant, pin-in-head Trox stainless steel machine screws into factory-installed, threaded inserts.
 5. Door Latch: Track of door latch prevents in-swing doors from swinging out beyond stile; on out-swing doors, door keeper prevents door from swinging in beyond stile; 16 gauge (1.6 mm) sliding door latch, 14 gauge (2 mm) keeper.

: Door locked from inside by sliding door latch into keeper.

7. Hinge Type:
 - a. Standard.
 - 1) Balanced, with field-adjustable cam to permit door to be fully closed or partially open when compartment is unoccupied.
 - b. Full-Height Institutional Hinge.
 - 1) Hinges: 16 gauge (1.6 mm) stainless steel, self-closing, 3 section hinges.
8. Mounting Brackets:
 - a. Standard Concealed.
 - 1) Mounting Brackets: Mounted inside compartment; exposed brackets on exterior of compartment not acceptable with the exception of outs-wing doors.
 - b. Full-Height.
 - 1) Mounting Brackets: 18 gauge (1.2 mm) stainless steel and extend full height of panel.
 - 2) U-Channels: Secure panels to stiles.
 - 3) Angle Brackets: Secure stiles-to-walls and panels to walls.

2.5 HIGH PRESSURE LAMINATE WITH PARTICLE BOARD SUBSTRATE (Bobrick Metro Series)

- A. High Pressure Laminate Toilet Partitions:
 1. Design:
 - a. Standard Height.
 - 1) Door/Panel Height: 58 inches (147 cm).
 - 2) Floor Clearance: 12 inches (30 cm).
 2. Mounting Configuration:
 - a. Floor-mounted.
 - 1) Stile Height: 69 inches (175 cm).
 - b. Floor-mounted, overhead-braced with extruded anodized aluminum head-rails, 0.065 inch (1.65 mm) thick with anti-grip profile.
 - 1) Stile Height: 83 inches (211 cm).
 - c. Ceiling-hung.
 - 1) Stile Height: 8 feet 0 inches (244 cm) or as required 10 feet 0 inches (305 cm) maximum.
- B. High Pressure Laminate Urinal Screens:
 1. Mounting Configuration:
 - a. Floor-to-ceiling.
 - 1) Screen Height: 58 inches (178 cm) with floor clearance: 12 inches (30 cm).
 - b. Post-to-ceiling.
 - 1) Screen Height: 58 inches (178 cm).
 - 2) Floor Clearance: 12 inches (30 cm).
 - 3) Post Height: Up to 10 feet 0 inches (305 cm) maximum.
 - c. Wall-hung.
 - 1) Screen Height: 42 inches (107 cm) with 18 inches (46 cm) floor clearance.
 - 2) Screen Height: 48 inches (122 cm) with 12 inches (30 cm) floor clearance.
- C. High Pressure Laminate Dressing Compartments:
 1. Design Type:
 - a. Standard Height.
 - 1) Door/Panel Height: 58 inches (178 cm).
 - 2) Floor Clearance: 12 inches (30 cm).
 2. Mounting Configuration:

- a. Floor-mounted, overhead-braced with extruded anodized aluminum head-rails, 0.065 inch (1.65 mm) thick with anti-grip profile and integral curtain tracks and hooks for compartments without doors.
 - 1) Bobrick vinyl curtains.
 - 2) Stile Height: 83 inches (211 cm).
- D. Finished Thickness: 1 inch (25 mm) for stiles, doors, screens and panels.
- E. Materials: 3-ply, stiles, panels, doors, and screens.
 - 1. Cores: 45 lb (20.4 kg) density, industrial grade, resin-impregnated, particle board.
 - 2. Surfaces: High-pressure laminated plastic NEMA LDS-1985 minimum thickness 0.050 inch (1.33 mm) with matte finish.
 - 3. Fabrication: Bonded high-pressure plastic laminate to core material with adhesive specially formulated to prevent delamination. Edges bonded prior to bonding face sheets. Splices or joints in faces or edges are not acceptable except in the case of laminate material limitations.
 - 4. Color:
 - a. As selected by Architect from manufacturer's standard Plastic Laminate range.
 - b. As indicated on Drawings.
 - c. As selected by Architect from manufacturer's 5 Day Rapid Response Metro Series range.
- F. Fire Resistance:
 - 1. National Fire Protection Association/International Building Code Interior Wall and Ceiling Finish: Class B / Uniform Building Code: Class II.
 - a. Flame Spread Index (ASTM E 84): 60 for panels and stiles.
 - b. Smoke Developed Index (ASTM E 84): 265 for panels and stiles.
- G. Stiles: Floor-anchored stiles furnished with expansion shields and threaded rods
 - 1. Stile Leveling Device:
 - a. Standard:
 - 1) Overhead-Braced: 12 gauge (2.8 mm), 3 inches x 1-1/4 inches (75 x 32 mm) plated steel stile bracket factory installed to bottom of stile. Furnished with leveling bolt, shoe retainer, floor L-bracket, plastic anchor #14-16, #14 x 5/8 inches (M6.3 x 16 mm) stainless steel sheet-metal screws and #14 x 1-3/4 inches (M6.3 x 45 mm) stainless steel sheet metal floor screws.
 - 2) Floor-Anchored: 3/8 inches x 1 inches (10 x 25 mm) steel bar, zinc chromate plated, bolted to stile using 6 inches x 3/8 inches (152 x 10 mm) diameter carbon steel lag bolt. Furnished with 3/8 inches (10mm) diameter threaded rods, hex nuts, washers, spacer sleeve (ceiling-hung only), expansion shield and shoe retainer.
 - 3) Ceiling-Hung: 3/8 inches x 1 inches (10 x 25 mm) steel bar, zinc chromate plated, bolted to stile using 6 inches x 3/8 inches (152 x 10 mm) diameter carbon steel lag bolt. Furnished with 3/8 inches (10mm) diameter threaded rods, hex nuts, washers, spacer sleeve (ceiling-hung only), expansion shield and shoe retainer.
 - b. Steel Core Stile Option:
 - 1) Leveling Devices: 3/8 inch x 7/8 inch (10 mm x 22 mm) steel bar welded to 11 gauge (3 mm) steel-reinforcing core; chromate-treated and double zinc-plated; welded to sheet-steel core of stiles.
 - 2. Stile Shoes: One-piece, 22 gauge (0.8 mm), 18-8, Type 304 stainless steel, 4 inch (102 mm) height; tops with 90 degree return to stile. One-piece shoe capable of adapting to 3/4 inch (19 mm) or 1 inch (25 mm) stile thickness and capable of being fastened (by clip) to stiles starting at wall line.
- H. Wall Posts: Pre-drilled for door hardware, 18-8, Type 304, 16 gauge (1.6 mm) stainless steel

with satin finish; 1 inch (25 mm) x 1-1/2 inches (38 mm) x 58 inches high (1473 mm).

- I. Anchors: Expansion shields and threaded rods at floor connections as applicable. Threaded rods secured to supports above ceiling as applicable. Supports above ceiling furnished and installed as Work of Section 05 50 00 - Metal Fabrications.
- J. Hardware:
 - 1. Compliance: Operating force of less than 5 lbs. (2.25 kg).
 - 2. Emergency Access: Hinges, latch allow door to be lifted over keeper from outside compartment on inswing doors.
 - 3. Materials:
 - a. Stainless Steel
 - 1) Hinges: Pivot hinges constructed of stainless steel with satin finish.
 - 2) Door Hardware: Latches, keepers, coat hooks constructed of stainless steel with satin finish.
 - 3) Mounting Brackets: Constructed of 18-8, Type-304, heavy-gauge stainless steel with satin finish.

PART 3 PRODUCTS

3.1 PREPARATION

- A. Prepare substrates including but not limited to blocking and supports in walls and ceilings at points of attachment using methods recommended by the manufacturer for achieving the best result for the substrates under the project conditions.
 - 1. Inspect areas scheduled to receive compartments for correct dimensions, plumbness of walls, and soundness of surfaces that would affect installation of mounting brackets.
 - 2. Verify spacing of plumbing fixtures to assure compatibility with installation of compartments.
- B. If preparation is the responsibility of another installer, notify Architect in writing of deviations from manufacturer's recommended installation tolerances and conditions.
- C. Do not proceed with installation until substrates have been properly prepared with blocking and supports in walls and ceilings at points of attachment and deviations from manufacturer's recommended tolerances are corrected. Commencement of installation constitutes acceptance of conditions.

3.2 INSTALLATION

- A. Install products in strict compliance with manufacturer's written instructions and recommendations, including the following:
 - 1. Verify blocking and supports in walls and ceilings has been installed properly at points of attachment.
 - 2. Verify location does not interfere with door swings or use of fixtures.
 - 3. Use fasteners and anchors suitable for substrate and project conditions
 - 4. Install units rigid, straight, plumb, and level.
 - 5. Conceal evidence of drilling, cutting, and fitting to room finish.
 - 6. Test for proper operation.

3.3 ADJUSTING, CLEANING AND PROTECTION

- A. Adjust hardware for proper operation after installation. Set hinge cam on in-swinging doors to hold doors open when unlatched. Set hinge cam on out-swinging doors to hold unlatched doors in closed position.

- B. Touch-up, repair or replace damaged products.
- C. Clean exposed surfaces of compartments, hardware, and fittings.

END OF SECTION

SECTION 10 2813

TOILET ACCESSORIES

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Toilet [bath] [and] [shower] accessories.
 - 2. Framed mirrors.
- B. Related Sections:
 - 1. Division 01: Administrative, procedural, and temporary work requirements.

1.2 REFERENCES

- A. ASTM International (ASTM):
 - 1. A123/A123M - Standard Specification for Zinc (Hot-Galvanized) Coatings on Iron and Steel Products.
 - 2. A269 - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
 - 3. A167 - Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
 - 4. A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
 - 5. B456 - Standard Specification for Electrodeposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium.
 - 6. C1036 - Standard Specification for Flat Glass.

1.3 QUALITY ASSURANCE

- A. Conform to applicable accessibility plumbing code for locating accessories.

1.4 WARRANTIES

- A. Furnish manufacturer's 5 year warranty providing coverage against mirror silver spoilage.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers:
 - 1. Build with Ferguson: <https://www.build.com/product/summary/>
 - 2. Harney Hardware: <https://www.harneyhardware.com/>
 - 3. ~~A and J Washroom Accessories. (www.ajwashroom.com)~~
 - 4. American Specialties, Inc. (www.americanspecialties.com)
 - 5. Bobrick Washroom Equipment, Inc. (www.bobrick.com)
 - 6. Bradley Corp. (www.bradleycorp.com)
 - 7. General Accessory Mfg. Co. (www.gamcousa.com)

- B. Substitutions: Not permitted.

2.2 MATERIALS

- A. Stainless Steel:
 - 1. Sheet: ASTM A167, Type 304, rollable temper.
 - 2. Tubing: ASTM A269.
 - 3. Finish: Satin Nickel
 - 4. Construction Type 430 stainless steel

2.3 ACCESSORIES

- A. Fasteners: Stainless steel where exposed, hot dip galvanized where concealed; type best suited to substrate conditions.

2.4 FABRICATION

- A. Use stainless steel for exposed surfaces; galvanized steel may be used in concealed locations.
- B. Form exposed surfaces from single sheet of stock, free from joints, and flat, without distortion.
- C. Weld joints of fabricated components and grind smooth.
- D. Fabricate grab bars of tubing, free of visible joints, return to wall with end attachment flanges. [Peen grip surfaces.]
- E. Fabricate soap dispensers to operate with less than 5 pound force.
- F. Provide hangers, adapters, anchor plates, and accessories required for installation.
- G. Mirrors:
 - Stainless Steel Mirror: Bobrick B-165 1824
 - 1. Sheet: ASTM A167, Type 304, rollable temper.
 - 2. Tubing: ASTM A269.
 - 3. Size: 18"x24"
 - 4. Construction Type 430 stainless steel
- H. Shop assemble units and package complete with anchors and fittings.

2.5 FINISHES

- A. Stainless Steel: No. 4 satin.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Set plumb, level, square, and rigid.
- C. Install wiring between power supply and accessories.

3.2 SCHEDULE

NO.	DESCRIPTION	MANUFACTURER	MODEL NO.
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A **RECESSED PAPER TOWEL DISPENSER AND WASTE RECEPTACLE B - 369**

NO.	DESCRIPTION	MANUFACTURER	MODEL NO.
B	Toilet Multi Tissue Dispenser	BOBRICK	B-3888
C	Soap Dispenser	BOBRICK	B-2112
D	Feminine Tampon/Napkin Vendor	BOBRICK	B-270
E	Feminine Tampon/Napkin Disposal	BOBRICK	B-254
F	GRAB BARS	BOBRICK	B-6806 x18 & 36"x1.5"
G	Robe Hook	BOBRICK	B-233
H	STAINLESS STEEL FRAME MIRROR	BOBRICK	B-2908 1830 18"x30"
		BOBRICK	B-290 2460 24"X 60"

END OF SECTION

SECTION 10 2814

BABY CHANGING STATIONS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Baby Changing Stations, Stainless Steel:
 - 1. Recessed-mounted horizontal design. (Koala Model KB310-SSRE)
 - 2. Recessed-mounted horizontal design with matte black finish. (Koala Model KB310-SSRE-MBLK)

1.2 RELATED REQUIREMENTS

- A. Section 06 1000 - Rough Carpentry, blocking in walls.
- B. Section 09 2100 - Plaster and Gypsum Board Assemblies, blocking in walls.
- C. Section 09 3000 - Tiling, coordination with tile layout and installation.

1.3 SUBMITTALS

- A. Product Data: Submit manufacturer's data sheets for each product specified, including the following.
 - 1. Installation instructions and recommendations, including templates and rough-in measurements.
 - 2. Storage and handling requirements and recommendations.
 - 3. Cleaning and maintenance instructions.

1.4 QUALITY ASSURANCE

- A. Manufacturer: Provide products manufactured by a company with a minimum of 5 years successful experience manufacturing similar products.
- B. Single Source Requirements: To the greatest extent possible provide products from a single manufacturer.
- C. Accessibility Requirements: Comply with requirements applicable in the jurisdiction of the project, including but not limited to ADA, ICC A117.1, International Building Code (IBC), and state building code requirements as applicable.
- D. Baby Changing Stations: Provide products which comply with the following standards and requirements.
 - 1. Antimicrobial Treatment: Changing surfaces embedded with Microban®, with antibacterial claim substantiated by Kirby-Bauer test or other manufacturer approved equivalent standard industry test methodology.
 - 2. Americans with Disabilities Act (ADA).
 - 3. ICC A117.1 - Accessible and Usable Building and Facilities.

4. ANSI Z535.4 - Product Safety Signs and Labels.
5. ASTM F2285 - Standard Consumer Safety Performance Specification for Diaper Changing Tables for Commercial Use.
6. ASTM G 21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.
7. TAS – Texas Accessibility Standard
8. European Standards: EN 12221 Changing units for domestic use.
9. CPSIA: Conformity with the U.S. Product Safety Commission product safety rules, bans, standards and regulations that include applicable chemical compliance requirements.

E. Manufacturing Location: United States.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store and handle materials and products in strict compliance with manufacturer's instructions and recommendations. Protect from damage.

1.6 WARRANTY

- A. Manufacturer's Warranties: Submit manufacturer's standard 5 year warranty for materials and workmanship and include a provision for replacement caused by vandalism.

PART 2 PRODUCTS

2.1 MANUFACTURER

- A. Basis of Design Products: Based on the quality and performance requirements of the project, specifications are based solely on the products of Koala Kare Products, a Division of Bobrick, www.koalabear.com. Location of manufacturing shall be the United States.
- B. Substitutions: The Architect will consider products of comparable manufacturers as a substitution, pending the contractor's submission of adequate documentation of the substitution in accordance with procedures in Division 1 of the Project Manual. Documentation shall include a list of five similar projects of equivalent size where products have been installed for a minimum of two years, and manufacturer's certification that products are fabricated in the United States.

2.2 BABY CHANGING STATIONS, STAINLESS STEEL

- A. Recessed-Mounted Horizontal Design Stainless Steel Changing Station:
 1. Basis of Design: Model KB310-SSRE with external stainless steel bag hook as manufactured by Koala Kare Products, a Division of Bobrick.
 2. Basis of Design: Model KB310-SSRE-MBLK in matte black finish with external stainless steel bag hook as manufactured by Koala Kare Products, a Division of Bobrick.

3. Handles: Station shall have two solid handles that allow operation with less than 5 lbs. of force. Handles rest below 27" for cane detection when unit is in the down position.
4. Front Panel shall be deep drawn, one-piece, seamless, 18-8, Type 304, 20 gauge (0.91mm) stainless steel with satin finish and laser etched logo with rounded corners.
5. Aesthetics: Unit shall have no plastic covering or visible plastic on the front of the unit and no adhesive labels applied to the front panel.
6. Flange: Deep drawn, one-piece seamless, 18-8, Type 304, 18 gauge (1.2 mm) stainless steel with satin finish. Flange edges and corners shall have radii that complements the arc on the top, bottom, and side edges of the front panel.
7. Frame and Hinge Mechanism: Concealed 11-gauge chassis, compromised of 1" diameter integral steel-tubing that supports the changing bed and interacts with 11-gauge steel wall mounting bracket to provide steel-on-steel hinge stop. The wall frame shall serve as wall-mounting bracket.
8. External Diaper Bag Hook: 18-8, Type 304, 3/4 inch (19mm) diameter, wall-mounted, solid stainless steel rod with satin-finish.
9. Bed Surface: injection molded polypropylene with Microban® antimicrobial additive, and ISO 22196 tested for efficacy.
10. Surface is contoured, concave and smooth. Bed surface shall be minimum 535 sq. in.
11. Performance: Unit has minimal deflection from 90 degrees with a 200 lbs. static load placed in the center of the changing surface. Unit exceeds ASTM Standard F2285 static load requirement of 100 lbs.
12. Complies with requirements applicable in the jurisdiction of the project, including but not limited to ADA, TAS, ICC A117.1, International Building Code (IBC), and state building code requirements as applicable. Also complies with ASTM Standard F2285, Standard Consumer Safety Performance Specification for Diaper Changing Stations for Commercial use and EN 12221 for changing units for domestic use.
13. Dual Cavity Dispenser: Includes integral spring tab to make dispensing bed liners and diaper disposal sacks easier. Total 50 liner capacity. Equipped with tumbler lock, keyed alike Bobrick restroom accessories.
14. Operation: Concealed pneumatic cylinder providing controlled opening and closing of the changing station bed.
15. Instruction Graphics: Universal instruction graphics and safety messages in multiple languages.
16. Safety Straps: Replaceable, restraining straps.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install products in strict compliance with manufacturer's written instructions and recommendations, including the following:
 1. Verify wall blocking has been installed properly.
 2. Verify wall location does not interfere with door swings or use of fixtures.
 3. Use fasteners and anchors suitable for wall substrate and project conditions.
 4. Install units at location and height indicated on the Drawings.
 5. Install units level, plumb and in proper relationship with adjacent construction.
 6. Adjust for proper operation.

3.2 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

DIVISION 11 EQUIPMENT

NOT USED

DIVISION 12

**SECTION 12 9300
SITE FURNISHINGS**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following site and street furnishings:
 - 1. Benches
 - 2. Trash Receptacles
 - 3. Tables
 - 4. Sun Shades
- B. Products furnished, but not installed under this Section, include pipe sleeves or anchor bolts to be cast in concrete footings.

1.3 SUBMITTALS

- A. Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.
- B. Product data:
 - 1. Manufacturer's standard product literature.
 - 2. Shop drawings.
 - 3. Installation instructions.
 - 4. Maintenance instructions.
- C. Submit powder-coat finish samples for approval.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications:
 - 1. Minimum 15 years experience in the manufacture of site seating.
 - 2. Forest Stewardship Council ("FSC") Certified Supplier. Provide manufacturer's FSC certification number.
 - 3. Provide reference list of at least ten major transportation authorities, municipalities, universities, or
 - 4. other high-use public environments currently using site seating fabricated by the manufacturer.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Handle products in accordance with manufacturer's instructions.
- B. Store products in manufacturer's original packaging until ready for installation.
- C. Protect products from impacts and abrasion during storage.

1.6 WARRANTY

- A. Provide manufacturer's standard warranty:
 - 1. Warranty terms: three years from date of invoice against defects in materials and workmanship.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Provide the following site furnishings on the products named:

Manufacturer:
Landscape Forms; 7800 E. Michigan Avenue Kalamazoo, MI 49048
phone: 800-430-6209
email: comments@landscapeforms.com
website: www.landscapeforms.com

- 1. Approved Equal

- B. Benches

- 1. Model: Stay
- 2. Style: Length 68-1/2"
 - a. Backed
- 3. Mounting
 - a. Embedded
- 4. Divider Option:
 - a. No divider
- 5. Arm Option:
 - a. End Arms
- 6. Color:

- a. Flambe Orange

C. Trash Receptacles

- 1. Model: Pitch
- 2. Style:
 - a. Side Opening litter receptacle
 - 1) Height: 34 inches
 - 2) Top: 25 inches square
 - 3) Base: 17-1/2 inches square
 - 4) Capacity: 28 gallon
 - 5) Opening: Two 5 inch x 13 inch rectangular openings in the aluminum side panels
- 3. Mounting:
 - a. Free standing
- 4. Liner color:
 - a. Black
- 5. Arm Option:
 - a. End Arms
- 6. Color:
 - a. FlaFlambe Orangembe Orange
- 7. Installation:
 - a. Freestanding: levelers included.

D. Tables:

- 1. Model: Mingle
- 2. Style: Perforated metal seats
 - a. Backed
- 3. Number of seats:
 - a. 4
 - b. 5, spaced to allow 1 open seat for wheelchair access
 - c. 6
- 4. Tabletop:
 - a. Style:

- 1) Catena
 - b. Size:
 - 1) Diameter: 42 inches
 - c. Umbrella Hole: 2" dia hole, with grommet installed for use with 1-1/2" dia pole. Stainless steel hardware for securing the umbrella to the table is included.
- 5. Mounting
 - a. Freestanding with glides
- 6. Color
 - a. Flambe Orange
- E. Umbrella
 - 1. Model: Shade
 - 2. Mounting:
 - a. Table Mount
 - 3. Number of seats
 - a. Flambe Orange

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that substrates are stable and capable of supporting the weight of items covered under this section.
- B. Verify that substrates have been adequately prepared to securely anchor those items that will be surface mounted.

3.2 INSTALLATION

- A. Install according to the manufacturer's installation instructions. Stainless steel mounting hardware sold separately
- B. Install in conformance to applicable ADA guidelines and End User's established Accessibility policies.

END OF SECTION 12 9300

DIVISION 22

SECTION 220000
PLUMBING INDEX

SECTION	DESCRIPTION	PAGE NO.
220500	General Provisions and Common Work Results for Plumbing	1 - 28
220519	Meters and Gauges for Plumbing Piping	1 - 6
220523	General - Duty Valves for Plumbing Piping	1 - 9
220529	Hangers and Supports for Plumbing Piping and Equipment	1 - 11
220553	Identification for Plumbing Piping and Equipment	1 - 5
220700	Plumbing Insulation	1 - 15
221116	Domestic Water Piping	1 - 7
221119	Domestic Water Piping Specialties	1 - 9
221316	Sanitary Waste and Vent Piping	1 - 10
221319	Sanitary Waste Piping Specialties	1 - 10
221413	Storm Drainage Piping	1 - 7
221423	Storm Drainage Piping Specialties	1 - 6
223300	Electric Domestic Water Heaters	1 - 6
224000	Plumbing Fixtures	1 - 10
224700	Drinking Fountains and Water Coolers	1 - 4

SECTION 220500
GENERAL PROVISIONS AND COMMON WORK RESULTS FOR 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 and other sections of Division 22.

1.2 SUMMARY

- A. 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. Access Panels.
 - 9. Cleaning up/removal of debris.
 - 10. Equipment installation requirements common to equipment sections.
 - 11. Operating and maintenance data and owner instruction.
 - 12. Traps.
 - 13. Flashing.
 - 14. Painting and finishing.
 - 15. Concrete bases.
 - 16. Supports and anchorages.
 - 17. Materials prohibited.
 - 18. Certification.
 - 19. Guarantee of Work.
 - 20. Final plumbing connections.

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. ABS: Acrylonitrile-butadiene-styrene plastic.
 - 2. CPVC: Chlorinated polyvinyl chloride plastic.
 - 3. PE: Polyethylene plastic.
 - 4. PVC: Polyvinyl chloride plastic.
- G. The following are industry abbreviations for rubber materials:
 - 1. EPDM: Ethylene-propylene-diene terpolymer rubber.
 - 2. NBR: Acrylonitrile-butadiene rubber.
- H. The term "as indicated" means as shown on drawings by notes, graphics or schedules, or written into other portions of contract documents. Terms such as "shown", "noted", "scheduled" and "specified" have same meaning as "indicated", and are used to assist the reader in locating particular information.
- I. It is the intention of these Contract Documents to call for finished work, tested and ready for operation.
 - 1. The word "PROVIDE" shall mean "furnish and install, complete and ready for use" all items noted on the drawings and/or indicated in the Specifications.
 - 2. The word "FURNISH" shall mean "supply and deliver to the job site" all items noted on the drawings and/or indicated in the Specifications. The items will be installed by the Owner or another contractor.
 - 3. The word "INSTALL" shall mean "install complete and ready for use" all items furnished by the Owner or another contractor which are noted on the drawings and/or indicated in the Specifications to be installed by the Plumbing Contractor.
 - 4. The word "RELOCATE" shall mean "move from the existing location to the new location installed complete and ready for use" all items noted on the drawings and/or indicated in the Specifications.
- J. References made to Plumbing Contractor throughout Division 22 is intended to refer to the contractor or contractor who will furnish and install Plumbing materials and equipment.

1.4 QUALIFICATIONS FOR BIDDERS

- A. The Plumbing Contractor shall be experienced in work similar to that indicated for this Project and shall have a record of successful in-service performance.
- B. Upon request, the Plumbing Contractor shall provide a listing of similar jobs with references.
- C. Before submitting bid, the Plumbing Contractor shall visit the site and examine existing conditions on which his work is in any way dependent. The Plumbing Contractor shall immediately report to the Architect any condition which might prevent him from installing his equipment in the manner intended.

1.5 BID SUBMISSION REQUIREMENTS

- A. The Plumbing Contractor shall submit his bid, including the Base Bid and all Alternate Bids, in accordance with the General Provisions of the Contract, including General, Supplementary and Special Conditions.
- B. Only one manufacturer shall be listed for each equipment item.

1.6 LAWS, CODES, AND REGULATIONS

- A. All work shall be installed in accordance with accepted trade standards or practices. Accepted trade standards or practices shall be documented and shall be based on sound engineering design principles. Accepted trade standards or practices must include a statement indicating that the specific application in question is included within its scope. Accepted trade standards and practices must be documented through an engineering society or trade organization.
- B. Failure to follow laws, codes, public regulations and accepted trade standards or practices will result in rejection of the work. All rejected work shall be removed and replaced at no additional cost to the Owner.
- C. Nothing contained in these Specifications or shown on the Drawings shall be construed to be in conflict with state or local codes, ordinances or regulations governing the installation of the work specified herein. Should any change in the Drawings and/or Specifications be required in order to conform to the applicable codes, ordinances, regulations or laws, the Plumbing Contractor shall notify the engineer immediately upon discovery of the violation.
- D. Products furnished for this project shall be "LEAD FREE" as required by Federal legislation passed on January 4, 2011. This entails the wetted surfaces of plumbing fixtures, equipment, valves, etc. described in each section to have a weighted-average lead content of no more than 0.25% when used in applications intended to convey or dispense water for human consumption through drinking or cooking.

1.7 REGULATORY REQUIREMENTS

- A. Conform to applicable Building Codes.
 - 1. Commonwealth of Pennsylvania, Department of Labor and Industry.
 - a. Fire and Panic Regulations.
 - b. Regulations Governing Boilers and Unfired Pressure Vessels.
 - c. Elevator Law.
- B. Plumbing: Conform to the 2018 International Plumbing Code and the Allegheny County Health Department - Current Addition & Amendments.
- C. Energy conservation shall be provided for plumbing systems as described in the Pennsylvania Building Energy Conservation Act 222.

1.8 PERMITS, FEES, AND NOTICES

- A. The Plumbing Contractor shall give all requisite notices, obtain and pay all deposits and fees necessary for the installation, tests connections to the utility company service lines, street openings, repairs and inspection of all work provided under this Specification. These tests shall be conducted in the presence of the Architect.

1.9 APPLICABLE PUBLICATIONS

- A. The publications listed in each section form a part of that Section to the extent referenced.
- B. The publication date is the publication in effect as of the bid date, except when a specific publication date is specified.
- C. Obtain copies of referenced standards direct from publication source when needed for proper performance of work, or when required for submittal by Contract Documents.

1.10 SCOPE OF WORK

- A. The work to be performed consists of the satisfactory completion of all Plumbing work, as indicated in the Contract Documents.
- B. The work to be performed under these specifications shall include providing all labor, materials and equipment necessary to furnish and install, complete, properly and fully, all Plumbing Work as shown on drawings, herein specified and/or necessary thereto, whether or not specified herein in detail, and/or reasonably implied, and leaving the same in satisfactory operating condition. It is the intent of these specifications that a complete and operating system shall be installed and this Contractor shall carefully examine the site, plans, and specifications, and shall include all items necessary to accomplish this purpose.

1.11 SCHEDULING OF WORK

- A. This project consists of new construction and renovation work. Due to the size, scope and time required to complete this work, it may be necessary to perform the work in phases in order to allow the owner to continue with their business operations with a minimum amount of disruption.
- B. The Contractor shall thoroughly review the plumbing drawings, along with the architectural drawings, for the phasing sequence and shall incorporate into his bid the impact the phasing sequence and the construction schedule has on the Plumbing work in this project.
- C. Initially, upon award of all construction contracts, work shall begin on new construction. Early in this portion of the work, and so as to avoid or minimize disruption to the owner.

1.12 DESCRIPTION OF SYSTEMS

- A. Without intending to limit or restrict the volume of work required by this Specification and the applicable drawings, the work generally consists of:
1. Complete Plumbing systems including sanitary, waste, vent, hot water and cold water piping, specialties and equipment.
 2. Installation of new water heater, piping and piping specialties.
 3. Extension of existing plumbing system with new fixtures, piping, specialties and equipment.
 4. Thermal insulation of equipment and piping.
 5. Concrete pads for all floor mounted equipment.
 6. Cleaning of all equipment, piping, and fixtures.
 7. Painting of equipment, piping, supports and hangers.
 8. Testing, balancing and adjusting.
 9. Cutting and patching for new work in the existing building.
 10. Vibration isolation equipment.
 11. Structural and Mechanical Engineering services for the design and support of all piping systems for pipe sizes 6" and larger.
 12. Operating and maintenance instructions and manuals.
 13. Demonstration of successful system operation.

1.13 EQUIPMENT FURNISHED UNDER OTHER CONTRACTS

- A. Unless otherwise specified or shown on the drawings, this Contractor shall make final plumbing connections to all equipment furnished under General and Electrical Contracts. For HVAC equipment, this Contractor shall provide a capped water outlet within two (2) feet of the HVAC equipment, and the HVAC Contractor shall make and be responsible for the final connections. For HVAC gas fired equipment, this Contractor shall make the final gas connections to the equipment.
- B. Unless otherwise specified or shown on drawings, the equipment furnished under the concurrent contracts will be furnished with their operating controls. This Contractor shall provide valves on water and gas, and unless otherwise shown or specified traps on waste outlets, and shall furnish all labor and materials required to connect the equipment and make it operative. Unless otherwise shown or specified valves on lines to equipment shall be ball valves.
- C. Equipment furnished under other contracts will be set in place by the Contractor for that equipment. Controlling devices for this equipment will be furnished with the equipment, but were supplied detached, they shall be installed into the plumbing work piping assemblies by the Plumbing Contractor.
- D. This Contractor shall refer to the shop drawings of equipment furnished under other contracts to obtain the locations of connections and arrangements of piping assemblies to which he is required to connect. All the required pipe, fittings, adapters, couplings and other accessories required to make the equipment operative shall be provided by this Contractor.
- E. Products furnished to the site and paid for by the Owner.

1.14 SPACE PRIORITY

- A. Ensure equitable use of available space for materials and equipment installed above ceilings. Allocate space in the order of priority as listed below. Items are listed in the order of priority, with items of equal importance listed under a single priority number.
 - 1. Gravity flow piping systems.
 - 2. Vent piping systems.
 - 3. Ceiling recessed lighting fixtures.
 - 4. Concealed air terminal units, fans.
 - 5. Air duct systems.
 - 6. Sprinkler systems piping.
 - 7. Forced flow piping systems.
 - 8. Electrical conduit, wiring, control wiring.
- B. Order of priority does not dictate installation sequence. Installation sequence shall be as mutually agreed by all affected trades.
- C. Change in order of priority is permissible by mutual agreement of all affected trades.
- D. The work of a particular trade shall not infringe upon the allocated space of another trade without permission of the contractor for the affected trade.
- E. The work of a particular trade shall not obstruct access for installation, operation and maintenance of the Work, materials and equipment of another trade.
- F. This Contractor shall verify roughing-in dimensions for all fixtures and equipment prior to his roughing-in for such fixtures and equipment.

1.15 CUTTING AND PATCHING

- A. Cutting and patching shall be in accordance with Division 1 Section "Execution".
- B. The Plumbing Contractor shall seal all openings he has utilized in fire-rated floors, ceilings or partitions after his work has been installed. The material used for sealing the openings shall have a fire-rating equal to or greater than the rating of the floor, ceiling or partition material.
- C. The Plumbing Contractor shall be responsible for providing all cutting, patching, and finishing of existing construction which is not specifically shown on the Architectural Drawings and which is required for the proper installation of his equipment and materials which are to be installed in the existing portion of this project. This work shall also be provided when removing existing equipment and materials. All cutting shall be kept to an absolute minimum consistent with the requirements of the project.
- D. Cutting, patching and finishing shall be performed by workmen skilled in this type of work. All patching shall be done utilizing materials of the same quality and texture as the adjacent undisturbed areas. All finishing shall match the undisturbed adjacent areas. Painting of the final finished areas, where general construction work occurs, will be the responsibility of the General Contractor. Painting of the final finished areas, where no general construction work occurs, shall be the responsibility of the Plumbing Contractor. The Plumbing Contractor shall paint entire plane in which damage occurs whether the surface is a wall or a ceiling.

- E. No cutting shall be done which may affect the building structurally or architecturally without first consulting with the General Contractor and then securing the approval of the Architect. Cutting shall be accomplished in such a manner as not to cause damage to the building or leave unsightly surfaces which cannot be concealed by plates, escutcheons or other construction. Where such unsightly conditions are caused, the Plumbing Contractor shall be required, at his own expense, to repair the damaged areas. Note all holes or openings in existing concrete or masonry shall be drilled, core bored or saw cut.
- F. Where present equipment or material is removed and unused openings remain in walls, floors, partitions, etc., the Plumbing Contractor shall properly patch all such openings.

1.16 RECORD DRAWINGS

- A. Provide in accordance with Division 01 Section PROJECT RECORD DOCUMENTS and as stated below.
- B. The Plumbing Contractor shall:
 - 1. During the construction period, maintain in good order a complete set of blue line plumbing contract drawings. Record the actual Plumbing installation as the work progresses. Include all changes to the contract and to equipment sizes and types. Keep these drawings available at the site at all times for inspection.
 - 2. Take proper caution against the use of superseded drawings. Check all such copies and mark "void". Where drawings have been corrected by memorandum, assume the responsibility for marking all drawings so affected with the changes; such marked drawings shall remain in use until revised drawings are issued.

1.17 INTENT OF DRAWINGS AND SPECIFICATIONS

- A. The implied and stated intent of the drawings and specifications is to establish minimum acceptable quality standards for materials, equipment and workmanship, and to provide operable plumbing systems complete in every respect.
- B. Any apparatus, appliance, material or work not shown as standard industry practice on drawings, but mentioned in the specifications, or vice versa, shall be provided by the Plumbing Contractor without additional expense to the Owner.
- C. The drawings are diagrammatic, intending to show general arrangement and location of system components, and are not intended to be rigid in detail.
- D. Due to the small scale of the drawings, all required offsets and fittings may not be shown but shall be provided at no change in Contract price.
- E. As many of the small lines required for the complete installation are shown on the drawings as is practicable, but some may have been omitted. The Contractor shall do all such piping that may be required or directed to effect proper connections to all apparatus, equipment, and fixtures in accordance with the manufacturer's detailed drawings and instructions.
- F. The equipment schedules shown on the drawings list the manufacturer used as the basis of design in the preparation of the Bid Drawings. The equipment specifications list that manufacturer as well as other manufacturers the Engineer, Architect and/or Owner find acceptable from a performance and product quality standpoint. Listing these other manufacturers in no way implies that the Engineer or Architect has exhaustively researched the

products available by these manufacturers to determine whether they have a positive or negative monetary impact on the design shown on the Bid Drawings. In addition, listing these other manufacturers in no way implies that the Engineer or Architect has exhaustively researched the products available by these manufacturers to determine whether the dimensions of these products will have a negative impact on the space allotted for this equipment. If the Contractor or his Subcontractors decide to use a product or manufacturer that is listed as acceptable in the specifications but is different from the product or manufacturer scheduled on the drawings, it will be the responsibility of the Contractor or his Subcontractors to fully explore the product to ensure that it can be installed in the space allotted and shall pay any and all costs (including additional professional design fees) associated with the use of these products or manufacturers that impact the structure, the electrical system(s), the HVAC system(s) and/or the Plumbing system(s) due to an increase in weight, electrical load, drain and vent requirements, connection sizes, etc., between the scheduled item and the equipment item used.

1. Use of a product or manufacturer not scheduled on the Bid Drawings constitutes a representation that:
 - a. The Plumbing Trade has investigated the proposed product and determined that the product can be installed within the space allotted.
 - b. The Plumbing Trade will coordinate the installation of product used into the work
 - c. The Plumbing Trade will be responsible for making all changes as may be required to make the work complete in all respects; waives all claims for additional costs under his responsibility, which may subsequently become apparent.

1.18 SUBMITTALS

- A. Provide in accordance with Division 01 Section SUBMITTAL PROCEDURES and as stated below.
- B. Submit plans to the Pennsylvania Department of Labor and Industry (L&I) Boiler Division. Install water heaters, fired and unfired pressure vessels in conformance with approved drawings providing all required valves, platforms, ladders, exits and clearances. Submit approved L&I drawings to Architect before construction.
- C. Submit Product Data, shop drawings, and samples in accordance with the General Conditions and Supplementary Conditions, within 60 days of award of contract for every item of material, etc. used.
- D. Designate in the construction schedule, or in a separate coordinated schedule, the dates for submission and the dates that reviewed shop drawings, product data and samples will be needed.
- E. Shop Drawings shall be presented in a clear and thorough manner. Details shall be identified by reference to sheet and detail, schedule or room numbers shown on Contract Drawings.
- F. The following is a list of some important material, equipment and systems that require shop drawing approval, refer to each section of this specification for additional submittal requirements:
 1. Section 220519: Meters and Gauges for Plumbing Piping
 2. Section 220523: General Duty Valves for Plumbing Piping
 3. Section 220529: Hangers and Supports for Plumbing Piping and Equipment
 4. Section 220553: Identification for Plumbing Piping and Equipment
 5. Section 220700: Plumbing Insulation

6. Section 221116: Domestic Water Piping
 7. Section 221119: Domestic Water Piping Specialties
 8. Section 221316: Sanitary Waste and Vent Piping
 9. Section 221319: Sanitary Waste Piping Specialties
 10. Section 221413: Facility Storm Drainage Piping
 11. Section 221423: Storm Drainage Piping Specialties
 12. Section 223300: Electric Domestic Water Heaters
 13. Section 224000: Plumbing Fixtures
 14. Section 224700: Drinking Fountains and Water Coolers
- G. All drawings prepared by the Plumbing Contractor, for the Plumbing Contractor's use, shall be submitted for approval. Such drawings include, but are not limited to, pipe fabrication and layout drawings, Plumbing piping and layout drawings, equipment layout drawings, coordination drawings, and drawings of miscellaneous details.
- H. Office samples shall be of sufficient size and quantity to clearly illustrate functional characteristics of the product, with integrally related parts and attachment devices, and full range of color, texture and pattern.
- I. The Plumbing Contractor shall be responsible for reviewing shop drawings, product data and samples prior to submission. The Plumbing Contractor shall clearly mark or highlight the submittal to indicate all pertinent information such as model number, dimensions, capacities, clearances, performance characteristics, etc., and shall delete any data which is not relevant to the work. The Plumbing Contractor shall also determine and verify field measurements, field construction criteria, catalog numbers and similar data, and conformance with specifications.
- J. The Plumbing Contractor shall coordinate each submittal with requirements of the work and of the Contract Documents.
- K. The Plumbing Contractor shall notify the Architect in writing, at time of submission, of any deviations in the submittals from requirements of the Contract Documents.
- L. The Plumbing Contractor shall begin no fabrication or work which requires submittals until return of submittals with Architect approval.
- M. The Plumbing Contractor shall make submittals promptly in accordance with approved schedule, and in such sequence as to cause no delay in the work or in the work of any other Contractor.
- N. Unless required otherwise by the General Conditions or the Supplementary Conditions, the number of submittals required shall be as follows:
1. Shop Drawings: Submit the number of opaque reproductions which the Plumbing Contractor requires, plus three copies, one will be retained by the Architect, one copy will be retained by the Engineer, and one copy will be retained by the Owner.
 2. Product Data: Submit the number of copies which the Plumbing Contractor requires, plus three copies; one copy will be retained by the Architect, one copy will be retained by the Engineer, and one copy will be retained by the Owner.
 3. Samples: Submit the number stated in each specification section.
- O. The Plumbing Contractor shall also include in each submittal the date of submission and the dates of any previous submissions; the project title and number; the names of the Plumbing Contractor, the supplier, and the manufacturer; identification of the product, with the specification section number; identification of revisions on resubmittals; and the Plumbing Contractor's stamp, initialed or signed, certifying to review of submittal, verification of products,

field measurements and field construction criteria, and coordination of the information within the submittal with requirements of the work and of Contract Documents.

- P. For resubmission requirements, the Plumbing Contractor shall make any corrections or changes in the submittals (i.e., shop drawings, samples or product data) required by the Architect and resubmit until approved.
- Q. The Architect will review submittals with reasonable promptness and in accordance with schedule, affix stamp and initials or signature, and indicate requirements for re-submittal, or approval of submittal, and return submittals to Plumbing Contractor for distribution, or for resubmission.
- R. Submittals for equipment and pumps shall include manufacturer's published performance curves showing flow rate, pressure drop, efficiency, horsepower, NPSH required (for pumps), and operating points.
- S. As soon as practicable, and within 30 days after the date of award of contract, and prior to installation of any equipment or material a completed schedule of equipment and material proposed for installation shall be submitted to the A/E for approval.
- T. All material submitted for approval, excepting special equipment and special adaptation of regular equipment as hereinafter specified and as specifically shown on the drawings, shall be standard printed matter made available by the manufacturer to the public and in effect at the time of opening of bids and shall indicate that the material or equipment is regularly produced and recommended for the service required. In the event any items of material or equipment contained in the schedule fail to comply with the specification requirements, such items may be rejected.
- U. In the event that the contractor fails to submit the required schedule of materials and equipment within the allowed time, the A/E will select a complete line of materials, fixtures, and equipment. The selection made shall be final and binding, and the items shall be furnished and installed by the contractor without any change in contract price or time of completion.
- V. Product data for the following:
 - 1. Transition fittings.
 - 2. Dielectric fittings.
 - 3. Mechanical sleeve seals.
 - 4. Escutcheons.
- W. Welding certificates.

1.19 SUBSTITUTIONS AND PRODUCT OPTIONS

- A. Provide in accordance with Division 01 Section SUBSTITUTION PROCEDURES and as stated below.
- B. It will be the responsibility of this contractor to pay any and all costs associated with any approved substitutions which impact the structure, the electrical system(s), the plumbing system(s) and/or the Plumbing system(s) due to an increase in weight, electrical load, drain requirements, connection sizes, etc., between the approved substitution item and the equipment item scheduled and/or indicated as the basis of design.

- C. For products specified only by reference standard, select any product meeting that standard. For products specified by naming several products or manufacturers, select any one of the products or manufacturers named, which complies with the drawings and specifications. For products specified by naming one or more products or manufacturers and "or equal", Plumbing Contractor must submit a request as for substitutions for any product or manufacturer not specifically named.
- D. The Architect will consider written requests from the Plumbing Contractor for substitution of products by manufacturers not listed in the Specification for a period up to 10 days prior to the Bid. Within this period, submit a separate request for each product, supported with complete data, with drawings and samples as appropriate and as required under the "submittals" paragraph in this section to include: Comparison of the qualities of the proposed substitution with that specified; changes required in other elements of the work because of the substitution; effect on the construction schedule; cost data comparing the proposed substitution with the product specified; availability of maintenance service, and source of replacement materials.
- E. A request for a substitution constitutes a representation that the Plumbing Contractor has investigated the proposed product and determined that it is equal to or superior in all respects to that specified; can be installed within the space allotted; will provide the same warranties or bonds for the substitution as for the product specified; will coordinate the installation of an accepted substitution into the work, and make such other changes as may be required to make the work complete in all respects; waives all claims for additional costs, under his responsibility, which may subsequently become apparent.
- F. The Plumbing Contractor will compensate the Architect and Engineer on a time and material basis for their costs involved in reviewing a substitution.

1.20 OPERATING AND MAINTENANCE DATA AND OWNER INSTRUCTION

- A. Provide in accordance with Division 01 Section OPERATION AND MAINTENANCE DATA and as stated below.
- B. The manual shall contain as a minimum: models and serial numbers for the equipment; description of the equipment/system and its components; recommended routine, preventative and emergency maintenance; start-up, operating and safety instructions; recommended frequency of inspection; oil type; belt tension adjustment; performance curves, engineering data, and tests; "trouble-shooting guide"; a spare parts list; and names, addresses and telephone numbers for the equipment installer, the maintenance contractor, and the local spare parts source.
- C. Provide complete operating and maintenance information for products specified in:
 - 1. Section 223300: Electric Domestic Water Heaters
 - 2. Section 224000: Plumbing Fixtures
 - 3. Section 224700: Drinking Fountains and Water Coolers

1.21 QUALITY ASSURANCE

- A. Provide in accordance with Division 01 Section QUALITY REQUIREMENTS.
- B. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

- C. 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.
- D. Electrical Characteristics for Plumbing 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.

1.22 DELIVERY, STORAGE, HANDLING, AND PROTECTION

- A. Provide in accordance with Division 01 Section PRODUCT REQUIREMENTS and as stated below.
- B. Arrange deliveries of products in accordance with construction schedules. Coordinate to avoid conflict with work and conditions at the site. Deliver products in undamaged condition, in manufacturer's original containers or packaging, with identifying labels intact and legible.
- C. Immediately on delivery, inspect shipments to assure compliance with requirements of Contract Documents and approved submittals, and those products are properly protected and undamaged.
- D. Provide equipment and personnel to handle products by methods to prevent soiling or damage to products or packaging.
- E. 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.
- F. Store new products in accordance with manufacturer's instructions, with seals and labels intact and legible. Store new products or items being re-used in a manner to prevent damage due to the elements, prevent damage due to construction operations at the site, and allow for ease of inspection.
- G. Provide substantial coverings as necessary to protect installed products from damage from traffic and subsequent construction operations. Remove when no longer needed.
- H. The Plumbing Contractor, at his own expense, shall make good to the Architect and the Owner's satisfaction any damage to his work incurred by the action of the elements or any other cause due to the neglect on the part of the Plumbing Contractor or his representatives.
- I. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.23 PROTECTION OF SERVICES AND EQUIPMENT

- A. Repair, replace and maintain in service any utilities, facilities or services (underground, aboveground, interior and/or exterior) which are damaged, broken, or otherwise rendered inoperative during the course of construction. The method used in repairing, replacing or maintaining the services shall be approved by the Architect and/or Engineer.

- B. The Plumbing Contractor shall protect all work, materials and equipment during the construction period. All openings must be securely covered, or otherwise protected, in order to prevent injury due to dropped tools, materials or dirt.

1.24 SPECIAL CONDITIONS RELATED TO PLUMBING WORK

- A. During the course of construction, cap or otherwise seal off, in an approved manner, those portions of the piping system in which work is not being performed, in order to prevent the entry of dirt or dust.
- B. The Plumbing Contractor shall coordinate all utility shut-downs with the Owner.
- C. Install equipment along with control devices and all replaceable fittings with sufficient clearance for operation and maintenance functions.
- D. Do not install piping in transformer vaults or electrical equipment rooms. In accordance with the National Electric Code Article 110-34f, do not install piping adjacent to or above any surface of electrical controls, panels, switches, terminals, boxes or similar electrical equipment. Drip-pan protection shall not be permitted, except where detailed.
- E. Exposed piping shall be run so as to allow maximum headroom consistent with proper pitch. Piping shall not interfere with any light, opening, door, window or equipment. Headroom in front of openings, doors and windows shall not be less than the top of the opening. Minimum clearance of 1 inch shall be maintained around all piping, valves and fittings.
- F. Outside, underground piping shall have a minimum of 36 inches of earth cover, except provide greater coverage to equal locally recorded frost penetrations.
- G. Lay out the work and establish all heights and grades required for installation.
- H. All material and equipment to be furnished under this contract shall be new and shall conform to the grade, quality and standards specified herein. Items of equipment shall be the latest standard product as advertised in printed catalogs by reputable manufacturers for the purpose intended and shall have replacement parts available.
- I. Equipment shall be installed in strict accordance with the manufacturer's instructions for type and capacity of each piece of equipment. The Plumbing Contractor shall obtain these instructions from the manufacturer and such instructions shall be considered a part of these specifications. Type, capacity, and application of equipment shall be suitable and capable of satisfactory operation for the purpose intended in the plumbing system.
- J. Equipment and materials of the same general type shall be of the same make throughout the work to provide uniform appearance, operation, and maintenance.
- K. It shall be the responsibility of the Contractor to ensure that the items to be furnished fit the space available. He shall make necessary field measurements to ascertain space requirements, including those for connection, and shall furnish and install such sizes and shapes of equipment that the final installation shall suit the true intent and meaning of the drawings and specifications.

- L. Where equipment requiring different arrangement or connections from those shown is approved, it shall be the responsibility of the Contractor to install that equipment to operate properly and in harmony with the intent of drawings and specifications. When directed by the Architect, the Contractor shall submit drawings showing the proposed installation. If the proposed installation is approved, the Contractor shall make all incidental changes in piping, ductwork, supports, insulation, wiring, heaters, panelboards, etc. He shall provide any additional motors, controllers, valves, fittings, and other additional equipment for the proper operation of the system resulting from the selection of that equipment, including all required changes in affected trades. The Contractor shall be responsible for the proper location of roughing-in and in connections by other trades. All changes shall be made at no increase in the Contract Amount or additional cost to the other trades.
- M. Unless otherwise noted on the drawings or in the specifications, concrete pads and bases for heaters, tanks, and other equipment shall be furnished and installed by the Contractor furnishing the equipment requiring such pad or base. The Contractor shall establish sizes and locations of the various concrete bases required and shall provide all necessary anchor bolts, together with the templates for holding these bolts in position. Anchor bolts shall be placed in steel pipe sleeves to allow for adjustment, with suitable plate at bottom end of sleeve to hold the bolt. Each concrete base shall be not less than 4" high, which shall project 3" on all sides beyond the equipment. Special vibration isolation foundations that are required are specified with the equipment supported.
- N. The Contractor shall support, plumb, rigid and true to line, all work and equipment furnished under each section. The Contractor shall study thoroughly all general, structural, mechanical, and electrical drawings, shop drawings, and catalog data to determine how equipment, fixtures, piping, conduit, ductwork, etc. are to be supported, mounted, or suspended and shall provide extra steel bolts, inserts, pipe standards, brackets and accessories for proper support, whether or not shown on the drawings. When directed, the Contractor shall submit prints showing supports for approval.
- O. Provide safety guards for all pulleys, belt-drives and rotating equipment. Safety requirements of the Pennsylvania Department of Labor and Industry and OSHA shall be met.

1.25 COORDINATION

- A. Sequence of Work
 - 1. Provide in accordance with Division 01 Section SUMMARY.
- B. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for plumbing installations.
- C. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- D. Coordinate requirements for access panels and doors for plumbing items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."
- E. This Plumbing Contractor must cooperate completely and coordinate work with the General Trade and other trades providing equipment under this division and other divisions of the specifications.

- F. Interference drawings shall be prepared as a combined effort of all trades. Each trade shall proceed with their own set of drawings on electronic backgrounds in Auto Cad Format prepared by the Mechanical Contractor. The Mechanical Contractor shall start their drawings immediately upon award of contract. Drawings shall be at 1/4" = 1'0" scale based on sheet size and plan location and orientation as shown on the architectural drawings. All interference drawings shall be capable of being overlaid to coordinate interferences and for printing. All congested areas and mechanical room plans shall be drawn at 3/8" = 1'0" scale.
- G. After the Mechanical Contractor has finished, it shall forward one print along with an electronic file to the Plumbing trade that in turn will show and coordinate the plumbing work on the combined plans with the other trades. After the Plumbing trade has finished, it shall forward one print along with an electronic file to the Electrical trade that, in turn, will show and coordinate the electrical work on the combined plans with the other trades. After the Electrical trade has finished, it shall forward one print along with an electronic file to the Plumbing trade that, in turn, will show and coordinate the electrical work on the combined plans with the other trades
- H. Interference plans and elevations shall show in detail the location of the following items which require coordination because of size and proximity to other equipment and systems. Drawings shall show in order of installation priority within the allotted space the items prioritized in the paragraph entitled "Space Priority".
 - 1. In addition, show mechanical and electrical work in equipment rooms.
 - 2. On the interference drawings, show all electrical conduits which are 1-1/2" and larger.
- I. Reproducible copies along with electronic file of the finished interference drawings shall be submitted to the Architect for record and approval before actual installation work begins. Each trade shall make completed interference drawings available to their craft for installation of the work.
- J. Individual trade interference drawings may be used as shop drawings and/or as record drawings at the completion of the project.

1.26 DEMONSTRATION AND TRAINING

- A. Provide in accordance with Division 01 Section DEMONSTRATION AND TRAINING and as stated below.
- B. After the tests and adjustments have been made, approved factory-authorized system representatives and the Contractor shall fully instruct Owner in all details of operation and maintenance of equipment installed under this Contract. Dates and times of such instructions shall be as directed by Owner, including any necessary weekend or after-hours instruction.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 22 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 22 piping Sections for special joining materials not listed below.
- B. Pipe Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
 - 1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
 - a. Full-Face Type: For flat-face, Class 125, cast iron and cast-bronze flanges.
 - b. Narrow-Face Type: For raised-face, Class 250, cast iron and steel flanges.
 - 2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- E. Solder Filler Metals: ASTM 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, BA91, 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. ABS Piping: ASTM D 2235.
 - 2. CPVC Piping: ASTM F 493.
 - 3. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
 - 4. PVC to ABS Piping Transition: ASTM D 3138.
- I. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

2.4 TRANSITION FITTINGS

- A. AWWA Transition Couplings: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.
 - 1. Manufacturers:
 - a. Cascade Waterworks Mfg. Company
 - b. Dresser Industries, Inc.; DMD Division
 - c. Ford Meter Box Company, Inc. (The); Pipe Products Division
 - d. JCM Industries
 - e. Smith-Blair, Inc.
 - f. Viking Johnson
 - 2. Underground Piping NPS 1-1/2 (DN 40) and Smaller: Manufactured fitting or coupling.
 - 3. Underground Piping NPS 2 (DN 50) and Larger: AWWA C219, metal sleeve-type coupling.
 - 4. Aboveground Pressure Piping: Pipe fitting.
- B. Plastic-to-Metal Transition Fittings: CPVC and PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
 - 1. Manufacturers:
 - a. Eslon Thermoplastics
- C. Plastic-to-Metal Transition Adapters: One-piece fitting with manufacturer's SDR 11 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
 - 1. Manufacturers:
 - a. Thompson Plastics, Inc.
- D. Plastic-to-Metal Transition Unions: MSS SP-107, CPVC and PVC four-part union. Include brass end, solvent-cement-joint end, rubber O-ring, and union nut.
 - 1. Manufacturers:
 - a. Nibco, Inc.
 - b. Nibco, Inc.; Chemtrol Division
- E. Flexible Transition Couplings for Underground Non-pressure Drainage Piping: ASTM C 1173 with elastomeric sleeve, ends same size as piping to be joined, and corrosion-resistant metal band on each end.
 - 1. Manufacturers:
 - a. Cascade Waterworks Mfg. Company
 - b. Fernco, Inc.
 - c. Mission Rubber Company
 - d. Plastic Oddities, Inc.

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°F.
 - 1. Manufacturers:
 - a. Capitol Manufacturing Company
 - b. Central Plastics Company
 - c. Eclipse, Inc.
 - d. Epco Sales, Inc.
 - e. Hart Industries, International, Inc.
 - f. Watts Industries, Inc.; Water Products Division
 - g. Zurn Industries, Inc.; Wilkins Division
- D. Dielectric Flanges: Factory fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.
 - 1. Manufacturers:
 - a. Capitol Manufacturing Company
 - b. Central Plastics Company
 - c. Epco Sales, Inc.
 - d. Watts Industries, Inc.; Water Products Division
- 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. Manufacturers:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Central Plastics Company
 - d. Pipeline Seal and Insulator, Inc.
 - 2. 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°F.
 - 1. Manufacturers:
 - a. Calpico, Inc.
 - b. Lochinvar Corporation

- 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°F.

1. Manufacturers:
 - a. Perfection Corporation
 - b. Precision Plumbing Products, Inc.
 - c. Sioux Chief Manufacturing Co., Inc.
 - d. Victaulic Company 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. Manufacturers:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Metraflex Company
 - d. Pipeline Seal and Insulator, Inc.
2. Sealing Elements: EPDM or NBR 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 or Stainless steel. Include two for each sealing element.
4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating or 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.
- E. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.
- F. PVC Pipe: ASTM D 1785, Schedule 40.
- G. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.
- H. Sleeves for Pipes through Non-Fire Rated Walls and Floors: Form with galvanized steel.

- I. Sleeves for Pipes through Exterior Masonry and Concrete Walls and Slabs below Grade: Form with schedule 40 steel pipe with water stops.
- J. Sleeves for Pipes through Masonry and Concrete Walls and Slabs above Grade: Form with Schedule 40 steel pipe.
- K. Sleeves for Pipe through Drywall and Plaster Partitions: Form with galvanized steel.
- L. Provide Link-Seal by Thunderline Corporation for below grade piping penetrations through exterior walls and slabs.

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 and rough brass.
- D. Split-Casting, Cast brass Type: With concealed hinge and set screw.
 - 1. Finish: Polished chrome plated and rough brass.
- 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, non-shrink and nonmetallic, dry hydraulic-cement grout.
 - 1. Characteristics: Post-hardening, volume-adjusting, non-staining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.
 - 3. Packaging: Premixed and factory packaged.

2.10 ACCESS PANELS

- A. Where required for access to valves, cleanouts, etc., and where new and existing items require adjustments, inspection or service, removable panels complete with frame shall be furnished and installed by this Contractor. Access panels shall be a minimum of 10" x 10". Panels are required for their intended service and shall be of the type, fire rating, finish, color and material

required for the finish and construction into which they are installed. Coordinate with General Contractor and Architect prior to purchasing.

- B. Access panels shall be a minimum of 18" x 18" or larger where needed to remove equipment and allow man access. Doors shall be hinged and removable.

PART 3 - EXECUTION

3.1 PLUMBING 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 plumbing 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. Equipment to Be Removed: Disconnect and cap services and remove equipment.
 - 4. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
 - 5. 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.
- D. When demolishing existing equipment, the Plumbing Contractor shall remove all existing piping, insulation, supports, hangers, hanger rods, anchor bolts, structural steel, and concrete pads related to the work being removed. When demolishing piping branch runouts, remove the entire branch which is accessible above lay-in ceilings or accessible during the construction period back to the main, unless otherwise noted. When demolishing equipment and fixtures and the branch runouts are inaccessible, cap, seal, and abandon the branch runouts in an approved manner.
- E. Where demolition of work results in unsightly openings in occupied spaces or jeopardizes the integrity of a fire or smoke barrier, the opening shall be patched in accordance with Division 1.
- F. Where demolition requires the removal of a concrete equipment pad, remove the pad, cut all anchor bolts, dowel pins, and steel bases off flush with the floor so as to eliminate any tripping hazard. Fill any openings, voids, or holes with a fine cement grout or another appropriate floor patching material. Provide surface finish to match adjacent flooring material.

3.2 CLEANING UP/REMOVAL OF DEBRIS

- A. This Contractor shall periodically, and at such times as directed by the Professional, remove from the premises all trash and debris caused by the performance of his work. At the completion of the work, all parts of the plumbing installation shall be thoroughly cleaned by this Contractor. All piping, flush valves, fixtures, trim, strainers, etc., shall be cleaned of all grease, dirt and metal cuttings. All plumbing fixtures shall be cleaned to restore to their original condition.
- B. Any damage to the building finishes or furnishings due to the failure of this Contractor to afford proper protection during the execution of his work, shall be restored in a manner satisfactory to the Architect/Owner.

3.3 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 22 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. Water piping shall be graded in such a manner as to be completely drain the entire system and to permit air relief of hot water piping systems.
- L. Select system components with pressure rating equal to or greater than system operating pressure.

- M. 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, cast brass type with polished chrome plated or rough-brass finish.
 - g. Bare Piping in Equipment Rooms: One-piece, cast brass type.
 - h. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor plate type.
 2. 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 (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 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.
- V. Exposed piping in finished spaces shall be chrome-plated

3.4 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 22 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.
- I. Plastic piping solvent-cement joints; clean and dry joining surfaces. Join pipe and fittings according to the following:
 - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
 - 2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
 - 3. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
 - 4. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
 - 5. PVC Non-pressure Piping: Join according to ASTM D 2855.
 - 6. PVC to ABS Non-pressure Transition Fittings: Join according to ASTM D 3138 Appendix.
- J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.
- K. Plastic Non-pressure Piping Gasketed Joints: Join according to ASTM D 3212.

3.5 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
 - 1. Install unions, in piping NPS 2 (DN 50) and smaller, adjacent to each valve and at final connection to each piece of equipment.
 - 2. Install flanges, in piping NPS 2-1/2 (DN 65) and larger, adjacent to flanged valves and at final connection to each piece of equipment.
 - 3. 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.

3.6 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Provide in accordance with Division 01 Section EXECUTION and as stated below.
- B. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.

- C. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- D. Install plumbing equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- E. Install equipment to allow right of way for piping installed at required slope.

3.7 STARTING OF PLUMBING SYSTEMS AND EQUIPMENT

- A. Provide material and labor required to perform start-up of each respective item of equipment and system prior to beginning of test, adjust and balance procedures. Refer to the section in Division 22 in which the system or equipment item is specified for specific start-up requirements for that system or equipment item.

3.8 TRAPS

- A. Unless otherwise specified or shown on the drawings, all plumbing fixtures, floor drains, and equipment furnished by this or other current contracts shall be individually trapped with full bore traps. Generally, plumbing fixture traps shall be on the wall outlet type connecting to a sanitary tee drainage fitting, the vent being extended vertically and provided with offsets where shown or specified.
- B. Traps supplied with the plumbing fixtures are specified elsewhere; however, all equipment furnished under other contracts and requiring waste connections and not furnished with traps, shall be provided with traps furnished and installed by this Contractor. All unburied traps shall be cast brass of the sizes shown on the drawings, and shall, where exposed, be chrome plated and connected to the roughing with chrome plated copper tubing. Buried traps shall be cast iron.
- C. Where buried, running traps shall have one vent hub fitted with extension section of pipe to permit cleanout plug to be installed under cover plate, set flush with finished floor. All unburied P-traps shall have cleanout plug on the bottom of the bed of the trap. Buried P-traps shall not have cleanout plugs.

3.9 FLASHING

- A. Openings in roofs for extended soil and vent pipe shall be flashed by the General Contractor. Refer to detail on Architectural drawings.

3.10 PAINTING

- A. Painting of plumbing 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.

3.11 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 4 inches (100 mm) 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 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section "Cast-in-Place Concrete".

3.12 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 plumbing materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

3.13 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor plumbing materials and equipment.
- B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.
- C. Attach to substrates as required to support applied loads.

3.14 GROUTING

- A. Mix and install grout for plumbing 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.

3.15 MATERIALS PROHIBITED

- A. Absolutely no materials, equipment, etc., containing asbestos and/or lead shall be installed on this construction project. No deviations will be entertained or accepted.

3.16 FINAL CLEANING

- A. Provide in accordance with Division 01 Section CLOSEOUT PROCEDURES.

3.17 CERTIFICATION

- A. After a final site observation has been performed by the engineer, the contractor shall provide the Owner with a letter certifying that he did not install any asbestos-containing and/or lead containing materials on this project a result of his construction work. In addition, the contractor shall provide the owner with a letter from each of his sub-contractors certifying the same.

3.18 GUARANTEE OF WORK

- A. Provide in accordance with Division 01 Section CLOSEOUT PROCEDURES and as stated below.
- B. Where applicable, furnish manufacturer's written warranty for materials and equipment.
- C. This Plumbing Contractor shall furnish a written warranty stating that all work shall be free from defects of equipment, material for workmanship for a period of one year from date of final acceptance and all defects developing during that period shall be made good without cost to the Owner.
- D. This Plumbing Contractor shall service the installation for one year from date of final acceptance. This shall include all emergency service and adjustment, with the exception of the oiling of motors and cleaning of filters and screens.

3.19 FINAL PLUMBING CONNECTIONS

- A. Provide rough-in and final connection of all Plumbing services needed for equipment provided by the Owner or by other trades. Shop Drawings will be furnished by those providing the equipment. These Drawings shall be checked by the trade responsible for rough-in and final connections before submission to the Architect for approval. The work shall be done in accordance with the approved Shop Drawings.
- B. In general, connection and termination points are given in the Contract Documents. Where not given or where conflicts occur, refer the question to the Architect for a binding decision.

END OF SECTION 220500

SECTION 220519
METERS AND GAUGES 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. Thermometers
 - 2. Gauges
 - 3. Test plugs

- B. Related Sections:

- 1. Division 22 Section 221116 "Domestic Water Piping" for domestic and fire protection water service meters inside the building.

1.3 DEFINITIONS

- A. CR: Chlorosulfonated polyethylene synthetic rubber.
- B. EPDM: Ethylene-propylene-diene terpolymer rubber.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated, include performance curves.
- B. Shop Drawings: Schedule for thermometers and gauges indicating manufacturer's number, scale range, and location for each.
- C. Product Certificates: For each type of thermometer and gauge, signed by product manufacturer.

PART 2 - PRODUCTS

2.1 METAL CASE, LIQUID-IN-GLASS THERMOMETERS

- A. Manufacturers - subject to compliance with requirements, provide products by one of the following:
 - 1. Palmer - Wahl Instruments Inc.
 - 2. Trerice, H. O. Company

3. Weiss Instruments, Inc.
 4. Weksler Instruments Operating Unit; Dresser Industries; Instrument Division
- B. Case: Die-cast aluminum, 9 inches long.
- C. Tube: Red or blue reading, mercury or organic-liquid filled, with magnifying lens.
- D. Tube Background: Satin-faced, non-reflective aluminum with permanently etched scale markings.
- E. Window: Glass or plastic.
- F. Connector: Adjustable type, 360 degrees in horizontal plane, with locking device.
- G. Stem: Copper plated steel, aluminum, or brass for thermowell installation and of length to suit installation.
- H. Accuracy: Plus, or minus 1 percent of range or plus or minus 1 scale division to maximum of 1.5 percent of range.

2.2 DIRECT MOUNTING, VAPOR ACTUATED DIAL THERMOMETERS

- A. Manufacturers - subject to compliance with requirements, provide products by one of the following:
1. Ashcroft Commercial Instrument Operations; Dresser Industries; Instrument Division
 2. Trerice, H. O. Company
 3. Weiss Instruments, Inc.
 4. Weksler Instruments Operating Unit; Dresser Industries; Instrument Division
- B. Case: Liquid-filled type, cast aluminum, 4-1/2 inch diameter.
- C. Element: Bourdon tube or other type of pressure element.
- D. Movement: Mechanical, connecting element and pointer.
- E. Dial: Satin-faced, non-reflective aluminum with permanently etched scale markings.
- F. Pointer: Red or other dark-color metal.
- G. Window: Glass or plastic.
- H. Ring: Metal.
- I. Connector: Adjustable type, 360 degrees in horizontal plane, with locking device.
- J. Thermal System: Liquid- or mercury-filled bulb in copper plated steel, aluminum, or brass stem for thermowell installation and of length to suit installation.
- K. Accuracy: Plus, or minus 1 percent of range or plus or minus 1 scale division to maximum of 1.5 percent of range.

2.3 REMOTE MOUNTING, VAPOR ACTUATED DIAL THERMOMETERS

- A. Manufacturers - subject to compliance with requirements, provide products by one of the following:
 - 1. Ashcroft Commercial Instrument Operations; Dresser Industries; Instrument Division
 - 2. Palmer - Wahl Instruments Inc.
 - 3. Trerice, H. O. Company
 - 4. Weiss Instruments, Inc.
 - 5. Weksler Instruments Operating Unit; Dresser Industries; Instrument Division
- B. Case: Dry type, cast aluminum, 4-1/2 inch diameter with holes for panel mounting.
- C. Element: Bourdon tube or other type of pressure element.
- D. Movement: Mechanical, connecting element and pointer.
- E. Dial: Satin-faced, non-reflective aluminum with permanently etched scale markings.
- F. Pointer: Red or other dark color metal.
- G. Window: Glass or plastic.
- H. Ring: Metal.
- I. Connector: Bottom union type.
- J. Thermal System: Liquid- or mercury-filled bulb in copper-plated steel, aluminum, or brass stem for thermowell installation and of length to suit installation.
- K. Accuracy: Plus, or minus 1 percent of range or plus or minus 1 scale division to maximum of 1.5 percent of range.

2.4 THERMOWELLS

- A. Manufacturers - subject to compliance with requirements, provide products by one of the following:
 - 1. Ashcroft Commercial Instrument Operations; Dresser Industries; Instrument Division
 - 2. Palmer - Wahl Instruments Inc.
 - 3. Trerice, H. O. Company
 - 4. Weiss Instruments, Inc.
 - 5. Weksler Instruments Operating Unit; Dresser Industries; Instrument Division
- B. Manufacturers: Same as manufacturer of thermometer being used.
- C. Description: Pressure-tight, socket-type metal fitting made for insertion into piping and of type, diameter, and length required to hold thermometer.

2.5 PRESSURE GAUGES

- A. Manufacturers - subject to compliance with requirements, provide products by one of the following:
1. Ashcroft Commercial Instrument Operations; Dresser Industries; Instrument Division
 2. Palmer - Wahl Instruments Inc.
 3. Trerice, H. O. Company
 4. Weiss Instruments, Inc.
 5. Weksler Instruments Operating Unit; Dresser Industries; Instrument Division
- B. Direct Mounting, Dial type Pressure Gauges: Indicating-dial type complying with ASME B40.100.
1. Case: Dry type, cast aluminum, 4-1/2-inch diameter.
 2. Pressure Element Assembly: Bourdon tube, unless otherwise indicated.
 3. Pressure Connection: Brass, NPS 1/4 (DN 8), bottom-outlet type unless back-outlet type is indicated.
 4. Movement: Mechanical, with link to pressure element and connection to pointer.
 5. Dial: Satin-faced, non-reflective aluminum with permanently etched scale markings.
 6. Pointer: Red or other dark-color metal.
 7. Window: Glass or plastic.
 8. Ring: Metal.
 9. Accuracy: Grade A, plus or minus 1 percent of middle half scale.
 10. Vacuum pressure Range: 30-in. Hg of vacuum to 15 psig of pressure.
 11. Range for Fluids under Pressure: Two times operating pressure.
- C. Remote Mounting, Dial type Pressure Gauges: ASME B40.100, indicating-dial type.
1. Case: Dry type, cast aluminum, 4-1/2 inch diameter with holes for panel mounting.
 2. Pressure-Element Assembly: Bourdon tube, unless otherwise indicated.
 3. Pressure Connection: Brass, NPS 1/4 (DN 8), bottom-outlet type unless back-outlet type is indicated.
 4. Movement: Mechanical, with link to pressure element and connection to pointer.
 5. Dial: Satin-faced, non-reflective aluminum with permanently etched scale markings.
 6. Pointer: Red or other dark color metal.
 7. Window: Glass or plastic.
 8. Ring: Metal.
 9. Accuracy: Grade A, plus or minus 1 percent of middle half scale.
 10. Vacuum pressure Range: 30-in. Hg of vacuum to 15 psig of pressure.
 11. Range for Fluids under Pressure: Two times operating pressure.
- D. Pressure Gauge Fittings:
1. Valves: NPS 1/4 (DN 8) brass or stainless steel needle type.
 2. Snubbers: ASME B40.5, NPS 1/4 (DN 8) brass bushing with corrosion-resistant, porous-metal disc of material suitable for system fluid and working pressure.

2.6 TEST PLUGS

- A. Manufacturers - subject to compliance with requirements, provide products by one of the following:
 - 1. Flow Design, Inc.
 - 2. MG Piping Products Company
 - 3. National Meter, Inc.
 - 4. Peterson Equipment Company, Inc.
 - 5. Sisco Manufacturing Company
 - 6. Trerice, H. O. Company
 - 7. Watts Industries, Inc.; Water Products Division
- B. Description: Corrosion-resistant brass or stainless steel body with core inserts and gasketed and threaded cap, with extended stem for units to be installed in insulated piping.
- C. Minimum Pressure and Temperature Rating: 500 psig at 200°F.
- D. Core Inserts: One or two self-sealing rubber valves.
 - 1. Insert material for water service at 20° to 200°F shall be CR.
 - 2. Insert material for water service at -30° to +275°F shall be EPDM.
- E. Test Kit: Furnish one test kit containing one pressure gauge and adaptor, two thermometer(s), and carrying case. Pressure gauge, adapter probes, and thermometer sensing elements shall be of diameter to fit test plugs and of length to project into piping.
 - 1. Pressure Gauge: Small bourdon-tube insertion type with 2- to 3-inch diameter dial and probe. Dial range shall be 0 to 200 psig.
 - 2. Low Range Thermometer: Small bimetallic insertion type with 1- to 2-inch diameter dial and tapered-end sensing element. Dial ranges shall be 25° to 125°F.
High Range Thermometer: Small bimetallic insertion type with 1- to 2-inch diameter dial and tapered-end sensing element. Dial ranges shall be 0° to 220°F.
 - 3. Carrying case shall have formed instrument padding.

PART 3 - EXECUTION

3.1 THERMOMETER APPLICATIONS

- A. Install liquid-in-glass thermometers in the outlet of each domestic, hot water storage tank.
- B. Install liquid-filled-case-type, vapor actuated dial thermometers at suction and discharge of each pump.
- C. Provide the following temperature ranges for thermometers:
 - 1. Domestic Hot Water: 30° to 180°F, with 2-degree scale divisions.
 - 2. Domestic Cold Water: 0° to 100°F, with 2-degree scale divisions.

3.2 GAUGE APPLICATIONS

- A. Install dry case type pressure gauges for discharge of each pressure-reducing valve.
- B. Install dry case type pressure gauges at suction and discharge of each pump.

3.3 INSTALLATIONS

- A. Install direct mounting thermometers and adjust vertical and tilted positions.
- B. Install remote mounting dial thermometers on panel, with tubing connecting panel and thermometer bulb supported to prevent kinks. Use minimum tubing length.
- C. Install thermowells with socket extending a minimum of 2 inches into fluid or to center of pipe and in vertical position in piping tees where thermometers are indicated.
- D. Install direct mounting pressure gauges in piping tees with pressure gauge located on pipe at most readable position.
- E. Install remote mounting pressure gauges on panel.
- F. Install needle valve and snubber fitting in piping for each pressure gauge.
- G. Install test plugs in tees in piping.
- H. Install permanent indicators on walls or brackets in accessible and readable positions.
- I. Install connection fittings for attachment to portable indicators in accessible locations.
- J. Install thermometers and gauges adjacent to machines and equipment to allow service and maintenance for thermometers, gauges, machines, and equipment.
- K. Adjust faces of thermometers and gauges to proper angle for best visibility.

END OF SECTION 220519

SECTION 220523
GENERAL - DUTY VALVES 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 the following general-duty valves:
 - 1. Copper alloy ball valves.
 - 2. Ferrous alloy ball valves.
 - 3. Bronze check valves.
 - 4. Spring-loaded, lift disc check valves.
 - 5. Bronze gate valves.
 - 6. Cast iron gate valves.
- B. Products furnished for this project shall be "LEAD FREE" as required by Federal legislation passed on January 4, 2011. This entails the wetted surfaces of plumbing fixtures, equipment, valves, etc. described in this section to have a weighted-average lead content of no more than 0.25% when used in applications intended to convey or dispense water for human consumption through drinking or cooking.

1.3 DEFINITIONS

- A. The following are standard abbreviations for valves:
 - 1. CWP: Cold working pressure.
 - 2. EPDM: Ethylene-propylene-diene terpolymer rubber.
 - 3. NBR: Acrylonitrile-butadiene rubber.
 - 4. PTFE: Polytetrafluoroethylene plastic.
 - 5. TFE: Tetrafluoroethylene plastic.

1.4 SUBMITTALS

- A. Product Data: For each type of valve indicated. Include body, seating, and trim materials; valve design; pressure and temperature classifications; end connections; arrangement; dimensions; and required clearances. Include list indicating valve and its application. Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories.

1.5 QUALITY ASSURANCE

- A. ASME Compliance for Ferrous Valves: ASME B16.10 and ASME B16.34 for dimension and design criteria.

- B. NSF Compliance: NSF 61 for valve materials for potable-water service.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooves, and weld ends.
3. Set angle, gate, and globe valves closed to prevent rattling.
4. Set ball and plug valves open to minimize exposure of functional surfaces.
5. Set butterfly valves closed or slightly open.
6. Block check valves in either closed or open position.

- B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher than ambient dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use hand wheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 VALVES - GENERAL

- A. Refer to Part 3 "Valve Applications" article for applications of valves.
- B. Bronze Valves: NPS 2 (DN 50) and smaller with threaded ends, unless otherwise indicated.
- C. Ferrous Valves: NPS 2-1/2 (DN 65) and larger with flanged ends, unless otherwise indicated.
- D. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- E. Valve Sizes: Same as upstream pipe, unless otherwise indicated.
- F. Valves shall be of the "LEAD FREE" design.
- G. Valve Actuators:
 1. Hand wheel: For valves other than quarter-turn types.
 2. Lever Handle: For quarter-turn valves NPS 6 (DN 150) and smaller, except plug valves.
- H. Extended Valve Stems: On insulated valves.

- I. Valve Flanges: ASME B16.1 for cast iron valves, ASME B16.5 for steel valves, and ASME B16.24 for bronze valves.
- J. Valve Grooved Ends: AWWA C606.
 - 1. Solder Joint: With sockets according to ASME B16.18.
 - a. Caution: Use solder with melting point below 840°F for angle, check, gate, and globe valves below 421°F for ball valves.
 - 2. Threaded: With threads according to ASME B1.20.1.
- K. Valve Bypass and Drain Connections: MSS SP-45.

2.3 COPPER ALLOY BALL VALVES

- A. Manufacturers
 - 1. Two-Piece, Copper alloy Ball Valves:
 - a. Conbraco Industries, Inc.; Apollo Division
 - b. Crane Company; Crane Valve Group; Stockham Division
 - c. Grinnell Corporation
 - d. Hammond Valve
 - e. Milwaukee Valve Company
 - f. Nibco, Inc.
 - g. Watts Industries, Inc.; Water Products Division
- B. Copper alloy Ball Valves, General: MSS SP-110.
- C. Two-Piece, Copper alloy 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.

2.4 FERROUS ALLOY BALL VALVES

- A. Manufacturers
 - 1. Conbraco Industries, Inc.; Apollo Division
 - 2. Crane Company; Crane Valve Group; Stockham Division
 - 3. Hammond Valve
 - 4. Milwaukee Valve Company
 - 5. Nibco, Inc.
- B. Ferrous alloy Ball Valves, General: MSS SP-72, with flanged ends.
- C. Ferrous alloy Ball Valves: Class 150, full or regular port.
- D. Ferrous alloy Ball Valves: Class 300, full or regular port.

2.5 BRONZE CHECK VALVES

A. Manufacturers

1. Type 3, Bronze, Swing Check Valves with Metal Disc:
 - a. Cincinnati Valve Company
 - b. Crane Company; Crane Valve Group; Stockham Division
 - c. Grinnell Corporation
 - d. Hammond Valve
 - e. Milwaukee Valve Company
 - f. Nibco, Inc.
 - g. Watts Industries, Inc.; Water Products Division
2. Type 4, Bronze, Swing Check Valves with Nonmetallic Disc:
 - a. Cincinnati Valve Company
 - b. Crane Company; Crane Valve Group; Stockham Division
 - c. Grinnell Corporation
 - d. Hammond Valve
 - e. Milwaukee Valve Company
 - f. Nibco, Inc.
 - g. Watts Industries, Inc.; Water Products Division

B. Bronze Check Valves, General: MSS SP-80.

- C. Type 3, Class 125, Bronze, Swing Check Valves: Bronze body with bronze disc and seat.
- D. Type 3, Class 150, Bronze, Swing Check Valves: Bronze body with bronze disc and seat.
- E. Type 3, Class 200, Bronze, Swing Check Valves: Bronze body with bronze disc and seat.
- F. Type 4, Class 125, Bronze, Swing Check Valves: Bronze body with nonmetallic disc and bronze seat.
- G. Type 4, Class 150, Bronze, Swing Check Valves: Bronze body with nonmetallic disc and bronze seat.
- H. Type 4, Class 200, Bronze, Swing Check Valves: Bronze body with nonmetallic disc and bronze seat.

2.6 SPRING LOADED, LIFT DISC CHECK VALVES

A. Manufacturers

1. Type II, Compact Wafer, Lift disc Check Valves:
 - a. Grinnell Corporation
 - b. Hammond Valve
 - c. Milwaukee Valve Company
 - d. Mueller Steam Specialty
 - e. Nibco, Inc.

2. Type III, Globe Lift disc Check Valves:

- a. Grinnell Corporation
- b. Hammond Valve
- c. Milwaukee Valve Company
- d. Nibco, Inc.

3. Type IV, Threaded Lift disc Check Valves:

- a. Grinnell Corporation
- b. Milwaukee Valve Company
- c. Mueller Steam Specialty
- d. Nibco, Inc.
- e. Watts Industries, Inc.; Water Products Division

- B. Lift disc Check Valves, General: FCI 74-1, with spring-loaded bronze or alloy disc and bronze or alloy seat.
- C. Type II, Class 125, Compact-Wafer, Lift disc Check Valves: Compact-wafer style with cast iron shell with diameter made to fit within bolt circle.
- D. Type II, Class 250, Compact-Wafer, Lift disc Check Valves: Compact-wafer style with cast iron shell with diameter made to fit within bolt circle.
- E. Type III, Class 125, Globe Lift disc Check Valves: Globe style with cast iron shell and flanged ends.
- F. Type III, Class 250, Globe Lift disc Check Valves: Globe style with cast iron shell and flanged ends.
- G. Type IV, Class 125, Threaded Lift disc Check Valves: Threaded style with bronze shell and threaded ends.
- H. Type IV, Class 150, Threaded Lift disc Check Valves: Threaded style with bronze shell and threaded ends.

2.7 BRONZE GATE VALVES

A. Manufacturers

1. Type 1, Bronze, Non-rising Stem Gate Valves:

- a. Cincinnati Valve Company
- b. Crane Company; Crane Valve Group; Stockham Division
- c. Grinnell Corporation
- d. Hammond Valve
- e. Milwaukee Valve Company
- f. Nibco, Inc.
- g. Watts Industries, Inc.; Water Products Division

2. Type 2, Bronze, Rising Stem, Solid-Wedge Gate Valves:

- a. Cincinnati Valve Company
- b. Crane Company; Crane Valve Group; Stockham Division
- c. Grinnell Corporation
- d. Hammond Valve
- e. Milwaukee Valve Company
- f. Nibco, Inc.

B. Bronze Gate Valves, General: MSS SP-80, with ferrous alloy handwheel.

C. Type 1, Class 125, Bronze Gate Valves: Bronze body with non-rising stem and bronze solid wedge and union-ring bonnet.

D. Type 1, Class 150, Bronze Gate Valves: Bronze body with non-rising stem and bronze solid wedge and union-ring bonnet.

E. Type 1, Class 200, Bronze Gate Valves: Bronze body with non-rising stem and bronze solid wedge and union-ring bonnet.

F. Type 2, Class 125, Bronze Gate Valves: Bronze body with rising stem and bronze solid wedge and union-ring bonnet.

G. Type 2, Class 150, Bronze Gate Valves: Bronze body with rising stem and bronze solid wedge and union-ring bonnet.

H. Type 2, Class 200, Bronze Gate Valves: Bronze body with rising stem and bronze solid wedge and union-ring bonnet.

2.8 CAST IRON GATE VALVES

A. Manufacturers

1. Type I, Cast iron, non-rising stem Gate Valves:

- a. Cincinnati Valve Company
- b. Crane Company; Crane Valve Group; Stockham Division
- c. Grinnell Corporation.
- d. Hammond Valve.
- e. Milwaukee Valve Company.
- f. Nibco, Inc.
- g. Watts Industries, Inc.; Water Products Division

2. Type I, Cast iron, Rising-Stem Gate Valves:

- a. Cincinnati Valve Company
- b. Crane Company; Crane Valve Group; Stockham Division
- c. Grinnell Corporation.
- d. Hammond Valve.
- e. Milwaukee Valve Company.
- f. Nibco, Inc.
- g. Watts Industries, Inc.; Water Products Division

- B. Cast iron Gate Valves, General: MSS SP-70, Type I.
- C. Class 125, NRS, Bronze mounted, Cast iron Gate Valves: Cast iron body with bronze trim, non-rising stem, and solid-wedge disc.
- D. Class 125, OS&Y, Bronze mounted, Cast iron Gate Valves: Cast iron body with bronze trim, rising stem, and solid-wedge disc.
- E. Class 125, NRS, All-Iron, Cast iron Gate Valves: Cast iron body with cast iron trim, non-rising stem, and solid-wedge disc.
- F. Class 125, OS&Y, All-Iron, Cast iron Gate Valves: Cast iron body with cast iron trim, rising stem, and solid-wedge disc.
- G. Class 250, NRS, Bronze mounted, Cast iron Gate Valves: Cast iron body with bronze trim, non-rising stem, and solid-wedge disc.
- H. Class 250, OS&Y, Bronze mounted, Cast iron Gate Valves: Cast iron body with bronze trim, rising stem, and solid-wedge disc.
- I. Class 250, NRS, All-Iron, Cast iron Gate Valves: Cast iron body with cast iron trim, non-rising stem, and solid-wedge disc.
- J. Class 250, OS&Y, All-Iron, Cast iron Gate Valves: Cast iron body with cast iron trim, rising stem, and solid-wedge disc.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine piping system for compliance with requirements for installation tolerances and other conditions affecting performance.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.
- B. 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.
- C. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- D. Examine threads on valve and mating pipe for form and cleanliness.
- E. 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.
- F. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE APPLICATIONS

- A. Refer to piping Sections for specific valve applications. If valve applications are not indicated, use the following:
 - 1. Shutoff Service: Ball, butterfly, or gate valves.
 - 2. Throttling Service: Angle, ball, butterfly, or globe valves.
 - 3. Pump Discharge: Spring-loaded, lift disc check valves.
- B. If valves with specified CWP ratings are not available, the same types of valves with higher CWP ratings may be substituted.
- C. Domestic Water Piping - use the following types of valves with "LEAD FREE" design:
 - 1. Ball Valves, NPS 2 (DN 50) and Smaller: Two-piece, 600-psig CWP rating, copper alloy.
 - 2. Ball Valves, NPS 2-1/2 (DN 65) and Larger: Class 150, ferrous alloy.
 - 3. Swing Check Valves, NPS 2 (DN 50) and Smaller: Type 4, Class 125, bronze.
 - 4. Swing Check Valves, NPS 2-1/2 (DN 65) and Larger: Type II, Class 125, gray iron.
 - 5. Spring-Loaded, Lift disc Check Valves, NPS 2 (DN 50) and Smaller: Type IV, Class 125 minimum.
 - 6. Spring-Loaded, Lift disc Check Valves, NPS 2-1/2 (DN 65) and Larger: Type II or III, Class 125, cast iron.
 - 7. Gate Valves, NPS 2 (DN 50) and Smaller: Type 1 or 2, Class 200, bronze.
 - 8. Gate Valves, NPS 2-1/2 (DN 65) and Larger: Type I, Class 125, NRS bronze mounted cast iron.
- D. Sanitary Waste and Storm Drainage Piping - use the following types of valves:
 - 1. Ball Valves, NPS 2 (DN 50) and Smaller: Two-piece, 600-psig CWP rating, copper alloy.
 - 2. Ball Valves, NPS 2-1/2 (DN 65) and Larger: Class 150, ferrous alloy.
 - 3. Gate Valves, NPS 2 (DN 50) and Smaller: Type 1, Class 125, bronze.
 - 4. Gate Valves, NPS 2-1/2 (DN 65) and Larger: Type I, Class 125, NRS, bronze mounted cast iron.
- E. Select valves, except wafer and flangeless types, with the following end connections:
 - 1. For Copper Tubing, NPS 2 (DN 50) and Smaller: Solder-joint or threaded ends.
 - 2. For Copper Tubing, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flanged or threaded ends.
 - 3. For Copper Tubing, NPS 5 (DN 125) and Larger: Flanged ends.
 - 4. For Steel Piping, NPS 2 (DN 50) and Smaller: Threaded ends.
 - 5. For Steel Piping, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flanged or threaded ends.
 - 6. For Steel Piping, NPS 5 (DN 125) and Larger: Flanged ends.
 - 7. For Grooved-End, Steel Piping: Valve ends may be grooved.

3.3 VALVE INSTALLATION

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- C. Locate valves for easy access and provide separate support where necessary.

- D. Install valves in horizontal piping with stem at or above center of pipe.
- E. Install valves in position to allow full stem movement.
- F. Install check valves for proper direction of flow and as follows:
 - 1. Swing Check Valves: In horizontal position with hinge pin level.
 - 2. Dual Plate Check Valves: In horizontal or vertical position, between flanges.
 - 3. Lift Check Valves: With stem upright and plumb.

3.4 JOINT CONSTRUCTION

- A. Refer to Division 22 Section 220500 "Common Work Results for Plumbing" for basic piping joint construction.
- B. Grooved Joints: Assemble joints with keyed coupling housing, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions.
- C. Soldered Joints: Use ASTM B 813, water flushable, lead free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.

3.5 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

END OF SECTION 220523

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.

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.

1.5 SUBMITTALS

- A. Product data for the following:
 - 1. Steel pipe hangers and supports.
 - 2. Thermal hanger shield inserts.
 - 3. Powder actuated fastener systems.
 - 4. Pipe positioning systems.
- B. Welding certificates.

1.6 QUALITY ASSURANCED

A. 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. 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. ERICO/Michigan Hanger Company
5. Globe Pipe Hanger Products, Inc.
6. Grinnell Corporation
7. National Pipe Hanger Corporation
8. PHD Manufacturing, Inc.
9. PHS Industries, Inc.
10. Piping Technology & Products, Inc.

C. Galvanized, Metallic Coatings: Pre-galvanized or hot dipped.

D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

E. Padded Hangers: Hanger with 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 Division
 - 3. Power-Strut Division; Tyco International, Ltd.
 - 4. 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 THERMAL HANGER SHIELD INSERTS

- A. Description: 100-psig minimum, compressive-strength insulation insert encased in sheet metal shield.
- B. Manufacturers:
 - 1. ERICO/Michigan Hanger Company
 - 2. PHS Industries, Inc.
 - 3. Pipe Shields, Inc.
- C. Insulation Insert Material for Cold Piping: Water repellent treated, ASTM C 533, Type I calcium silicate with vapor barrier.
- D. Insulation Insert Material for Hot Piping: Water repellent treated, ASTM C 533, Type I calcium silicate.
- E. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- F. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- G. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.6 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. 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. Hilti, Inc.
- c. ITW Ramset/Red Head
- d. Powers Fasteners

2.7 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 Company
- b. MIRO Industries.

- C. Low type, Single-Pipe Stand: One-piece plastic 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 Company
- b. MIRO Industries
- c. Portable Pipe Hangers

2. Base: Plastic or 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.

2.8 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. Corporation
 2. HOLDRITE Corp.; Hubbard Enterprises
 3. Samco Stamping, Inc.

2.9 EQUIPMENT SUPPORTS

- A. Description: Welded, shop or field fabricated equipment support made from structural steel shapes.

2.10 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, non-shrink and nonmetallic grout; suitable for interior and exterior applications.
1. Properties: Non-staining, noncorrosive, and nongaseous.
 2. Design Mix: 5000-psi, 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 non-insulated or insulated stationary pipes, NPS 1/2 to NPS 30 (DN 15 to DN 750).
 - 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of 120° to 450°F pipes, NPS 4 to NPS 16 (DN 100 to DN 400), requiring up to 4 inches of insulation.
 - 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to NPS 24 (DN 20 to DN 600), requiring clamp flexibility and up to 4 inches of insulation.
 - 4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes, NPS 1/2 to NPS 24 (DN 15 to DN 600), if little or no insulation is required.
 - 5. Pipe Hangers (MSS Type 5): For suspension of pipes, NPS 1/2 to NPS 4 (DN 15 to DN 100), to allow off-center closure for hanger installation before pipe erection.
 - 6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of non-insulated stationary pipes, NPS 3/4 to NPS 8 (DN 20 to DN 200).
 - 7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of non-insulated stationary pipes, NPS 1/2 to NPS 8 (DN 15 to DN 200).
 - 8. Adjustable Band Hangers (MSS Type 9): For suspension of non-insulated stationary pipes, NPS 1/2 to NPS 8 (DN 15 to DN 200).
 - 9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of non-insulated stationary pipes, NPS 1/2 to NPS 2 (DN 15 to DN 50).
 - 10. Split Pipe-Ring with or without Turnbuckle-Adjustment Hangers (MSS Type 11): For suspension of non-insulated stationary pipes, NPS 3/8 to NPS 8 (DN 10 to DN 200).
 - 11. Extension Hinged or 2-Bolt Split Pipe Clamps (MSS Type 12): For suspension of non-insulated stationary pipes, NPS 3/8 to NPS 3 (DN 10 to DN 80).
 - 12. U-Bolts (MSS Type 24): For support of heavy pipes, NPS 1/2 to NPS 30 (DN 15 to DN 750).
 - 13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
 - 14. Pipe Saddle Supports (MSS Type 36): For support of pipes, NPS 4 to NPS 36 (DN 100 to DN 900), with steel pipe base stanchion support and cast iron floor flange.
 - 15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes, NPS 4 to NPS 36 (DN 100 to DN 900), with steel pipe base stanchion support and cast iron floor flange and with U-bolt to retain pipe.
 - 16. Adjustable, Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes, NPS 2-1/2 to NPS 36 (DN 65 to DN 900), if vertical adjustment is required, with steel pipe base stanchion support and cast iron floor flange.
 - 17. Single Pipe Rolls (MSS Type 41): For suspension of pipes, NPS 1 to NPS 30 (DN 25 to DN 750), from 2 rods if longitudinal movement caused by expansion and contraction might occur.
 - 18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes, NPS 2-1/2 to NPS 20 (DN 65 to DN 500), from single rod if horizontal movement caused by expansion and contraction might occur.
 - 19. Complete Pipe Rolls (MSS Type 44): For support of pipes, NPS 2 to NPS 42 (DN 50 to DN 1050), if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
 - 20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes, NPS 2 to NPS 24 (DN 50 to DN 600), if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.

21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes, NPS 2 to NPS 30 (DN 50 to DN 750), if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.
- 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 (DN 20 to DN 500).
 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20 (DN 20 to DN 500), 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°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°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. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field assembled metal framing systems.
- D. Thermal hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- E. 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.
- F. 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.
- G. Pipe Positioning System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture. Refer to Division 22 Section 224000 "Plumbing Fixtures" for plumbing fixtures.
- H. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- I. Equipment Support Installation: Fabricate from welded structural steel shapes.
- J. 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.
- K. Install lateral bracing with pipe hangers and supports to prevent swaying.
- L. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 (DN 65) and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- M. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

- N. 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.
- O. 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 (DN 100) 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 (DN 100) 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 (DN 8 to DN 90): 12 inches long and 0.048 inch thick.
 - b. NPS 4 (DN 100): 12 inches long and 0.06 inch thick.
 - c. NPS 5 and NPS 6 (DN 125 and DN 150): 18 inches long and 0.06 inch thick.
 - d. NPS 8 to NPS 14 (DN 200 to DN 350): 24 inches long and 0.075 inch thick.
 - e. NPS 16 to NPS 24 (DN 400 to DN 600): 24 inches long and 0.105 inch thick.
 - 5. Pipes NPS 8 (DN 200) 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 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. Valve tags
 - 5. 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 pre-drilled 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, 1/8 inch thick, and having predrilled holes for attachment hardware.
2. Letter Color: Black.
3. Background Color: Black or White.
4. Maximum Temperature: Able to withstand temperatures up to 160°F.
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
6. 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.
7. Fasteners: Stainless steel rivets or self-tapping screws.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

C. Label Content: Include equipment's Drawing designation or unique equipment number, drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.

D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2 x 11-inch (A4) bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.

B. Letter Color: Black.

C. Background Color: Yellow.

- D. Maximum Temperature: Able to withstand temperatures up to 160°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, 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. Pre-tensioned Pipe Labels: Pre-coiled, semi-rigid 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 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, 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. Fasteners: Brass wire-link or beaded chain; or S-hook.
- B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch (A4) bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
 - 1. Valve tag schedule shall be included in operation and maintenance data.

2.5 WARNING TAGS

- A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
 - 1. Size: Approximately 4 by 7 inches.
 - 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 surface 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. Piping Color Coding: Painting of piping is specified in Division 09 Section "Interior Painting."
- B. 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 25 feet along each run. Reduce intervals to 10 feet in areas of congested piping and equipment.
 - 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
- C. Pipe Label Color Schedule
 - 1. Cold Water Piping:
 - a. Background Color: Green.
 - b. Letter Color: White.

2. Hot Water Supply Piping:
 - a. Background Color: Yellow.
 - b. Letter Color: Black.
3. Storm Drainage Piping:
 - a. Background Color: Green.
 - b. Letter Color: White.
4. Sanitary Waste 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 round.
 - b. Hot Water: 2 inches round.
 2. Valve Tag Color:
 - a. Cold Water: Green.
 - 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. Insulating cements.
 - 3. Adhesives.
 - 4. Lagging adhesives.
 - 5. Sealants.
 - 6. Factory applied jackets.
 - 7. Tapes.
 - 8. Securements.
 - 9. Corner angles.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, thickness, and jackets.
- B. Qualification Data: For qualified Installer.
- C. Field quality control reports.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. 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 220529 "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, Preformed Pipe Insulation

1. Products - subject to compliance with requirements, provide one of the following:
 - a. Fibrex Insulations Inc.; Coreplus 1200.
 - b. Johns Manville; Micro-Lok.
 - c. Knauf Insulation; 1000(Pipe Insulation.
 - d. Manson Insulation Inc.; Alley-K.
2. Type I, 850°F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory applied ASJ. Factory applied jacket requirements are specified in "Factory Applied Jackets" Article.

- G. Mineral Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semi-rigid board material with factory applied ASJ complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 2.5 lb/cu. ft. or more. Thermal conductivity (k-value) at 100°F is 0.29 Btu x in./h x sq. ft. x degree F (0.042 W/m x K) or less. Factory applied jacket requirements are specified in "Factory Applied Jackets" Article.

1. Products - subject to compliance with requirements, provide one of the following:
 - a. CertainTeed Corp.; CrimpWrap.
 - b. Johns Manville; MicroFlex.
 - c. Knauf Insulation; Pipe and Tank Insulation.
 - d. Manson Insulation Inc.; AK Flex.
 - e. Owens Corning; Fiberglas Pipe and Tank Insulation.

2.2 INSULATING CEMENTS

- A. Mineral Fiber Insulating Cement: Comply with ASTM C 195.

1. Products - subject to compliance with requirements, provide one of the following:
 - a. Insulco, Division of MFS, Inc.; Triple I.
 - b. P. K. Insulation Mfg. Co., Inc.; Super-Stik.

- B. Mineral fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.

1. Products - subject to compliance with requirements, provide one of the following:
 - a. Insulco, Division of MFS, Inc.; SmoothKote.
 - b. P. K. Insulation Mfg. Co., Inc.; PK No. 127, and Quik-Cote.
 - c. Rock Wool Manufacturing Company; Delta One Shot.

2.3 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.
- B. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.
 - 1. Products - subject to compliance with requirements, provide one of the following:
 - a. Aeroflex USA Inc.; Aeroseal.
 - b. Armacell LCC; 520 Adhesive.
 - c. Foster Products Corporation, H. B. Fuller Company; 85-75.
 - d. RBX Corporation; Rubatex Contact Adhesive.
- C. Mineral fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
 - 1. Products - subject to compliance with requirements, provide one of the following:
 - a. Childers 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.
- D. PVC Jacket Adhesive: Compatible with PVC jacket.
 - 1. Products - subject to compliance with requirements, provide one of the following:
 - a. Dow Chemical Company (The); 739, Dow Silicone.
 - b. Johns-Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
 - c. P.I.C. Plastics, Inc.; Welding Adhesive.
 - d. Red Devil, Inc.; Celulon Ultra Clear.
 - e. Speedline Corporation; Speedline Vinyl Adhesive.

2.4 LAGGING ADHESIVES

- A. Description: Comply with MIL-A-3316C Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.
 - 1. Products - subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-52.
 - b. Foster Products Corporation, H. B. Fuller Company; 81-42.
 - c. Marathon Industries, Inc.; 130.
 - d. Mon-Eco Industries, Inc.; 11-30.
 - e. Vimasco Corporation; 136.
 - 2. Fire-resistant, water based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over equipment and pipe insulation.
 - 3. Service Temperature Range: Minus 50° to plus 180°F.
 - 4. Color: White.

2.5 SEALANTS

A. Metal Jacket Flashing Sealants

1. Products - subject to compliance with requirements, provide one of 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°F.
5. Color: Aluminum.

B. PVC Jacket Flashing Sealants

1. Products - subject to compliance with requirements, provide one of 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°F.
5. Color: White.

2.6 FACTORY APPLIED JACKETS

A. Insulation system schedules indicate factory applied jackets on various applications. When factory applied jackets are indicated, comply with the following:

1. ASJ: White, Kraft paper, fiberglass reinforced scrim with aluminum foil backing; complying with ASTM C 1136, Type I.
2. FSK Jacket: Aluminum foil, fiberglass reinforced scrim with Kraft paper backing; complying with ASTM C 1136, Type II.

2.7 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Products - subject to compliance with requirements, provide one of the following:
 - a. 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.

2.8 SECUREMENTS

A. Bands

1. Products - subject to compliance with requirements, provide one of the following:
 - a. Childers Products; Bands.
 - b. PABCO Metals Corporation; Bands.
 - c. RPR Products, Inc.; Bands.
2. Aluminum: ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing seal.
3. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

B. Insulation Pins and Hangers

1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
 - a. Products - subject to compliance with requirements, provide one of the following:
 - 1) AGM Industries, Inc.; CWP-1.
 - 2) GEMCO; Cupped Head Weld Pin.
 - 3) Midwest Fasteners, Inc.; Cupped Head.
 - 4) Nelson Stud Welding; CHP.
2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch thick, aluminum sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
 - a. Products - subject to compliance with requirements, provide one of the following:
 - 1) AGM Industries, Inc.; RC-150.
 - 2) GEMCO; R-150.
 - 3) Midwest Fasteners, Inc.; WA-150.
 - 4) Nelson Stud Welding; Speed Clips.
 - b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.

C. Staples: Outward-clinching insulation staples, nominal 3/4-inch wide, stainless steel or Monel.

D. Wire: 0.062-inch soft-annealed, stainless steel.

1. Manufacturers - subject to compliance with requirements, provide products by one of the following:
 - a. C & F Wire
 - b. Childers Products
 - c. PABCO Metals Corporation
 - d. RPR Products, Inc.

2.9 CORNER ANGLES

- A. PVC Corner Angles: 30 mils thick, minimum 1 by 1 inch, PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.

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. 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 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.
7. Gas Piping.

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 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" 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 100 percent coverage of tank and vessel surfaces.
 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 over compress 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 pre-stressed 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 pre-stressed 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.
- B. Insulation Installation on Pumps
1. Fabricate metal boxes lined with insulation. Fit boxes around pumps and coincide box joints with splits in pump casings. Fabricate joints with outward bolted flanges. Bolt flanges on 6-inch centers, starting at corners. Install 3/8-inch diameter fasteners with wing nuts. Alternatively, secure the box sections together using a latching mechanism.
 2. Fabricate boxes from aluminum, at least 0.050 inch thick.

3. For below ambient services, install a vapor barrier at seams, joints, and penetrations. Seal between flanges with replaceable gasket material to form a vapor barrier.

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. For services not specified to receive a field applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
 9. 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 gauges, 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 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.
 5. Unless a PVC jacket is indicated in field applied jacket schedules, finish exposed surfaces with a metal jacket.

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 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 FINISHES

- A. Equipment and Pipe Insulation with Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 09 painting Sections.
1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
 - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless steel jackets.

3.9 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 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 PIPING INSULATION SCHEDULE - GENERAL

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
- B. 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.

3.11 INDOOR PIPING INSULATION SCHEDULE

- A. Domestic Cold Water
 - 1. NPS 1-1/4 (DN 32) and Smaller: Insulation shall be the following:
 - a. Mineral fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.
 - 2. NPS 1-1/2 (DN 40) and Larger: Insulation shall be the following:
 - a. Mineral fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
- B. Domestic Hot and Recirculated Hot Water
 - 1. NPS 1-1/4 (DN 32) and Smaller: Insulation shall be the following:
 - a. Mineral fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
 - 2. NPS 1-1/2 (DN 40) and Larger: Insulation shall be the following:
 - a. Mineral fiber, Preformed Pipe Insulation, Type I: 1-1/2 inch thick.
- C. Storm water
 - 1. All Pipe Sizes - insulation shall be the following:
 - a. Mineral fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
- D. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities:
 - 1. All Pipe Sizes - insulation shall be the following:
 - a. Mineral fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

3.12 OUTDOOR, UNDERGROUND PIPING INSULATION SCHEDULE

- A. Loose-fill insulation, for belowground piping, is specified in Division 33 piping distribution Sections.

Division 22 - Plumbing
Section 220700 - Plumbing Insulation

- B. Sanitary Waste Piping, All Sizes, Where Heat Tracing Is Installed: Cellular glass, 2 inches thick.

END OF SECTION 220700

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. This Section includes domestic water piping inside the building.
- B. Related Sections include the following:
 - 1. Division 22 Section 221119 "Domestic Water Piping Specialties" for water distribution piping specialties.

1.3 PERFORMANCE REQUIREMENTS

- A. Provide components and installation capable of producing domestic water piping systems with 125 psig unless otherwise indicated.

1.4 SUBMITTALS

- A. Product Data: For pipe, tube, fittings, and couplings.
- B. Water Samples: Specified in Part 3 "Cleaning" article.
- C. Field quality control test reports.

1.5 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 14, "Plastics Piping System Components and Related Materials," for plastic, potable domestic water piping and components. Include marking "NSF-pw" on piping.
- C. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9," for potable domestic water piping and components.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

2.2 PIPING MATERIALS

- A. Refer to Part 3 "Pipe and Fitting Applications" article for applications of pipe, tube, fitting, and joining materials.
- B. Transition Couplings for Aboveground Pressure Piping: Coupling or other manufactured fitting the same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.

2.3 COPPER TUBE AND FITTINGS

- A. Soft Copper Tube: ASTM B 88, Types K and L (ASTM B 88M, Types A and B), water tube, annealed temper.
 - 1. Copper Pressure Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
 - 2. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends. Furnish Class 300 flanges if required to match piping.
 - 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.

2.4 VALVES

- A. Bronze and cast iron, general duty valves are specified in Division 22 Section 220523 "General-Duty Valves for Plumbing Piping."
- B. Balancing and drain valves are specified in Division 22 Section 221119 "Domestic Water Piping Specialties."
- C. Valves shall be of the "LEAD FREE" design.

PART 3 - EXECUTION

3.1 EXCAVATION

- A. Excavating, trenching, and backfilling are specified in Division 31 Section "Earth Moving."

3.2 PIPE AND FITTING APPLICATIONS

- 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 may be used on aboveground piping, unless otherwise indicated.
- C. Grooved joints may be used on aboveground grooved-end piping.
- D. Domestic Water Piping on Service Side of Water Meter inside the Building - use the following piping materials for each size range:
 - 1. NPS 4 to NPS 6 (DN 100 to DN 150): Hard copper tube, Type L (Type B); copper pressure fittings; and soldered joints.
- E. Under-Building-Slab, Domestic Water Piping on House Side of Water Meter, NPS 4 (DN 100) and Smaller: Soft copper tube, Type L (Type B); copper pressure fittings; and soldered joints.
- F. Aboveground Domestic Water Piping - use any of the following piping materials for each size range:
 - 1. NPS 1 (DN 25) and Smaller: Hard copper tube, Type L (Type B); copper pressure fittings; and soldered joints.
 - 2. NPS 1-1/4 and NPS 1-1/2 (DN 32 and DN 40): Hard copper tube, Type L (Type B); copper pressure fittings; and soldered joints.
 - 3. NPS 2 (DN 50): Hard copper tube, Type L (Type B); copper pressure fittings; and soldered joints.
 - 4. NPS 2 (DN 50): Hard copper tube, Type L (Type B) with grooved ends; copper grooved-end fittings; grooved-end-tube couplings; and grooved joints.
 - 5. NPS 2-1/2 to NPS 3-1/2 (DN 65 to DN 90): Hard copper tube, Type L (Type B); copper pressure fittings; and soldered joints.
 - 6. NPS 2-1/2 to NPS 3-1/2 (DN 65 to DN 90): Hard copper tube, Type L (Type B) with grooved ends; copper grooved-end fittings; grooved-end-tube couplings; and grooved joints.
 - 7. NPS 4 to NPS 6 (DN 100 to DN 150): Hard copper tube, Type L (Type B); copper pressure fittings; and soldered joints.

3.3 VALVE APPLICATIONS

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
 - 1. Shutoff Duty: Use bronze ball or gate valves for piping NPS 2 (DN 50) and smaller. Use cast iron butterfly or gate valves with flanged ends for piping NPS 2-1/2 (DN 65) and larger.
 - 2. Throttling Duty: Use bronze ball or globe valves for piping NPS 2 (DN 50) and smaller. Use cast iron butterfly valves with flanged ends for piping NPS 2-1/2 (DN 65) and larger.
 - 3. Hot Water Piping, Balancing Duty: Calibrated or Memory-stop balancing valves.
 - 4. Drain Duty: Hose end drain valves.
- B. Cast iron, grooved end valves may be used with grooved-end piping.

- C. Install shutoff valve close to water main on each branch and riser serving plumbing fixtures or equipment, on each water supply to equipment, and on each water supply to plumbing fixtures that do not have supply stops. Use ball or gate valves for piping NPS 2 (DN 50) and smaller. Use butterfly or gate valves for piping NPS 2-1/2 (DN 65) and larger.
- D. Install drain valves for equipment at base of each water riser, at low points in horizontal piping, and where required to drain water piping.
 - 1. Install hose end drain valves at low points in water mains, risers, and branches.
 - 2. Install stop and waste drain valves where indicated.
- E. Valves shall be of the "LEAD FREE" design.

3.4 PIPING INSTALLATION

- A. Basic piping installation requirements are specified in Division 22 Section 220500 "Common Work Results for Plumbing."
- B. Install under-building-slab copper tubing according to CDA's "Copper Tube Handbook."
- C. 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 220500 "Common Work Results for Plumbing."
- D. Install wall penetration system at each service pipe penetration through foundation wall. Make installation watertight. Wall penetration systems are specified in Division 22 Section 220500 "Common Work Results for Plumbing."
- E. Install shutoff valve, hose end drain valve, strainer, pressure gauge, and test tee with valve, inside the building at each domestic water service entrance. Pressure gauges are specified in Division 22 Section 220519 "Meters and Gauges for Plumbing Piping," and drain valves and strainers are specified in Division 22 Section 221119 "Domestic Water Piping Specialties."
- F. Install water-pressure regulators downstream from shutoff valves. Water-pressure regulators are specified in Division 22 Section 221119 "Domestic Water Piping Specialties."
- G. Install domestic water piping level with 0.25 percent slope downward toward drain and plumb.
- H. Install ductile-iron, water service piping according to AWWA C600 and AWWA M41.
 - 1. Install PE corrosion protection encasement according to ASTM A 674 or AWWA C105.

3.5 JOINT CONSTRUCTION

- A. Basic piping joint construction requirements are specified in Division 22 Section 220500 "Common Work Results for Plumbing."
- B. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.
- C. Grooved Joints: Assemble joints with grooved-end-pipe or grooved-end-tube coupling housing, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions.

3.6 HANGER AND SUPPORT INSTALLATION

- A. Pipe hanger and support devices are specified in Division 22 Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
- B. 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: MSS Type 49, spring cushion rolls, if indicated.
 - 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 220529 "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 one size for double-rod hangers, to a minimum of 3/8 inch.
- F. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/4 (DN 32) and Smaller: 84 inches with 3/8-inch rod.
 - 2. NPS 1-1/2 (DN 40): 108 inches with 3/8-inch rod.
 - 3. NPS 2 (DN 50): 10 feet with 3/8-inch rod.
 - 4. NPS 2-1/2 (DN 65): 11 feet with 1/2-inch rod.
 - 5. NPS 3 and NPS 3-1/2 (DN 80 and DN 90): 12 feet with 1/2-inch rod.
 - 6. NPS 4 and NPS 5 (DN 100 and DN 125): 12 feet with 5/8-inch rod.
 - 7. NPS 6 (DN 150): 12 feet with 3/4-inch rod.
 - 8. NPS 8 to NPS 12 (DN 200 to DN 300): 12 feet with 7/8-inch rod.
- G. Install supports for vertical steel piping every 15 feet.
- H. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 3/4 (DN 20) and smaller: 60 inches with 3/8-inch rod.
 - 2. NPS 1 and NPS 1-1/4 (DN 25 and DN 32): 72 inches with 3/8-inch rod.
 - 3. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 96 inches with 3/8-inch rod.
 - 4. NPS 2-1/2 (DN 65): 108 inches with 1/2-inch rod.
 - 5. NPS 3 to NPS 5 (DN 80 to DN 125): 10 feet with 1/2-inch rod.
 - 6. NPS 6 (DN 150): 10 feet with 5/8-inch rod.
 - 7. NPS 8 (DN 200): 10 feet with 3/4-inch rod.
- I. Install supports for vertical copper tubing every 10 feet.

3.7 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, and extend and connect to the following:
 - 1. Plumbing Fixtures: Cold and hot water supply piping in sizes indicated, but not smaller than required by plumbing code. Refer to Division 22 Section 224000 "Plumbing Fixtures."
 - 2. Equipment: Cold and hot water supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 (DN 65) and larger.

3.8 FIELD QUALITY CONTROL

- A. Inspect domestic water piping as follows:
 - 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 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
 - a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in 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. Re-inspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for re-inspection.
 - 4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- B. Test domestic water piping as follows:
 - 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 separate report for each test, complete with diagram of portion of piping tested.
 - 3. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 - 4. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.

5. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
6. Prepare reports for tests and required corrective action.

3.9 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 plugs used 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.

3.10 CLEANING

A. Clean and disinfect potable and non-potable domestic water piping as follows:

1. Purge new piping and parts of existing domestic water piping that have been altered, extended, or repaired before using.
2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction or, if methods are not prescribed, procedures described in either AWWA C651 or AWWA C652 or as described below:
 - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - b. Fill and isolate system according to either of the following:
 - 1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
 - 2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.
 - c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
 - d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

B. Prepare and submit reports of purging and disinfecting activities.

C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

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. Water pressure reducing valves.
 - 4. Temperature actuated water mixing valves.
 - 5. Strainers.
 - 6. Hose bibbs.
 - 7. Wall hydrants.
 - 8. Drain valves.
 - 9. Water hammer arresters.
 - 10. Trap seal primer valves.
- B. Products furnished for this project shall be "LEAD FREE" as required by Federal legislation passed on January 4, 2011. This entails the wetted surfaces of plumbing fixtures, equipment, valves, etc. described in this section to have a weighted-average lead content of no more than 0.25% when used in applications intended to convey or dispense water for human consumption through drinking or cooking.
- C. Related Sections include the following:
 - 1. Division 22 Section 220519 "Meters and Gauges for Plumbing Piping" for thermometers, pressure gauges, and flow meters in domestic water piping.
 - 2. Division 22 Section 221116 "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. Manufacturers - subject to compliance with requirements, provide products by one of the following:
 - a. Ames Company
 - b. Conbraco Industries, Inc.
 - c. Watts Industries, Inc.; Water Products Division
 - d. Zurn Plumbing Products Group; Wilkins Division
 - 2. Standard: ASSE 1001.
 - 3. Size: NPS 1/4 to NPS 3 (DN 8 to DN 80), 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. Manufacturers - subject to compliance with requirements, provide products by one of the following:
 - a. Conbraco Industries, Inc.
 - b. Legend Valve
 - c. Watts Industries, Inc.; Water Products Division
 - d. Woodford Manufacturing Company
 - e. Zurn Plumbing Products Group; Light Commercial Operation
 - f. Zurn Plumbing Products Group; Wilkins Division
 - 2. Standard: ASSE 1011.
 - 3. Body: Bronze, non-removable, with manual drain.
 - 4. Outlet Connection: Garden hose threaded complying with ASME B1.20.7.
 - 5. Finish: Chrome or nickel-plated.

2.2 BACKFLOW PREVENTERS

A. Reduced Pressure Zone Backflow Preventers

1. Manufacturers - subject to compliance with requirements, provide products by one of the following:
 - a. Ames Company
 - b. Conbraco Industries, Inc.
 - c. Watts Industries, Inc.; Water Products Division
 - d. Zurn Plumbing Products Group; Wilkins Division
2. Standard: ASSE 1013.
3. Product shall be of the "LEAD FREE" design.
4. Operation: Continuous pressure applications.
5. Pressure Loss: 12 psig maximum, through middle 1/3 of flow range.
6. Size: 2"
7. Design Flow Rate: 50 gpm
8. Pressure Loss at Design Flow Rate: 10 psig for sizes NPS 2 (DN 50) and smaller;
9. Body: Bronze for NPS 2 (DN 50) and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 (DN 65) and larger.
10. End Connections: Threaded for NPS 2 (DN 50) and smaller flanged for NPS 2-1/2 (DN 65) and larger.
11. Configuration: Designed for horizontal, straight through flow.
12. Accessories:
 - a. Valves: Ball type with threaded ends on inlet and outlet of NPS 2 (DN 50) and smaller; outside screw and yoke gate-type with flanged ends on inlet and outlet of NPS 2-1/2 (DN 65) and larger.
 - b. Air Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.

B. Hose Connection Backflow Preventers

1. Manufacturers - subject to compliance with requirements, provide products by one of the following:
 - a. Conbraco Industries, Inc.
 - b. Watts Industries, Inc.; Water Products Division
 - c. Woodford Manufacturing Company.
2. Standard: ASSE 1052.
3. Product shall be of the "LEAD FREE" design.
4. Operation: Up to 10-foot head of water back pressure.
5. Inlet Size: NPS 1/2 or NPS 3/4 (DN 15 or DN 20).
6. Outlet Size: Garden hose thread complying with ASME B1.20.7.
7. Capacity: At least 3-gpm flow.

C. Backflow Preventer Test Kits

1. Manufacturers - subject to compliance with requirements, provide products by one of the following:
 - a. Conbraco Industries, Inc.
 - b. Watts Industries, Inc.; Water Products Division
 - c. Zurn Plumbing Products Group; Wilkins Division

2. Description: Factory calibrated, with gauges, fittings, hoses, and carrying case with test-procedure instructions.

2.3 WATER PRESSURE REDUCING VALVES

A. Water Regulators

1. Manufacturers - subject to compliance with requirements, provide products by one of the following:
 - a. Conbraco Industries, Inc.
 - b. Watts Industries, Inc.; Water Products Division
 - c. Zurn Plumbing Products Group; Wilkins Division
2. Standard: ASSE 1003.
3. Product shall be of the "LEAD FREE" design.
4. Pressure Rating: Initial working pressure of 150 psig.
5. Size: 2"
6. Design Flow Rate: 50 gpm
7. Design Inlet Pressure: 75 psig
8. Design Outlet Pressure Setting: 65 psig
9. Body: Bronze with chrome plated finish for NPS 2 (DN 50) and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 and NPS 3 (DN 65 and DN 80).
10. Valves for Booster Heater Water Supply: Include integral bypass.
11. End Connections: Threaded for NPS 2 (DN 50) and smaller; flanged for NPS 2-1/2 and NPS 3 (DN 65 and DN 80).

B. Individual Fixture, Water Tempering Valves (To be provided under all lavatories and sinks):

1. Manufacturers - subject to compliance with requirements, provide products by one of the following:
 - a. Conbraco Industries, Inc.
 - b. Lawler Manufacturing Company, Inc.
 - c. Leonard Valve Company
 - d. Powers; a Watts Industries Company
 - e. Watts Industries, Inc.; Water Products Division
 - f. Zurn Plumbing Products Group; Wilkins Division
2. Standard: ASSE 1070, thermostatically controlled water tempering valve.
3. Product shall be of the "LEAD FREE" design.
4. Pressure Rating: 125 psig minimum, unless otherwise indicated.
5. Body: Brass body with corrosion-resistant interior components.
6. Temperature Control: Adjustable.
7. Inlets and Outlet: Threaded.
8. Finish: Rough or chrome plated bronze.
9. Model 7-210-CK "Maxline" manufactured by Symmons.

2.4 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers

1. Pressure Rating: 125 psig minimum, unless otherwise indicated.
2. Body: Bronze for NPS 2 (DN 50) and smaller; cast iron with interior lining complying with AWWA C550 or FDA-approved, epoxy coating and for NPS 2-1/2 (DN 65) and larger.
3. Product shall be of the "LEAD FREE" design.
4. End Connections: Threaded for NPS 2 (DN 50) and smaller flanged for NPS 2-1/2 (DN 65) and larger.
5. Screen: Stainless steel with round perforations, unless otherwise indicated.
6. Drain: Factory installed; hose end drain valve.

2.5 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 1/2 or NPS 3/4 (DN 15 or DN 20) 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, non-removable, 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.

2.6 WALL HYDRANTS

A. Non-freeze Wall Hydrants

1. 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. Tyler Pipe; Wade Division
 - d. Watts Drainage Products Inc.
 - e. Woodford Manufacturing Company.
 - f. Zurn Plumbing Products Group; Light Commercial Operation.
 - g. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.21.3M for concealed-outlet, self-draining wall hydrants.
3. Pressure Rating: 125 psig.
4. Operation: Loose key.

5. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
6. Inlet: NPS 3/4 or NPS 1 (DN 20 or DN 25).
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): Two with each wall hydrant.

2.7 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 (DN 20).
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 (DN 20).
4. Body: ASTM B 62 bronze.
5. Inlet: NPS 3/4 (DN 20) 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 (DN 20).
4. Body: Copper alloy or ASTM B 62 bronze.
5. Drain: NPS 1/8 (DN 6) side outlet with cap.

2.8 WATER HAMMER ARRESTERS

A. Water Hammer Arresters

1. Manufacturers - subject to compliance with requirements, provide products by one of the following:
 - a. AMTROL, Inc.
 - b. Josam Company

- c. PPP Inc.
 - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - e. Tyler Pipe; Wade Division
 - f. Watts Drainage Products Inc.
 - g. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASSE 1010 or PDI-WH 201.
 3. Type: Copper tube with piston.
 4. Size: ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.

2.9 AIR VENTS

A. Bolted Construction Automatic Air Vents

1. Body: Bronze.
2. Pressure Rating: 125-psig minimum pressure rating at 140°F.
3. Float: Replaceable, corrosion-resistant metal.
4. Mechanism and Seat: Stainless steel.
5. Size: NPS 3/8 (DN 10) 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 (DN 10) minimum inlet.
6. Inlet and Vent Outlet End Connections: Threaded.

2.10 TRAP SEAL PRIMER VALVES

A. Supply Type, Trap Seal Primer Valves

1. Manufacturers - subject to compliance with requirements, provide products by one of the following:
 - a. PPP Inc.
 - b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - c. Watts Industries, Inc.; Water Products Division
2. Standard: ASSE 1018.
3. Pressure Rating: 125 psig minimum.
4. Body: Bronze.
5. Inlet and Outlet Connections: NPS 1/2 (DN 15) threaded, union, or solder joint.
6. Gravity Drain Outlet Connection: NPS 1/2 (DN 15) threaded or solder joint.
7. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Refer to Division 22 Section 220500 "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 brakes 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 and bypass with memory-stop balancing valve. Install pressure gauges on inlet and outlet.
- D. Install water control valves with inlet and outlet shutoff valves and bypass with globe valve. Install pressure gauges on inlet and outlet.
- E. Install temperature-actuated water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.
 - 1. Install thermometers and water regulators if specified.
 - 2. Install cabinet-type units recessed in or surface mounted on wall as specified.
- F. Install Y-pattern strainers for water on supply side of each control valve, water pressure-reducing valve, solenoid valve, and pump.
- G. Install outlet boxes recessed in wall. Install 2-by-4-inch fire-retardant-treated-wood blocking wall reinforcement between studs. Fire retardant treated wood blocking is specified in Division 06 Section "Rough Carpentry."
- H. Install hose stations with check stops or shutoff valves on inlets and with thermometer on outlet.
 - 1. Install shutoff valve on outlet if specified.
 - 2. Install cabinet-type units recessed in or surface mounted on wall as specified. Install 2-by-4-inch fire-retardant-treated-wood blocking wall reinforcement between studs. Fire-retardant-treated-wood blocking is specified in Division 06 Section "Rough Carpentry."
- I. Install water hammer arresters in water piping according to PDI-WH 201.
- J. Install air vents at high points of water piping. Install drain piping and discharge onto floor drain.
- K. Install supply type, trap-seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor drain body, trap, or inlet fitting. Adjust valve for proper flow.

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 260526 "Grounding and Bonding for Electrical Systems."
- C. Connect wiring according to Division 26 Section 260519 "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. Reduced pressure zone backflow preventers.
 - 2. Water pressure reducing valves.
 - 3. Primary water tempering valves.
 - 4. Supply type, trap seal primer 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 220553 "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, reduced pressure principal backflow preventer, 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 thermostatic water mixing valves.

END OF SECTION 221119

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. Roof flashing assemblies.
- 4. Through penetration firestop assemblies.
- 5. Miscellaneous sanitary drainage piping specialties.
- 6. Flashing materials.
- 7. Fresh Air Inlets

- B. ABS: Acrylonitrile-butadiene-styrene plastic.

- C. FRP: Fiberglass reinforced plastic.

- D. HDPE: High-density polyethylene plastic.

- E. PE: Polyethylene plastic.

- F. PP: Polypropylene plastic.

- G. PVC: Polyvinyl chloride plastic.

1.3 SUBMITTALS

- A. Shop Drawings: Show fabrication and installation details for frost resistant vent terminals.

- 1. Wiring Diagrams: Power, signal, and control wiring.

- B. Field quality control test reports.

- C. Operation and Maintenance Data: For drainage piping specialties to include in emergency, operation, and maintenance manuals.

1.4 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.

1.5 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- B. Coordinate size and location of roof penetrations.

PART 2 - PRODUCTS

2.1 CLEANOUTS

A. Exposed Metal Cleanouts

- 1. Manufacturers - subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Division
 - b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - c. Tyler Pipe; Wade Division
 - d. Watts Drainage Products Inc.
 - e. 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: plastic plug.
- 6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
- 7. Closure: Stainless steel plug with seal.

B. Exposed Exterior Surfaced Area Cleanouts

- 1. Manufacturers - subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Division
 - b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - c. Tyler Pipe; Wade Division
 - d. Watts Drainage Products Inc.
 - e. 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: cast iron plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Closure: Stainless steel plug with seal.
8. Model: ZN-1400-HD manufactured by Zurn.

C. Exposed Exterior Un-Surfaced Area Cleanouts

1. Manufacturers - subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Division
 - b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - c. Tyler Pipe; Wade Division
 - d. Watts Drainage Products Inc.
 - e. 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: cast iron plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Closure: Stainless steel plug with seal.
8. Model: Z-1474 manufactured by Zurn.

D. Metal Floor Cleanouts

1. Manufacturers - subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Division
 - b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - c. Tyler Pipe; Wade Division
 - d. Watts Drainage Products Inc.
 - e. Zurn Plumbing Products Group; Light Commercial Operation.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.36.2M 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: Plastic plug.
9. Adjustable Housing Material: Cast iron.
10. Frame and Cover Material and Finish: Polished nickel bronze.
11. Frame and Cover Shape: Round.
12. Top Loading Classification: Medium Duty.
13. Riser: ASTM A 74, Service class, cast iron drainage pipe fitting and riser to cleanout.
14. Standard: ASME A112.3.1.
15. Size: Same as connected branch.

16. Housing: Stainless steel.
17. Closure: Stainless steel with seal.
18. Riser: Stainless steel drainage pipe fitting to cleanout.
19. Model: ZN-1400 manufactured by Zurn.

E. Cast Iron Wall Cleanouts

1. Manufacturers - subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Division
 - b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - c. Tyler Pipe; Wade Division
 - d. Watts Drainage Products Inc.
 - e. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.36.2M. Include wall access.
3. Size: Same as connected drainage piping.
4. Body: Hubless, cast iron soil pipe test tee as required to match connected piping.
5. Closure: drilled-and-threaded plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Wall Access: Round, flat, chrome plated brass or stainless steel cover plate with screw.
8. Wall Access: Round stainless steel wall installation frame and cover.

2.2 FLOOR DRAINS

A. Cast Iron Floor Drains

1. Manufacturers - subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Division
 - b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - c. Tyler Pipe; Wade Division
 - d. Watts Drainage Products Inc.
 - e. Zurn Plumbing Products Group; Light Commercial Operation.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Floor Drain (FD-1):
 - a. Standard: ASME A112.6.3.
 - b. Pattern: Floor drain.
 - c. Body Material: Gray iron.
 - d. Seepage Flange: Required.
 - e. Anchor Flange: Required.
 - f. Clamping Device: Required.
 - g. Outlet: Bottom.
 - h. Backwater Valve: Not required.
 - i. Coating on Interior and Exposed Exterior Surfaces: Acid-resistant epoxy.
 - j. Sediment Bucket: Required.
 - k. Top or Strainer Material: Nickel bronze.
 - l. Top of Body and Strainer Finish: Durra-Coated Cast Iron.

- m. Top Shape: Round.
 - n. Top Loading Classification: Medium Duty.
 - o. Funnel: Not required.
 - p. Trap Material: Cast iron.
 - q. Trap Pattern: Standard P-trap.
 - r. Trap Features: Trap-seal primer valve drain connection, where required.
 - s. Model: ZN-415-6-B-Y-AR manufactured by Zurn.
3. Floor Drain (FD-2):
- a. Standard: ASME A112.6.3.
 - b. Pattern: Floor drain.
 - c. Body Material: Gray iron.
 - d. Seepage Flange: Required.
 - e. Anchor Flange: Required.
 - f. Clamping Device: Required.
 - g. Outlet: Bottom.
 - h. Backwater Valve: Not required.
 - i. Coating on Interior and Exposed Exterior Surfaces: Acid-resistant epoxy.
 - j. Sediment Bucket: Required.
 - k. Top or Strainer Material: Nickel bronze with raised lip set flush with floor.
 - l. Top of Body and Strainer Finish: Durra-Coated Cast Iron.
 - m. Top Shape: Round.
 - n. Top Loading Classification: Medium Duty.
 - o. Funnel: Not required.
 - p. Trap Material: Cast iron.
 - q. Trap Pattern: Standard P-trap.
 - r. Trap Features: Trap-seal primer valve drain connection, where required.
 - s. Model: ZN-415-7I-Y-AR manufactured by Zurn.

2.3 ROOF FLASHING ASSEMBLIES

A. Roof Flashing Assemblies

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

- a. Acorn Engineering Company; Elmdor/Stoneman Division
- b. Thaler Metal Industries Ltd.

- B. Description: Manufactured assembly made of 6.0-lb/sq. ft., 0.0938-inch thick, flashing collar and skirt extending at least 8 inches from pipe, with galvanized steel boot reinforcement and counterflashing fitting.

- 1. Open-Top Vent Cap: Without cap.
- 2. Low-Silhouette Vent Cap: With vandal proof vent cap.
- 3. Extended Vent Cap: With field installed, vandal proof vent cap.

2.4 THROUGH PENETRATION FIRESTOP ASSEMBLIES

A. Through penetration Firestop Assemblies

1. Manufacturers - subject to compliance with requirements, provide products by one of the following:
 - a. ProSet Systems Inc.
2. Standard: UL 1479 assembly of sleeve and stack fitting with firestopping plug.
3. Size: Same as connected soil, waste, or vent stack.
4. Sleeve: Molded PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.
5. Stack Fitting: ASTM A 48/A 48M, gray iron, hubless-pattern, wye branch with neoprene O-ring at base and gray iron plug in thermal-release harness. Include PVC protective cap for plug.
6. Special Coating: Corrosion resistant on interior of fittings.

2.5 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Open Drains

1. Description: Shop or field fabricate from ASTM A 74, Service class, hub-and-spigot, cast iron, soil-pipe fittings. Include P-trap, hub-and-spigot riser section; and where required, increaser fitting joined with ASTM C 564, rubber gaskets.
2. Size: Same as connected waste piping.

B. Deep Seal Traps

1. Description: Cast iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap-seal primer valve connection.
2. Size: Same as connected waste piping.
 - a. NPS 2 (DN 50): 4-inch minimum water seal.
 - b. NPS 2-1/2 (DN 65) and Larger: 5-inch minimum water seal.

C. Floor Drain, Trap-Seal Primer Fittings

1. Description: Cast iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
2. Size: Same as floor drain outlet with NPS 1/2 (DN 15) side inlet.

D. 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.

E. 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 1 inch 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.

F. Stack Flashing Fittings

1. Description: Counterflashing-type, cast iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
2. Size: Same as connected stack vent or vent stack.

G. 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.

H. Frost-Resistant Vent Terminals

1. Description: Manufactured or shop-fabricated assembly constructed of copper or galvanized steel.
2. Design: To provide 1-inch enclosed air space between outside of pipe and inside of flashing collar extension, with counterflashing.

I. 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 soil, waste, or vent piping.

J. Vent Caps

1. Description: FAI-1, wall type, round chrome plated nickel bronze, crowned and perforated, with 4 point locking device. Model: Z-1471-CP manufactured by Zurn.
2. Description: FAI-2, wall type, round chrome plated nickel bronze with securing cover, 4 inch pipe size, female threaded connection. Model: Z-1472-CP manufactured by Zurn.

2.6 FLASHING MATERIALS

A. Copper Sheet: ASTM B 152/B 152M, of the following minimum weights and thicknesses, unless otherwise indicated:

1. General Applications: 12 oz./sq. ft.
2. Vent Pipe Flashing: 8 oz./sq. ft.

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 (Z275) 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 220500 "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.
- B. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
 - 1. Size same as drainage piping up to NPS 4 (DN 100). Use NPS 4 (DN 100) for larger drainage piping unless larger cleanout is indicated.
 - 2. Locate at each change in direction of piping greater than 45 degrees.
 - 3. Locate at minimum intervals of 50 feet for piping NPS 4 (DN 100) and smaller and 100 feet for larger piping.
 - 4. Locate at base of each vertical soil and waste stack.
- C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- E. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
 - 1. Position floor drains for easy access and maintenance.
 - 2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:
 - a. Radius, 30 Inches 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.

- F. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.
- G. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.
- H. Install through penetration firestop assemblies in plastic conductors and stacks at floor penetrations.
- I. Install deep-seal traps on floor drains and other waste outlets, if indicated.
- J. 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.
- K. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.
- L. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.
- M. Install vent caps on each vent pipe passing through roof.
- N. Install frost-resistant vent terminals on each vent pipe passing through roof. Maintain 1-inch clearance between vent pipe and roof substrate.
- O. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.
- P. Install frost-proof vent caps on each vent pipe passing through roof. Maintain 1-inch clearance between vent pipe and roof substrate.
- Q. Install wood-blocking reinforcement for wall mounting type specialties.
- R. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.
- S. 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 260526 "Grounding and Bonding for Electrical Systems."
- D. Connect wiring according to Division 26 Section 260519 "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:
 - 1. Copper Sheets: Solder joints of copper sheets.
- B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
 - 1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, 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. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Division 07 Section "Sheet Metal Flashing and Trim."
- F. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast iron sleeve having calking recess.
- G. Fabricate and install flashing and pans, sumps, and other drainage shapes.

3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
- B. Tests and Inspections:
 - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.5 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 221319

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. Roof flashing assemblies.
 - 4. Through penetration firestop assemblies.
 - 5. Miscellaneous sanitary drainage piping specialties.
 - 6. Flashing materials.
 - 7. Fresh Air Inlets
- B. ABS: Acrylonitrile-butadiene-styrene plastic.
- C. FRP: Fiberglass reinforced plastic.
- D. HDPE: High-density polyethylene plastic.
- E. PE: Polyethylene plastic.

- F. PP: Polypropylene plastic.
- G. PVC: Polyvinyl chloride plastic.

1.3 SUBMITTALS

- A. Shop Drawings: Show fabrication and installation details for frost resistant vent terminals.
 - 1. Wiring Diagrams: Power, signal, and control wiring.
- B. Field quality control test reports.
- C. Operation and Maintenance Data: For drainage piping specialties to include in emergency, operation, and maintenance manuals.

1.4 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.

1.5 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- B. Coordinate size and location of roof penetrations.

PART 2 - PRODUCTS

2.1 CLEANOUTS

- A. Exposed Metal Cleanouts:
 - 1. Manufacturers - subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Division
 - b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - c. Tyler Pipe; Wade Division
 - d. Watts Drainage Products Inc.

- e. 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: plastic plug.
 - 6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
 - 7. Closure: Stainless steel plug with seal.
- B. Exposed Exterior Surfaced Area Cleanouts:
- 1. Manufacturers - subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Division
 - b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - c. Tyler Pipe; Wade Division
 - d. Watts Drainage Products Inc.
 - e. 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: cast iron plug.
 - 6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
 - 7. Closure: Stainless steel plug with seal.
 - 8. Model: ZN-1400-HD manufactured by Zurn.
- C. Exposed Exterior Un-surfaced Area Cleanouts:
- 1. Manufacturers - subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Division
 - b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - c. Tyler Pipe; Wade Division
 - d. Watts Drainage Products Inc.
 - e. 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: cast iron plug.
 - 6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
 - 7. Closure: Stainless steel plug with seal.
 - 8. Model: Z-1474 manufactured by Zurn.
- D. Metal Floor Cleanouts:

1. Manufacturers - subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Division
 - b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - c. Tyler Pipe; Wade Division
 - d. Watts Drainage Products Inc.
 - e. Zurn Plumbing Products Group; Light Commercial Operation.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.36.2M 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 call.
8. Closure: Plastic plug.
9. Adjustable Housing Material: Cast iron.
10. Frame and Cover Material and Finish: Polished nickel bronze.
11. Frame and Cover Shape: Round.
12. Top Loading Classification: Medium Duty.
13. Riser: ASTM A 74, Service class, cast iron drainage pipe fitting and riser to cleanout.
14. Standard: ASME A112.3.1.
15. Size: Same as connected branch.
16. Housing: Stainless steel.
17. Closure: Stainless steel with seal.
18. Riser: Stainless steel drainage pipe fitting to cleanout.
19. Model: ZN-1400 manufactured by Zurn.

E. Cast Iron Wall Cleanouts:

1. Manufacturers - subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Division
 - b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - c. Tyler Pipe; Wade Division
 - d. Watts Drainage Products Inc.
 - e. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.36.2M. Include wall access.
3. Size: Same as connected drainage piping.
4. Body: Hubless, cast iron soil pipe test tee as required to match connected piping.
5. Closure: drilled-and-threaded plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Wall Access: Round, flat, chrome plated brass or stainless steel cover plate with screw.
8. Wall Access: Round stainless steel wall installation frame and cover.

2.2 FLOOR DRAINS

A. Cast Iron Floor Drains:

1. Manufacturers - subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Division
 - b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - c. Tyler Pipe; Wade Division
 - d. Watts Drainage Products Inc.
 - e. Zurn Plumbing Products Group; Light Commercial Operation.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Floor Drain (FD-1):
 - a. Standard: ASME A112.6.3.
 - b. Pattern: Floor drain.
 - c. Body Material: Gray iron.
 - d. Seepage Flange: Required.
 - e. Anchor Flange: Required.
 - f. Clamping Device: Required.
 - g. Outlet: Bottom.
 - h. Backwater Valve: Not required.
 - i. Coating on Interior and Exposed Exterior Surfaces: Acid-resistant epoxy.
 - j. Sediment Bucket: Required.
 - k. Top or Strainer Material: Nickel bronze.
 - l. Top of Body and Strainer Finish: Durra-Coated Cast Iron.
 - m. Top Shape: Round.
 - n. Top Loading Classification: Medium Duty.
 - o. Funnel: Not required.
 - p. Trap Material: Cast iron.
 - q. Trap Pattern: Standard P-trap.
 - r. Trap Features: Trap-seal primer valve drain connection, where required.
 - s. Model: ZN-415-6-B-Y-AR manufactured by Zurn.
3. Floor Drain (FD-2):
 - a. Standard: ASME A112.6.3.
 - b. Pattern: Floor drain.
 - c. Body Material: Gray iron.
 - d. Seepage Flange: Required.
 - e. Anchor Flange: Required.
 - f. Clamping Device: Required.
 - g. Outlet: Bottom.
 - h. Backwater Valve: Not required.
 - i. Coating on Interior and Exposed Exterior Surfaces: Acid-resistant epoxy.
 - j. Sediment Bucket: Required.
 - k. Top or Strainer Material: Nickel bronze with raised lip set flush with floor.
 - l. Top of Body and Strainer Finish: Durra-Coated Cast Iron.
 - m. Top Shape: Round.

- n. Top Loading Classification: Medium Duty.
- o. Funnel: Not required.
- p. Trap Material: Cast iron.
- q. Trap Pattern: Standard P-trap.
- r. Trap Features: Trap-seal primer valve drain connection, where required.
- s. Model: ZN-415-7I-Y-AR manufactured by Zurn.

2.3 ROOF FLASHING ASSEMBLIES

A. Roof Flashing Assemblies:

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

- a. Acorn Engineering Company; Elmdor/Stoneman Division
- b. Thaler Metal Industries Ltd.

B. Description: Manufactured assembly made of 6.0-lb/sq. ft., 0.0938-inch thick, flashing collar and skirt extending at least 8 inches from pipe, with galvanized steel boot reinforcement and counterflashing fitting.

1. Open-Top Vent Cap: Without cap.
2. Low-Silhouette Vent Cap: With vandal proof vent cap.
3. Extended Vent Cap: With field installed, vandal proof vent cap.

2.4 THROUGH PENETRATION FIRESTOP ASSEMBLIES

A. Through penetration Firestop Assemblies:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ProSet Systems Inc.
2. Standard: UL 1479 assembly of sleeve and stack fitting with firestopping plug.
3. Size: Same as connected soil, waste, or vent stack.
4. Sleeve: Molded PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.
5. Stack Fitting: ASTM A 48/A 48M, gray iron, hubless-pattern, wye branch with neoprene O-ring at base and gray iron plug in thermal-release harness. Include PVC protective cap for plug.
6. Special Coating: Corrosion resistant on interior of fittings.

2.5 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Open Drains:

1. Description: Shop or field fabricate from ASTM A 74, Service class, hub-and-spigot, cast iron, soil-pipe fittings. Include P-trap, hub-and-spigot riser section; and where required, increaser fitting joined with ASTM C 564, rubber gaskets.
2. Size: Same as connected waste piping.

B. Deep Seal Traps:

1. Description: Cast iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap-seal primer valve connection.
2. Size: Same as connected waste piping.
 - a. NPS 2 (DN 50): 4-inch minimum water seal.
 - b. NPS 2-1/2 (DN 65) and Larger: 5-inch minimum water seal.

C. Floor Drain, Trap-Seal Primer Fittings:

1. Description: Cast iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
2. Size: Same as floor drain outlet with NPS 1/2 (DN 15) side inlet.

D. 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.

E. 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 1 inch 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.

F. Stack Flashing Fittings:

1. Description: Counter flashing-type, cast iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
2. Size: Same as connected stack vent or vent stack.

G. 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.

H. Frost-Resistant Vent Terminals:

1. Description: Manufactured or shop-fabricated assembly constructed of copper or galvanized steel.
2. Design: To provide 1-inch enclosed air space between outside of pipe and inside of flashing collar extension, with counter flashing.

I. 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 soil, waste, or vent piping.

J. Vent Caps:

1. Description: FAI-1, wall type, round chrome plated nickel bronze, crowned and perforated, with 4 point locking device. Model: Z-1471-CP manufactured by Zurn.
2. Description: FAI-2, wall type, round chrome plated nickel bronze with securing cover, 4 inch pipe size, female threaded connection. Model: Z-1472-CP manufactured by Zurn.

2.6 FLASHING MATERIALS

A. Copper Sheet: ASTM B 152/B 152M, of the following minimum weights and thicknesses, unless otherwise indicated:

1. General Applications: 12 oz./sq. ft.
2. Vent Pipe Flashing: 8 oz./sq. ft.

- 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 (Z275) 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 220500 "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.
- B. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
 - 1. Size same as drainage piping up to NPS 4 (DN 100). Use NPS 4 (DN 100) for larger drainage piping unless larger cleanout is indicated.
 - 2. Locate at each change in direction of piping greater than 45 degrees.
 - 3. Locate at minimum intervals of 50 feet for piping NPS 4 (DN 100) and smaller and 100 feet for larger piping.
 - 4. Locate at base of each vertical soil and waste stack.
- C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

- E. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
 - 1. Position floor drains for easy access and maintenance.
 - 2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:
 - a. Radius, 30 Inches 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.
- F. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.
- G. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.
- H. Install through penetration firestop assemblies in plastic conductors and stacks at floor penetrations.
- I. Install deep-seal traps on floor drains and other waste outlets, if indicated.
- J. 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.
- K. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.
- L. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.
- M. Install vent caps on each vent pipe passing through roof.
- N. Install frost-resistant vent terminals on each vent pipe passing through roof. Maintain 1-inch clearance between vent pipe and roof substrate.
- O. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.
- P. Install frost-proof vent caps on each vent pipe passing through roof. Maintain 1-inch clearance between vent pipe and roof substrate.
- Q. Install wood-blocking reinforcement for wall mounting type specialties.

- R. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.
- S. 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 260526 "Grounding and Bonding for Electrical Systems."
- D. Connect wiring according to Division 26 Section 260519 "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:
 - 1. Copper Sheets: Solder joints of copper sheets.
- B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
 - 1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, 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. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Division 07 Section "Sheet Metal Flashing and Trim."
- F. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast iron sleeve having calking recess.
- G. Fabricate and install flashing and pans, sumps, and other drainage shapes.

3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
- B. Tests and Inspections:
 - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.5 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 221319

SECTION 221413
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 and outside the building:
 - 1. Pipe, tube, and fittings.
 - 2. Special pipe fittings.
 - 3. Encasement for underground metal piping.

1.3 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. LLDPE: Linear, low density polyethylene plastic.
- C. PE: Polyethylene plastic.
- D. PVC: Polyvinyl chloride plastic.
- E. TPE: Thermoplastic elastomer.

1.4 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working-pressure, unless otherwise indicated:
 - 1. Storm Drainage Piping: 10-foot head of water.
 - 2. Storm Drainage, Force Main Piping: 100 psig.
- 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 ASCE 7, "Minimum Design Loads for Buildings and Other Structures."

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.
- B. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-drain" for plastic drain piping and "NSF-sewer" for plastic sewer piping.
- C. Cast Iron soil pipe and fittings shall be marked with the collective trademark of Cast Iron Soil Pipe Institute (CISPI) and listed by NSF International.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. 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.

2.3 PVC PIPE AND FITTINGS (**UNDERGROUND ONLY**)

- A. Solid Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.
 - 1. PVC Socket Fittings: ASTM D 2665, socket type, made to ASTM D 3311, drain, waste, and vent patterns.

2.4 SPECIAL PIPE FITTINGS

- A. Flexible, Non-pressure Pipe Couplings: Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition pattern. Include shear ring, ends of same sizes as piping to be joined, and corrosion-resistant-metal tension band and tightening mechanism on each end.
 - 1. Manufacturers:
 - a. Dallas Specialty & Mfg. Company
 - b. Fernco, Inc.
 - c. Mission Rubber Company
 - d. NDS, Inc.
 - e. Plastic Oddities, Inc.
 - 2. Sleeve Materials:
 - a. For Cast iron Soil Pipes: ASTM C 564, rubber.
 - b. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.

- c. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.
- B. Shielded Non-pressure Pipe Couplings: ASTM C 1460, elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
 - 1. Manufacturers:
 - a. Cascade Waterworks Mfg. Company
 - b. Mission Rubber Company
- C. Pressure Pipe Couplings: AWWA C219 metal, sleeve-type same size as, with pressure rating at least equal to, and ends compatible with, pipes to be joined.
 - 1. Manufacturers:
 - a. Cascade Waterworks Mfg. Company
 - b. Dresser, Inc.; DMD Division
 - c. EBAA Iron Sales, Inc.
 - d. Romac Industries, Inc.
 - e. Smith-Blair, Inc.
 - f. Viking Johnson
 - 2. Center Sleeve Material: Manufacturer's standard.
 - 3. Gasket Material: Natural or synthetic rubber.
 - 4. Metal Component Finish: Corrosion-resistant coating or material.
- D. Flexible Ball Joints: Ductile iron fitting with combination of flanged and mechanical-joint ends complying with AWWA C110 or AWWA C153. Include gasketed ball-joint section and ductile iron gland, rubber gasket, and steel bolts.
 - 1. Manufacturers:
 - a. EBAA Iron Sales, Inc.
- E. Expansion Joints: Two or three-piece, ductile iron assembly consisting of telescoping sleeve(s) with gaskets and restrained-type, ductile iron, bell-and-spigot end sections complying with AWWA C110 or AWWA C153. Select and assemble components for expansion indicated. Include AWWA C111, ductile iron glands, rubber gaskets, and steel bolts.
 - 1. Manufacturers:
 - a. EBAA Iron Sales, Inc.
 - b. Romac Industries, Inc.
 - c. Star Pipe Products; Star Fittings Division
- F. Wall Penetration Fittings: Compound, ductile iron coupling fitting with sleeve and flexing sections for up to 20-degree deflection, gaskets, and restrained-joint ends complying with AWWA C110 or AWWA C153. Include AWWA C111, ductile iron glands, rubber gaskets, and steel bolts.
 - 1. Manufacturers:
 - a. SIGMA Corporation

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. Underground storm drainage piping shall be the following:
 - 1. Solid wall PVC pipe, PVC socket fittings, and solvent cemented joints.
 - 2. Dissimilar Pipe material Couplings: Shielded, non-pressure pipe couplings for joining dissimilar pipe materials with small difference in OD.

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 220500 "Common Work Results for Plumbing."
- C. Install cleanouts at grade and extend to where building storm drains connect to building storm sewers. Cleanouts are specified in Division 22 Section 221423 "Storm Drainage Piping Specialties."
- D. Install cleanout fitting with closure plug inside the building in storm drainage force-main piping.
- E. 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.
- F. 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.
- G. 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.
- H. Install storm drainage piping at the following minimum slopes, unless otherwise indicated:
 - 1. Building Storm Drain: 1 percent downward in direction of flow for piping NPS 3 (DN 80) and smaller. 1 percent downward in direction of flow for piping NPS 4 (DN 100) and larger.
 - 2. Horizontal Storm Drainage Piping: 2 percent downward in direction of flow.

- I. Sleeves are not required for cast iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.
- J. Install underground PVC storm drainage piping according to ASTM D 2321.
- K. 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 220500 "Common Work Results for Plumbing."
- B. PVC Non-pressure Piping Joints: Join piping according to ASTM D 2665.

3.5 HANGER AND SUPPORT INSTALLATION

- A. Pipe hangers and supports are specified in Division 22 Section 220529 "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.
- B. Install supports according to Division 22 Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
- C. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.
- E. Install hangers for cast iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 60 inches with 3/8-inch rod.
 - 2. NPS 3 (DN 80): 60 inches with 1/2-inch rod.
 - 3. NPS 4 and NPS 5 (DN 100 and DN 125): 60 inches with 5/8-inch rod.
 - 4. NPS 6 (DN 150): 60 inches with 3/4-inch rod.
 - 5. NPS 8 to NPS 12 (DN 200 to DN 300): 60 inches with 7/8-inch rod.
 - 6. Spacing for 10-foot lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.
- F. Install supports for vertical cast iron soil piping every 15 feet.

- G. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/4 (DN 32): 84 inches with 3/8-inch rod.
 - 2. NPS 1-1/2 (DN 40): 108 inches with 3/8-inch rod.
 - 3. NPS 2 (DN 50): 10 feet with 3/8-inch rod.
 - 4. NPS 2-1/2 (DN 65): 11 feet with 1/2-inch rod.
 - 5. NPS 3 (DN 80): 12 feet with 1/2-inch rod.
 - 6. NPS 4 and NPS 5 (DN 100 and DN 125): 12 feet with 5/8-inch rod.
 - 7. NPS 6 (DN 150): 12 feet with 3/4-inch rod.
 - 8. NPS 8 to NPS 12 (DN 200 to DN 300): 12 feet with 7/8-inch rod.
- H. Install supports for vertical steel piping every 15 feet.
- I. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/4 (DN 32): 72 inches with 3/8-inch rod.
 - 2. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 96 inches with 3/8-inch rod.
 - 3. NPS 2-1/2 (DN 65): 108 inches with 1/2-inch rod.
 - 4. NPS 3 to NPS 5 (DN 80 to DN 125): 10 feet with 1/2-inch rod.
 - 5. NPS 6 (DN 150): 10 feet with 5/8-inch rod.
 - 6. NPS 8 (DN 200): 10 feet with 3/4-inch rod.
- J. Install supports for vertical copper tubing every 10 feet.
- K. 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 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.

3.7 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.
 - 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Re-inspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for re-inspection.
- 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.

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 221413

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. Through penetration firestop assemblies.
 - 3. Miscellaneous storm drainage piping specialties.
 - 4. Flashing materials.
- B. Related Sections include the following:
 - 1. Division 22 Section 221319 "Sanitary Waste Piping Specialties" for floor drains.

1.3 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. FRP: Fiberglass reinforced plastic.
- C. HDPE: High density polyethylene plastic.
- D. PE: Polyethylene plastic.
- E. PP: Polypropylene plastic.
- F. PUR: Polyurethane plastic.
- G. 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. Manufacturers - subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Division
 - b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - c. Tyler Pipe; Wade Division
 - d. Watts Drainage Products Inc.
 - e. 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: plastic plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Closure: Stainless steel plug with seal.

B. Exposed Exterior Surfaced Area Cleanouts

1. Manufacturers - subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Division
 - b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - c. Tyler Pipe; Wade Division
 - d. Watts Drainage Products Inc.
 - e. 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: cast iron plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Closure: Stainless steel plug with seal.
8. Model: ZN-1400-HD manufactured by Zurn.

C. Exposed Exterior Un-Surfaced Area Cleanouts

1. Manufacturers - subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Division
 - b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - c. Tyler Pipe; Wade Division
 - d. Watts Drainage Products Inc.
 - e. 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: cast iron plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Closure: Stainless steel plug with seal.
8. Model: Z-1474 manufactured by Zurn.

D. Metal Floor Cleanouts

1. Manufacturers - subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Division
 - b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - c. Tyler Pipe; Wade Division
 - d. Watts Drainage Products Inc.
 - e. Zurn Plumbing Products Group; Light Commercial Operation.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.36.2M 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: Plastic plug.
9. Adjustable Housing Material: Cast iron.
10. Frame and Cover Material and Finish: Polished nickel bronze.
11. Frame and Cover Shape: Round.
12. Top Loading Classification: Medium Duty.
13. Riser: ASTM A 74, Service class, cast iron drainage pipe fitting and riser to cleanout.
14. Standard: ASME A112.3.1.
15. Size: Same as connected branch.
16. Housing: Stainless steel.
17. Closure: Stainless steel with seal.
18. Riser: Stainless steel drainage pipe fitting to cleanout.
19. Model: ZN-1400 manufactured by Zurn.

E. Cast Iron Wall Cleanouts

1. Manufacturers - subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Division
 - b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - c. Tyler Pipe; Wade Division
 - d. Watts Drainage Products Inc.
 - e. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.36.2M. Include wall access.
3. Size: Same as connected drainage piping.
4. Body: Hubless, cast iron soil pipe test tee as required to match connected piping.
5. Closure: drilled-and-threaded plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Wall Access: Round, flat, chrome plated brass or stainless steel cover plate with screw.
8. Wall Access: Round stainless steel wall installation frame and cover.

2.2 THROUGH PENETRATION FIRESTOP ASSEMBLIES

A. Through Penetration Firestop Assemblies

1. Manufacturers - subject to compliance with requirements, provide products by one of the following:
 - a. ProSet Systems Inc.
2. Standard: UL 1479 assembly of sleeve and stack fitting with firestopping plug.
3. Size: Same as connected pipe.
4. Sleeve: Molded PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.
5. Stack Fitting: ASTM A 48/A 48M, gray iron, hubless pattern, wye branch with neoprene O-ring at base and gray iron plug in thermal-release harness. Include PVC protective cap for plug.
6. Special Coating: Corrosion resistant on interior of fittings.

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.

B. Downspout Boots

1. Description: Manufactured, ASTM A 48/A 48M, gray iron casting, with strap or ears for attaching to building; NPS 4 (DN 100) outlet; and shop applied bituminous coating.
2. Size: Inlet size to match downspout.

3. Description: ASTM A 74, Service class, hub-and-spigot, cast iron soil pipe, with cleanout.
 4. Size: Same as or larger than connected downspout.
 5. Model: Z-191-CA manufactured by Zurn.

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 (Z275) 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 220500 "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.
- B. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
 1. Size same as drainage piping up to NPS 4 (DN 100). Use NPS 4 (DN 100) for larger drainage piping unless larger cleanout is indicated.
 2. Locate at each change in direction of piping greater than 45 degrees.
 3. Locate at minimum intervals of 50 feet for piping NPS 4 (DN 100) and smaller and 100 feet for larger piping.
 4. Locate at base of each vertical soil and waste stack.
- C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- E. Install through penetration firestop assemblies in plastic conductors and stacks at floor penetrations.

- F. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.
- G. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.
- H. Install manufactured, gray iron downspout boots at grade with top 12 inches to 18 inches above grade. Secure to building wall.
- I. Install cast iron soil pipe downspout boots at grade with top of hub 12 inches to 18 inches above grade. Secure to building wall.

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 floors and roofs with waterproof membrane.
 - 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

SECTION 223300
ELECTRIC DOMESTIC WATER 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. This Section includes the following electric water heaters:

- 1. Storage electric water heaters.
- 2. Compression tanks.
- 3. Water heater accessories.

1.3 SUBMITTALS

- A. Product Data: For each type and size of water heater indicated. Include rated capacities, operating characteristics, furnished specialties, and accessories.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Product Certificates: For each type of commercial and instantaneous electric water heater, signed by product manufacturer.
- D. Source quality control test reports.
- E. Field quality control test reports.
- F. Operation and Maintenance Data: For electric water heaters to include in emergency, operation, and maintenance manuals.
- G. Warranty: Special warranty specified in this Section.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain same type of electric water heaters through one source from a single manufacturer.
- B. Product Options: Drawings indicate size, profiles, and dimensional requirements of electric water heaters and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."
- 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. ASME Compliance: Where indicated, fabricate and label commercial water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
- E. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9," for all components that will be in contact with potable water.

1.5 COORDINATION

- A. Coordinate size and location of concrete bases with Architectural and Structural Drawings.

1.6 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of electric water heaters that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including storage tank and supports.
 - b. Faulty operation of controls.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal use.
 - 2. Warranty Period(s) - from date of Substantial Completion:
 - a. Electric Water Heaters:
 - 1) Storage Tank: Five years.
 - 2) Controls and Other Components: Three years.
 - b. Compression Tanks: One year(s).

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

2.2 ELECTRIC WATER HEATERS

- A. Standard, Storage Electric Water Heaters (DWH-1): Comply with UL 174.
 - 1. Manufacturers:
 - a. Bradford White Corporation
 - b. Lochinvar Corporation
 - c. Smith, A. O. Water Products Company

2. Storage Tank Construction: Steel.

- a. Tappings: ASME B1.20.1 pipe thread.
- b. Pressure Rating: 150 psig.
- c. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending lining material into tappings.

3. Factory Installed Storage Tank Appurtenances:

- a. Anode Rod: Replaceable magnesium.
- b. Dip Tube: Provide unless cold water inlet is near bottom of tank.
- c. Drain Valve: ASSE 1005.
- d. Insulation: Comply with ASHRAE/IESNA 90.1 or ASHRAE 90.2.
- e. Jacket: Steel with enameled finish.
 - 1) Standard: Cylindrical shape.
 - 2) Tabletop: Rectangular shape, with flat-top work surface and raised back.
- f. Heat Trap Fittings: Inlet type in cold water inlet and outlet type in hot water outlet.
- g. Heating Elements: Two; electric, screw-in immersion type with 12 kW or less total, and wired for non-simultaneous operation, unless otherwise indicated.
- h. Temperature Control: Adjustable thermostat for each element.
- i. Safety Control: High-temperature-limit cutoff device or system.
- j. Relief Valve: ASME rated and stamped and complying with ASME PTC 25.3 for combination temperature and pressure relief valves. Include relieving capacity at least as great as heat input, and include pressure setting less than water heater working pressure rating. Select relief valve with sensing element that extends into storage tank.

4. Capacity and Characteristics:

- a. Capacity: 20 gal.
- b. Jacket: Cylindrical shape.
- c. Heating Elements:
 - 1) Number: Two.
 - 2) Power Demand Each: 3 KW.
- d. Temperature Setting: 125°F.
- e. Electrical Characteristics:
 - 1) Volts: 208
 - 2) Phases: Three
 - 3) Hertz: 60

2.3 COMPRESSION TANKS

1. Manufacturers:

- a. AMTROL Inc.
- b. Watts Regulator Company
- c. Wessels Company

2. Construction:

- a. Tappings: Factory fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1 pipe thread.
- b. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
- c. Air Charging Valve: Factory installed.
- d. Model ST-5-C manufactured by AMTROL Inc.

2.4 WATER HEATER ACCESSORIES

- A. Combination Temperature and Pressure Relief Valves: ASME rated and stamped and complying with ASME PTC 25.3. Include relieving capacity at least as great as heat input, and include pressure setting less than water heater working pressure rating. Select relief valves with sensing element that extends into storage tank.
- B. Pressure Relief Valves: ASME rated and stamped and complying with ASME PTC 25.3. Include pressure setting less than water heater working pressure rating.
- C. Water Heater Stands: Water heater manufacturer's factory fabricated steel stand for floor mounting and capable of supporting water heater and water. Include dimension that will support bottom of water heater a minimum of 18 inches above the floor.
- D. Drain Pans: Corrosion-resistant metal with raised edge. Include dimensions not less than base of water heater and include drain outlet not less than NPS 3/4 (DN 20).
- E. Piping Manifold Kits: Water heater manufacturer's factory fabricated inlet and outlet piping arrangement for multiple unit installation. Include piping and valves for field assembly that are capable of isolating each water heater and of providing balanced flow through each water heater.
- F. Piping Type Heat Traps: Field fabricated piping arrangement according to ASHRAE/IESNA 90.1 or ASHRAE 90.2.

2.5 SOURCE QUALITY CONTROL

- A. Test and inspect water heater storage tanks, specified to be ASME code construction, according to ASME Boiler and Pressure Vessel Code.
- B. Hydrostatically test commercial water heater storage tanks before shipment to minimum of one and one-half times pressure rating.
- C. Prepare test reports.

PART 3 - EXECUTION

3.1 WATER HEATER INSTALLATION

- A. Install commercial water heaters on concrete bases.
 - 1. Exception: Omit concrete bases for commercial water heaters if installation on stand, bracket, suspended platform, or direct on floor is indicated.
 - 2. Concrete base construction requirements are specified in Division 22 Section 220500 "Common Work Results for Plumbing."
- B. Install water heaters level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.
- C. Install combination temperature and pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend commercial water heater relief valve outlet, with drain piping same as domestic water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.
- D. Install water heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose end drain valves at low points in water piping for water heaters that do not have tank drains. Refer to Division 22 Section 221119 "Domestic Water Piping Specialties" for hose end drain valves.
- E. Install thermometer on outlet piping of water heaters. Refer to Division 22 Section 220519 "Meters and Gauges for Plumbing Piping" for thermometers.
- F. Install piping-type heat traps on inlet and outlet piping of water heater storage tanks without integral or fitting-type heat traps.
- G. Fill water heaters with water.
- H. Charge compression tanks with air.

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 water heaters to allow service and maintenance. Arrange piping for easy removal of water heaters.
- C. Ground equipment according to Division 26 Section 260526 "Grounding and Bonding for Electrical Systems."
- D. Connect wiring according to Division 26 Section 260519 "Low Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory authorized service representative to inspect, test, and adjust field assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.
- B. Perform the following field tests and inspections and prepare test reports:
 - 1. Leak Test: After installation, test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Operational Test: After electrical circuitry has been energized, confirm proper operation.
 - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Remove and replace water heaters that do not pass tests and inspections and retest as specified above.

3.4 DEMONSTRATION

- A. Engage a factory authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain commercial and instantaneous electric water heaters. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 223300

SECTION 224000
PLUMBING FIXTURES

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 conventional plumbing fixtures and related components:
 - 1. Water closets (Including flushometers, toilet seats and fixture supports).
 - 2. Urinals (Including flushometers and fixture supports).
 - 3. Lavatories (Including faucets, fixture supports, thermostatic mixing valves, and protective shielding guards).
 - 4. Mop basins (Including faucets and accessories).
- B. Products furnished for this project shall be "LEAD FREE" as required by Federal legislation passed on January 4, 2011. This entails the wetted surfaces of plumbing fixtures, equipment, valves, etc. described in this section to have a weighted-average lead content of no more than 0.25% when used in applications intended to convey or dispense water for human consumption through drinking or cooking.
- C. Related Sections include the following:
 - 1. Division 10 Section "Toilet, Bath, and Laundry Accessories."
 - 2. Division 22 Section 221119 "Domestic Water Piping Specialties" for backflow preventers and specialty fixtures not included in this Section.
 - 3. Division 22 Section 224700 "Drinking Fountains and Water Coolers."

1.3 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.
- C. Cast Polymer: Cast filled polymer plastic material. This material includes cultured-marble and solid-surface materials.
- D. Cultured Marble: Cast filled polymer plastic material with surface coating.
- E. Fitting: Device that controls the flow of water into or out of the plumbing fixture. Fittings specified in this Section include supplies and stops, faucets and spouts, shower heads and tub spouts, drains and tailpieces, and traps and waste pipes. Piping and general-duty valves are included where indicated.

- F. FRP: Fiberglass reinforced plastic.
- G. PMMA: Polymethyl methacrylate (acrylic) plastic.
- H. PVC: Polyvinyl chloride plastic.
- I. Solid Surface: Nonporous, homogeneous, cast polymer plastic material with heat, impact, scratch, and stain resistance qualities.

1.4 SUBMITTALS

- A. Product Data: For each type of plumbing fixture indicated. Include selected fixture and trim, fittings, accessories, appliances, appurtenances, equipment, and supports. Indicate materials and finishes, dimensions, construction details, and flow control rates.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Operation and Maintenance Data: For plumbing fixtures to include in emergency, operation, and maintenance manuals.
- D. Warranty: Special warranty specified in this Section.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category through one source from a single manufacturer.
 - 1. Exception: If fixtures, faucets, or other components are not available from a single manufacturer, obtain similar products from other manufacturers specified for that category.
- 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. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities" for plumbing fixtures for people with disabilities.
- D. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.
- E. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.
- F. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.
- G. Comply with the following applicable standards and other requirements specified for plumbing fixtures:
 - 1. Enameled, Cast iron Fixtures: ASME A112.19.1M.
 - 2. Plastic Mop Service Basins: ANSI Z124.6.

3. Vitreous China Fixtures: ASME A112.19.2M.
 4. Water closet, Flush Valve, Tank Trim: ASME A112.19.5.
- H. Comply with the following applicable standards and other requirements specified for lavatory and sink faucets:
1. Backflow Protection Devices for Faucets with Side Spray: ASME A112.18.3M.
 2. Backflow Protection Devices for Faucets with Hose thread Outlet: ASME A112.18.3M.
 3. Diverter Valves for Faucets with Hose Spray: ASSE 1025.
 4. Faucets: ASME A112.18.1.
 5. Hose connection Vacuum Breakers: ASSE 1011.
 6. Hose coupling Threads: ASME B1.20.7.
 7. Integral, Atmospheric Vacuum Breakers: ASSE 1001.
 8. NSF Potable water Materials: NSF 61.
 9. Pipe Threads: ASME B1.20.1.
 10. Supply Fittings: ASME A112.18.1.
 11. Brass Waste Fittings: ASME A112.18.2.
- I. Comply with the following applicable standards and other requirements specified for miscellaneous fittings:
1. Atmospheric Vacuum Breakers: ASSE 1001.
 2. Brass and Copper Supplies: ASME A112.18.1.
 3. Dishwasher Air Gap Fittings: ASSE 1021.
 4. Manual Operation Flushometers: ASSE 1037.
 5. Plastic Tubular Fittings: ASTM F 409.
 6. Brass Waste Fittings: ASME A112.18.2.
 7. Sensor Operation Flushometers: ASSE 1037 and UL 1951.
- J. Comply with the following applicable standards and other requirements specified for miscellaneous components:
1. Flexible Water Connectors: ASME A112.18.6.
 2. Floor Drains: ASME A112.6.3.
 3. Grab Bars: ASTM F 446.
 4. Hose coupling Threads: ASME B1.20.7.
 5. Hot Water Dispensers: ASSE 1023 and UL 499.
 6. Off Floor Fixture Supports: ASME A112.6.1M.
 7. Pipe Threads: ASME B1.20.1.
 8. Plastic Shower Receptors: ANSI Z124.2.
 9. Plastic Toilet Seats: ANSI Z124.5.
 10. Supply and Drain Protective Shielding Guards: ICC A117.1.

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. Faucet Washers and O-Rings: Equal to 10 percent of amount of each type and size installed.
 2. Faucet Cartridges and O-Rings: Equal to 5 percent of amount of each type and size installed.
 3. Flushometer Valve, Repair Kits: Equal to 10 percent of amount of each type installed, but no fewer than 12 of each type.

4. Provide hinged-top wood or metal box, or individual metal boxes, with separate compartments for each type and size of extra materials listed above.
5. Flushometer Tank, Repair Kits: Equal to 5 percent of amount of each type installed, but no fewer than 2 of each type.
6. Toilet Seats: Equal to 5 percent of amount of each type installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with requirements, provide products by the list of acceptable manufacturers listed below.
- B. Acceptable Manufacturers - Vitreous China Fixtures
 1. American Standard Company, Inc.
 2. Kohler Company
 3. Sloan Valve Company
 4. Zurn Plumbing Products Group
- C. Acceptable Manufacturers - Fixture Trim
 1. American Standard Company, Inc.
 2. Chicago Faucet Company
 3. T & S Brass
- D. Acceptable Manufacturers - Flush Valves
 1. Moen Commercial, Inc.
 2. American Standard
 3. Sloan Valve Company
 4. Zurn Plumbing Products Group
- E. Acceptable Manufacturers - Water Closet Seats
 1. Beneke, Sanderson Plumbing Products Inc.
 2. Bemis Manufacturing Company
 3. Centoco Manufacturing
 4. Church, Bemis Manufacturing Company
 5. Olsonite, Bemis Manufacturing Company
- F. Acceptable Manufacturers - Fixture Carriers
 1. Josam Company
 2. Smith, Jay R. Manufacturing Company
 3. Tyler Pipe; Wade Division
 4. Watts Drainage Products Inc.
 5. Zurn Plumbing Products Group

G. Acceptable Manufacturers - ASSE 1070 Thermostatic Valves

1. Lawler Manufacturing Company, Inc.
2. Leonard Valve Company
3. Powers; a Watts Industries Company
4. Symmons Industries, Inc.
5. Watts Industries, Inc.
6. Zurn Plumbing Products Group

H. Acceptable Manufacturers - Mop Basins:

1. American Standard Company, Inc.
2. Fiat Products
3. Mustee, E.L & Sons, Inc.
4. Stern Williams Company, Inc.

2.2 WATER CLOSETS

A. Water Closet (WC-1) Floor Mounted, Flush Valve, Standard Height:

1. **Bowl:** ANSI A112.19.2; floor mounted siphon jet, vitreous china, elongated rim, 1-1/2-inch top inlet spud, bolt cap with retainers, Model 2234.001 "Madera FloWise" manufactured by American Standard.
2. **Flush Valve** (1.6 gpf - Manual): ANSI A112.18.1; exposed chrome plated, diaphragm type with oscillating, manual non-hold open handle, escutcheon, integral screwdriver stop and vacuum breaker, 1.6 gallons per flush; Model 111 "Royal" manufactured by Sloan Valve Company.
3. **Seat (Open):** Solid white plastic, open front, extended back, self-sustaining check hinges, stainless steel posts, without cover; Model 95SSCT manufactured by Olsonite.

B. Water Closet (WC-2) Floor Mounted, Flush Valve, ADA Height:

1. Bowl: ANSI A112.19.2; floor mounted siphon jet, vitreous china, elongated rim, 1-1/2-inch top inlet spud, bolt cap with retainers; Model 3043.001 "Madera FloWise" manufactured by American Standard.
2. Flush Valve (1.6 gpf - Manual): ANSI A112.18.1; exposed chrome plated, diaphragm type with ADA oscillating, manual non-hold open handle, escutcheon, integral screwdriver stop and vacuum breaker, handle height and operation to meet ADA requirements, 1.6 gallons per flush; Model 111 "Royal" manufactured by Sloan Valve Company.
3. Seat (Open): Solid white plastic, open front, extended back, self-sustaining check hinges, stainless steel posts, without cover; Model 95SSCT manufactured by Olsonite.

2.3 URINALS

A. Urinal (U-1) Wall hung, Flush Valve, ADA Height:

1. Urinal: ANSI A112.19.2; vitreous china, low consumption, wall hung washout urinal with shields, integral trap, 3/4-inch top spud, steel supporting wall hanger, mounted at ADA height; Model 6590.001 "Washbrook FloWise" manufactured by American Standard.

2. Flush Valve (1.0 gpf - Manual): ANSI A112.18.1; exposed chrome plated, diaphragm type with ADA oscillating, manual non-hold open handle, escutcheon, integral screwdriver stop and vacuum breaker, handle height and operation to meet ADA requirements, 1.0 gallons per flush; Model 186-1.0 "Royal" manufactured by Sloan Valve Company.
3. Wall Mounted Carrier: ASNI A112.6.1; cast iron and steel frame with tubular legs, lugs for floor and wall attachment, threaded fixture studs for fixture hanger, bearing studs; Model Z1222 manufactured by Zurn Plumbing Products Group.

2.4 LAVATORIES

A. Lavatory (L-1) Wall hung, Standard Height:

1. Basin: ANSI A112.19.2: vitreous china, wall hung lavatory, 20-inch x 18 inch minimum, 4-inch-high back, drilling on (4-inch centers), rectangular basin with splash lip, front overflow, mounted at standard height; Model 0355.012 (4" centers), "Lucerne" manufactured by American Standard.
2. Trim (0.5 gpm - manual with lever handles on 4" centers): ANSI A112.18.1; two handle, chrome plated center set faucet with conventional spout, lever handles on 4-inch centers, grid drain assembly with 1-1/4-inch tailpiece, washerless ceramic disc valve cartridges, 0.5 gpm vandal proof, non-aerating spray, chrome plated loose key angle stop valves and escutcheons, chrome plated 17-gauge brass P-trap with cleanout plug and arm with escutcheon. Model 802-VE2805ABCP manufactured by Chicago Faucet Company.
3. Thermostatic Mixing Valve: ASSE 1070 & 1017; brass body, brass and stainless steel internal components, dual stainless steel strainers and checks on inlet, temperature-response element, vandal resistant universal cap/temperature adjustment handle, lead free; Model 8210CK "Maxline" manufactured by Symmons.

B. Lavatory (L-2) Wall hung, ADA Height:

1. Basin: ANSI A112.19.2: vitreous china, wall hung lavatory, 20-inch x 18 inch minimum, 4-inch-high back, drilling on (4-inch centers), rectangular basin with splash lip, front overflow, mounted at ADA height; Model 0355.012 (4" centers) "Lucerne" manufactured by American Standard.
2. Trim (0.5 gpm - manual with lever handles on 4" centers): ANSI A112.18.1; two handle, chrome plated center set faucet with conventional spout, lever handles on 4-inch centers, grid drain assembly with 1-1/4-inch tailpiece, washerless ceramic disc valve cartridges, 0.5 gpm vandal proof, non-aerating spray, chrome plated loose key angle stop valves and escutcheons, chrome plated 17-gauge brass P-trap with cleanout plug and arm with escutcheon. Model 802-VE2805ABCP manufactured by Chicago Faucet Company.
3. Wall Mounted Carrier: ANSI A112.6.1; cast iron and steel frame with tubular legs, lugs for floor and wall attachment, threaded studs for fixture hanger, concealed arm supports, bearing plate and studs; Model Z1231 manufactured by Zurn Plumbing Products Group, Inc.
4. Thermostatic Mixing Valve: ASSE 1070 & 1017; brass body, brass and stainless steel internal components, dual stainless steel strainers and checks on inlet, temperature-response element, vandal resistant universal cap/temperature adjustment handle, lead free; Model 7-210-CK "Maxline" manufactured by Symmons.
5. Insulation Kit: Provide ADA conforming insulating wrap as manufactured by Truebro, Inc. or equivalent. Install p-traps as high as possible under the counter to lessen the visibility of the trap.

2.5 MOP BASINS

A. Mop Basin (MB-1):

1. Basin (Molded Stone): (24 x 24 x 10-inch-high white molded stone, floor mounted, with one-inch-wide shoulders, stainless steel strainer; Model MSB-(2424) manufactured by Fiat Products, Inc.
2. Trim: ANSI A112.18.1; exposed wall type supply lever handles, spout wall brace, vacuum breaker, hose end spout, eccentric adjustable inlets, integral screwdriver stops with covering caps and adjustable threaded wall flanges; Model 897-CRCF manufactured by Chicago Faucet Company. Provide 5 feet of ½ inch diameter plan end Reinforced Rubber Hose and Hose Bracket - Model 832-AA, Mop Hanger – Model 889-CC, Stainless Steel Bumper guard - Model E-88-AA, and stainless steel Wall Guard – Model MSG (2424) manufactured by Fiat Products, Inc.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before plumbing fixture installation.
- B. Examine cabinets, counters, floors, and walls for suitable conditions where fixtures will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Assemble plumbing fixtures, trim, fittings, and other components according to manufacturers' written instructions.
- B. Install off-floor supports, affixed to building substrate, for wall-mounting fixtures.
 1. Use carrier supports with waste fitting and seal for back-outlet fixtures.
 2. Use carrier supports without waste fitting for fixtures with tubular waste piping.
 3. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.
- C. Install back-outlet, wall-mounting fixtures onto waste fitting seals and attach to supports.
- D. Install floor mounting fixtures on closet flanges or other attachments to piping or building substrate.
- E. Install wall mounting fixtures with tubular waste piping attached to supports.
- F. Install floor mounting, back-outlet water closets attached to building floor substrate and wall bracket and onto waste fitting seals.
- G. Install fixtures level and plumb according to roughing-in drawings.

- H. Install water supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.
 - 1. Exception: Use ball, gate, or globe valves if supply stops are not specified with fixture. Valves are specified in Division 22 Section 220523 "General-Duty Valves for Plumbing Piping."
- I. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.
- J. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.
- K. Install flushometer valves for accessible water closets and urinals with handle mounted on wide side of compartment. Install other actuators in locations that are easy for people with disabilities to reach.
- L. Install toilet seats on water closets.
- M. Install faucet-spout fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
- N. Install water-supply flow-control fittings with specified flow rates in fixture supplies at stop valves.
- O. Install faucet flow-control fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
- P. Install traps on fixture outlets.
 - 1. Exception: Omit trap on fixtures with integral traps.
 - 2. Exception: Omit trap on indirect wastes, unless otherwise indicated.
- Q. Install escutcheons at piping wall ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings. Escutcheons are specified in Division 22 Section 220500 "Common Work Results for Plumbing."
- R. Set service basins in leveling bed of cement grout. Grout is specified in Division 22 Section 220500 "Common Work Results for Plumbing."
- S. Seal joints between fixtures and walls, floors, and countertops using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 07 Section "Joint Sealants."

3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

- C. Ground equipment according to Division 26 Section 260526 "Grounding and Bonding for Electrical Systems."
- D. Connect wiring according to Division 26 Section 260519 "Low Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

- A. Refer to architectural drawings for exact plumbing fixture locations, mounting heights and dimensions.
- B. Verify that installed plumbing fixtures are categories and types specified for locations where installed.
- C. Check that plumbing fixtures are complete with trim, faucets, fittings, and other specified components.
- D. Inspect installed plumbing fixtures for damage. Replace damaged fixtures and components.
- E. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.

3.5 ADJUSTING

- A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.
- B. Adjust water pressure at faucets and flushometer valves to produce proper flow and stream.
- C. Replace washers and seals of leaking and dripping faucets and stops.

3.6 CLEANING

- A. Clean fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials. Do the following:
 - 1. Remove faucet spouts and strainers, remove sediment and debris, and reinstall strainers and spouts.
 - 2. Remove sediment and debris from drains.
- B. After completing installation of exposed, factory finished fixtures, faucets, and fittings, inspect exposed finishes and repair damaged finishes.

3.7 PROTECTION

- A. Provide protective covering for installed fixtures and fittings.
- B. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 224000

SECTION 224700
DRINKING FOUNTAINS AND WATER COOLERS

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 electric water coolers and drinking fountains and related components:
 - 1. Drinking fountains
 - 2. Fixture supports
- B. Products furnished for this project shall be "LEAD FREE" as required by Federal legislation passed on January 4, 2011. This entails the wetted surfaces of plumbing fixtures, equipment, valves, etc. described in this section to have a weighted-average lead content of no more than 0.25% when used in applications intended to convey or dispense water for human consumption through drinking or cooking.

1.3 DEFINITIONS

- A. Accessible Electric Water Coolers and Drinking Fountains: Fixture that can be approached and used by people with disabilities.
- B. Cast Polymer: Dense, cast filled polymer plastic.
- C. Drinking Fountain: Fixture with nozzle for delivering stream of water for drinking.
- D. Fitting: Device that controls flow of water into or out of fixture.
- E. Fixture: Drinking fountain unless one is specifically indicated.

1.4 SUBMITTALS

- A. Product Data: For each fixture indicated. Include rated capacities, furnished specialties, and accessories.
- B. Operation and Maintenance Data: For fixtures 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. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities" and Public Law 101-336, "Americans with Disabilities Act"; for fixtures for people with disabilities.
- C. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.
- D. ARI Standard: Comply with ARI 1010, "Self-Contained, Mechanically Refrigerated Drinking-Water Coolers," for water coolers and with ARI's "Directory of Certified Drinking Water Coolers" for type and style classifications.
- E. ASHRAE Standard: Comply with ASHRAE 34, "Designation and Safety Classification of Refrigerants," for water coolers. Provide HFC 134a (tetrafluoroethane) refrigerant, unless otherwise indicated.

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. Filter Cartridges: Equal to 50 percent of amount installed for each type and size indicated, but no fewer than 5 of each.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS - REMOTE DRINKING FOUNTAINS

- A. Most Dependable Fountains
- B. Murdock
- C. Elkay

2.2 DRINKING FOUNTAINS

- A. Drinking Fountain (DF-1):
 - 1. (Double, round, bi-level, Standard & ADA Heights) Fountains: ARI 1010; one-piece welded construction 304 schedule 10 stainless steel, 18 gauge electro-polished stainless steel bowl, stainless steel anti-squirt head mounted with lock nut and washer to prevent tampering, mushroom style push bar, self-closing valve, oven baked powder coat, Model 440 SMFA manufactured by most Dependable Fountains. Color **Orange**

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for water and waste piping systems to verify actual locations of piping connections before fixture installation. Verify that sizes and locations of piping and types of supports match those indicated.
- B. Examine walls and floors for suitable conditions where fixtures are to be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

- A. Use mounting frames for recessed water coolers, unless otherwise indicated.
- B. Set freestanding and pedestal drinking fountains on floor.
- C. Set remote water coolers on floor, unless otherwise indicated.
- D. Use chrome plated brass or copper tube, fittings, and valves in locations exposed to view. Plain copper tube, fittings, and valves may be used in concealed locations.

3.3 INSTALLATION

- A. Install fixtures level and plumb. For fixtures indicated for children, install at height required by authorities having jurisdiction.
- B. Install water supply piping with shutoff valve on supply to each fixture to be connected to water distribution piping. Use ball, gate, or globe valve. Install valves in locations where they can be easily reached for operation. Valves are specified in Division 22 Section 220523 "General-Duty Valves for Plumbing Piping."
- C. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.

3.4 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- C. Ground equipment according to Division 26 Section 260526 "Grounding and Bonding for Electrical Systems."
- D. Connect wiring according to Division 26 Section 260519 "Low Voltage Electrical Power Conductors and Cables."

3.5 ADJUSTING

- A. Adjust fixture flow regulators for proper flow and stream height.

3.6 CLEANING

- A. After completing fixture installation, inspect unit. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.
- B. Clean fixtures, on completion of installation, according to manufacturer's written instructions.

END OF SECTION 224700

DIVISION 23

SECTION 230000
HVAC INDEX

SECTION	DESCRIPTION	PAGE NO.
230500	Common Work Results for HVAC	1 - 11
230510	Basic Electrical Requirements for HVAC Equipment	1 - 5
230513	Common Motor Requirements for HVAC Equipment	1 - 2
230548.13	Vibration Controls for HVAC Piping and Equipment	1 - 3
230593	Testing, Adjusting and Balancing for HVAC	1 - 8
233113	Metal Ducts	1 - 7
233300	Air Duct Accessories	1 - 6
233423	HVAC Power Ventilators	1 - 5
233713	Diffusers, Registers, and Grilles	1 - 2
233733	Louvers	1 - 4

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.
- B. All Division 23 Specification Sections also apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Definitions
 - 2. Permits, Codes, and Inspections.
 - 3. Visiting Premises
 - 4. Sleeves.
 - 5. Grout.
 - 6. Supports and anchorages.
 - 7. Access doors and panels.

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, 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 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.

1.4 SUBMITTALS

- A. Product data for the following:
 - 1. Sleeves.
 - 2. Grout.
 - 3. Access doors and panels.

1.5 PERMITS, CODES, AND INSPECTIONS

- A. Contractor shall obtain and pay for all permits and inspections required by laws, ordinances, rules, and regulations having jurisdiction for work included under this Contract, and shall submit approval certificates to the Architect.
- B. The HVAC installation shall comply fully with:
 - 1. All local, county and state laws, ordinances and regulations having jurisdiction and as applicable to the HVAC installations.
 - 2. All approved published instructions set forth by manufacturers of equipment furnished or installed on this project.
- C. The HVAC installation and all components shall be in compliance with all applicable codes and ordinances adopted by the local authority having jurisdiction. Unless noted otherwise in the applicable codes and ordinances adopted by the local authority having jurisdiction, requirements of the latest or state-adopted edition of the following Standards shall apply.
 - 1. American Society for Testing and Materials (ASTM)
 - 2. Americans with Disabilities Act (ADA)
 - 3. International Building Code (IBC)
 - 4. International Fire Code (IFC)
 - 5. International Energy Conservation Code (IECC)
 - 6. National Electric Code (NEC)
 - 7. National Fire Protection Association (NFPA)
 - 8. National Safety Code
 - 9. Occupational Safety and Health Act (OSHA)
 - 10. Sheet Metal & Air Conditioning Contractors National Association Standards (SMACNA)
 - 11. Underwriter's Laboratories, Inc. (UL)
- D. Submit certificates issued to authorized agencies which indicate the work conforms to the above requirements, as well as any additional certificates as may be required for the performance of this contract work.
- E. Certificate of Inspection: The Contractor shall procure and pay for the Certificate of Inspection from the municipality-approved inspection agency and deliver it to the Architect before final payment is made.

1.6 VISITING PREMISES

- A. All bidders are encouraged to visit the project site prior to submitting a bid proposal. The Contractor's is responsible for becoming familiar with the existing conditions of the project prior to submitting a bid proposal. Sufficient allowances shall be included in the bid proposal to perform work that may not be illustrated on the drawings, but due to existing conditions can be reasonably inferred as belonging to work required to complete this contract. Items which cannot be determined from a visual inspection, such as unforeseen conditions that are buried within walls, beneath concrete floors, or above hard ceilings, would not apply.
- B. By submission of a bid, the Contractor is attesting that responsible personnel are aware and familiar with all existing pertinent conditions.
- C. Contractor shall verify all measurements and dimensions at the site which may materially affect the contract price prior to submitting a bid proposal.

1.7 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.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver ducts with shop-applied plastic covers over each opening of every duct. Prior to applying the plastic covers on each duct, vacuum all dirt and debris from its interior. Maintain the plastic covers through shipping and storage. Handle ducts to prevent damage to the ducts and to the plastic covers. If a ducts plastic cover(s) is damaged or comes loose, re-vacuum the interior of the duct and apply new plastic covers. The plastic cover shall be maintained over the openings of each duct until that duct is ready to be installed.

1.9 DRAWINGS AND SPECIFICATIONS

- A. The implied and stated intent of the drawings and specifications is to establish minimum acceptable quality standards for materials, equipment and workmanship, and to provide operable mechanical systems complete in every respect.
- B. Any apparatus, appliance, material or work not typically shown on drawings as standard industry practice but is mentioned in the specifications, or vice versa, shall be provided by the HVAC Trade without additional expense to the Owner.
- C. The drawings are diagrammatic, intending to show general arrangement and location of system components, and are not intended to be rigid in detail.
- D. Due to the small scale of the drawings, all offsets and fittings required for a complete installation may not be shown but shall be provided at no change in Contract price.
- E. The equipment schedules shown on the drawings list the manufacturer used as the basis of design in the preparation of the Bid Drawings.
 - 1. The equipment specifications list that manufacturer as well as other manufacturers the Engineer, Architect and/or Owner find acceptable from a performance and product quality perspective, but not as the basis of design, provided the requirements of the specifications are met.
 - 2. Listing these other manufacturers in no way implies that the Engineer or Architect has exhaustively researched the products available by these manufacturers to determine whether they offer products which meet all of the specified requirements.
 - a. Manufacturers shall only offer proposals that meet the specified items.
 - b. Substitutions that in the engineer's opinion, do not meet the specified requirements due to variations in manufacturing or available options, will not be approved.
 - 3. Listing these other manufacturers in no way implies that the Engineer or Architect has exhaustively researched the products available by these manufacturers to determine whether they have a positive or negative monetary impact on the design shown on the Bid Drawings.

4. In addition, listing these other manufacturers in no way implies that the Engineer or Architect has exhaustively researched the products available by these manufacturers to determine whether the dimensions of these products will have a negative impact on the space allotted for this equipment.
5. If the Contractor or his Subcontractors decide to use a product or manufacturer that is listed as acceptable in the specifications but is different from the product or manufacturer scheduled on the drawings, it will be the responsibility of the Contractor or his Subcontractors to fully explore the product to ensure that it can be installed in the space allotted and shall pay any and all costs (including additional professional design fees) associated with the use of these products or manufacturers that impact the structure, the electrical system(s), the plumbing system(s) and/or the fire protection system(s) due to an increase in weight, electrical load, drain and vent requirements, connection sizes, etc., between the scheduled item and the equipment item used.
6. Use of a product or manufacturer not scheduled on the Bid Drawings constitutes a representation that:
 - a. The HVAC Trade has investigated the proposed product and determined that the product can be installed within the space allotted.
 - b. The HVAC Trade will coordinate the installation of product used into the work
 - c. The HVAC Trade will be responsible for making all changes as may be required to make the work complete in all respects; waives all claims for additional costs under his responsibility, which may subsequently become apparent.

PART 2 - PRODUCTS

2.1 NAMEPLATE DATA

- A. Provide factory-installed, permanent operational data nameplate on each item of HVAC equipment, indicating manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliances, and similar essential data.

2.2 SLEEVES

- A. Galvanized Steel Sheet (For Ductwork Only): 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.

2.3 GROUT

- A. Description: ASTM C 1107, Grade B, non-shrink and nonmetallic, dry hydraulic cement grout.
 1. Characteristics: Post hardening, volume adjusting, non-staining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 2. Design Mix: 5000-psi, 28-day compressive strength.
 3. Packaging: Premixed and factory packaged.

2.4 METAL SUPPORTS AND ANCHORAGES

- A. Structural design shall be provided through the HVAC trade by a civil or structural Engineer who is registered in the Commonwealth of Pennsylvania.
- B. Details of all structural steel shall be provided in shop drawing format. All structural steel shop drawings shall be stamped by the HVAC Trade's design Engineer prior to submittal.
- C. The design, materials, fabrication and erection shall conform to "Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings" of the American Institute of Steel Construction, "Code of Standard Practice for Steel Buildings and Bridges", of the American Institute of Steel Construction, and also, when applicable, shall conform to the "Code for Welding Building Construction" of the American Welding Society.
- D. Steel angles, channels, and plate shall be in accord with ASTM A36.
- E. Bolts, including nuts and washers, used for fabricating steel members shall be in accord with ASTM A325.
- F. Steel members, including fasteners, exposed to weather shall be galvanized.

2.5 ACCESS DOORS AND PANELS

- A. Manufacturers - subject to compliance with requirements, provide products by one of the following:
 - 1. Bar-Co., Inc.
 - 2. J.L. Industries
 - 3. Karp Associates, Inc.
 - 4. Milcor Division, Inryco, Inc.
 - 5. Nystrom, Inc.
- B. Steel Access Doors and Frames: Factory fabricated and assembled units, complete with attachment devices and fasteners ready for installation. Joints and seams shall be continuously welded, with welds ground smooth and flush with adjacent surfaces.
 - 1. Door material - 16-gauge steel, having a factory-prime finish suitable for field painting except as follows:
 - 2. Frame material - same material and finish as door, with the following features:
 - a. For installation in masonry, concrete, ceramic tile, or wood paneling: 1 inch-wide-exposed perimeter flange and adjustable metal masonry anchors.
 - b. For gypsum wallboard or plaster: Perforated flanges with wallboard bead.
 - c. For full-bed plaster applications: Galvanized expanded metal lath and exposed casing bead, welded to perimeter of frame.
- C. Flush Panel Doors: Furnish with concealed spring hinges or concealed continuous piano hinge.
- D. Fire rated Units: Insulated flush panel doors, with continuous piano hinge and self-closing mechanism.
 - 1. Fire Resistance Rating: Not less than 1½-hours.

- E. Locking Devices: Flush, screwdriver operated cam locks.
- F. Size: Doors and/or panels shall be of sufficient size for the intended function, but not less than 12 inches by 16 inches.

PART 3 - EXECUTION

3.1 INSTALLATION - GENERAL

- A. Before any HVAC construction work is performed and/or any equipment and materials are ordered, the HVAC Trade shall examine the project area(s) where HVAC work will be performed to verify actual locations, dimensions, and other conditions that may affect the installation of HVAC equipment, materials and associated work.

3.2 COORDINATION

- A. Arrange for 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."

3.3 SUBSTITUTIONS

- A. Provide in accordance with Division 01 Section SUBSTITUTION PROCEDURES and as stated below.
- B. Where the contractor proposes substitute equipment, contractor to submit complete product data indicating compliance with all requirements of the documents, including performance rating, size and resistance to wear and deterioration equivalent to the specified item at least ten (10) days prior to the bid date. In instances where substituted equipment requires additional material or work beyond that shown or required by the specified item, said additional material or work shall be the responsibility of this Contractor, regardless of the trade involved.

3.4 SUBMITTALS

- A. Provide in accordance with Division 01 Section SUBMITTAL PROCEDURES.

3.5 CUTTING AND PATCHING

- A. Cutting and patching shall be in accordance with the General Conditions and the applicable Section of Division 01, General Requirements.

- B. The HVAC trade shall seal all openings he has utilized in fire rated floors, ceilings or partitions after his work has been installed. The material used for sealing the openings shall have a fire-rating equal to or greater than the rating of the floor, ceiling or partition material.
- C. In new construction, where openings, chases, sleeves, inserts, anchors, etc., have not been provided by the General Trade, the HVAC trade shall be responsible for providing all cutting, patching, and finishing of new construction which is not specifically shown on the Architectural Drawings, but is required for the proper installation of HVAC equipment and materials as shown on the HVAC Drawings and specified in Division 23.
- D. Cutting, patching and finishing shall be performed by workmen skilled in this type of work. All patching shall be done utilizing materials of the same quality and texture as the adjacent undisturbed areas. All finishing shall match the undisturbed adjacent areas. Painting of the final finished areas, where general construction work occurs, will be the responsibility of the General Trade. Painting of the final finished areas, where no general construction work occurs, shall be the responsibility of the HVAC trade. The HVAC trade shall paint entire plane in which damage occurs whether the surface is a wall or a ceiling.
- E. No cutting shall be done which may affect the building structurally or architecturally without first consulting with the General Trade and then securing the approval of the Architect. Cutting shall be accomplished in such a manner as not to cause damage to the building or leave unsightly surfaces which cannot be concealed by plates, escutcheons or other construction. Where such unsightly conditions are caused, the HVAC trade shall be required, at his own expense, to repair the damaged areas. Note: all holes or openings in existing concrete or masonry shall be drilled, core bored or saw cut.
- F. Where an opening is cut into a block or brick wall for the purpose of ductwork or piping to pass through the wall, the HVAC trade shall be responsible for furnishing and installing a properly sized lintel to support the block or brick above the opening.
- G. Where present equipment or material is removed and unused openings remain in walls, floors, partitions, etc., the HVAC trade shall properly patch all such openings.

3.6 SPECIAL CONDITIONS RELATED TO HVAC WORK

- A. During the course of construction, cap or otherwise seal off, in an approved manner, those portions of the piping or duct system in which work is not being performed, in order to prevent the entry of dirt or dust. Should the HVAC trade fail to cover open ends of ducts, he may be required to vacuum the entire duct system and remove sections of ductwork for inspection.
- B. The HVAC trade shall coordinate all utility shutdowns with the Owner to determine when the most advantageous time is for the Owner to accommodate the utility shutdown. The HVAC trade shall coordinate the utility shutdown a minimum of **7 days** in advance.
- C. Install equipment along with control devices and all replaceable fittings with sufficient clearance for operation and maintenance functions.
- D. Lay out the work and establish all heights **and grades** required for installation.
- E. Provide safety guards for all pulleys, belt-drives and rotating equipment. Safety requirements of OSHA shall be met.

3.7 SPACE PRIORITY

- A. Ensure equitable use of available space for materials and equipment installed above ceilings. Allocate space in the order of priority as listed below. Items are listed in the order of priority, with items of equal importance listed under a single priority number.
 - 1. Gravity flow piping systems.
 - 2. Vent piping systems.
 - 3. Ceiling recessed lighting fixtures.
 - 4. Concealed air terminal units, fans.
 - 5. Air duct systems.
 - 6. Sprinkler systems piping.
 - 7. Forced flow piping systems.
 - 8. Electrical conduit, wiring, control wiring.
- B. Order of priority does not dictate installation sequence. Installation sequence shall be as mutually agreed by all affected trades.
- C. Change in order of priority is permissible by mutual agreement of all affected trades.
- D. The work of a particular trade shall not infringe upon the allocated space of another trade without permission of the contractor for the affected trade.
- E. The work of a particular trade shall not obstruct access for installation, operation, and maintenance of the Work, materials and equipment of another trade.

3.8 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.
- E. Install all new, relocated, or owner furnished equipment in accord with the manufacturer's written installation instructions.

3.9 PAINTING

- A. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.10 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Provide all materials, equipment, supplies and labor necessary to construct all miscellaneous steel required for supporting piping, ductwork and equipment for installation of the HVAC system. All miscellaneous steel, metal supports and anchorages required for supporting ductwork, piping and equipment is not shown on the Drawings, but shall be provided.
- B. All structural steel shall be designed to attach to the main building structure in such a manner as to not overstress this structure. Reinforcement of the building structure may be required in work areas located in existing buildings and in areas where the HVAC trade has relocated ductwork, piping, and equipment to areas other than is shown on the Drawings.
- C. Refer to Division 05 Section "Metal Fabrications" for structural steel.
- D. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.
- E. Shop and Field Welding: Shop and field welding shall be in accordance with AWS D1.1.

3.11 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.

3.12 FINAL CLEANING

- A. Provide in accordance with Division 01 Section CLOSEOUT PROCEDURES.

3.13 WARRANTIES

- A. Provide in accordance with Division 01 Section CLOSEOUT PROCEDURES and as stated below.
- B. Refer to individual equipment specifications for additional warranty requirements. If a contradiction exists, the most demanding requirements shall prevail.

- C. Compile and assemble the warranties specified in Division 23 into a separated set of vinyl covered, three ring binders, tabulated and indexed for easy reference.
- D. Provide complete warranty information for each item to include date of beginning of warranty or bond; duration of warranty or bond; and names, address, and telephone numbers and procedures for filing a claim and obtaining warranty services.
- E. Submit a single warranty stating that all portions of the work are in accordance with Contract requirements. Warrant all work against faulty and improper material and workmanship for a period of one (1) year from date of final acceptance by the Owner, except that where guarantees or warranties for longer terms are specified herein, such longer term shall apply. Within 24 hours after notification, correct any deficiencies that occur during the warranty period at no additional cost to Owner, all to the satisfaction of the Owner and Architect. Obtain similar warranties from subcontractors, manufacturers, suppliers and sub-trade specialists.
- F. Any material, equipment or appurtenance whose operation or performance does not comply with the requirements of the Contract Documents or that are damaged prior to acceptance will be held as defective and shall be removed and properly replaced at no additional cost to the Owner.

3.14 INSTALLATION OF ACCESS DOORS AND PANELS

- A. Access Doors and Panels:
 - 1. Where HVAC devices which require periodic maintenance, cleaning or adjustment will be concealed in shafts, chases, above drywall ceilings and in other inaccessible general construction work, the General Contractor shall furnish and install access doors and panels for all such devices. These HVAC devices include, but are not limited to, valves, traps, air vents, cleanouts, damper regulators, fire dampers, smoke dampers, controls and other devices,
 - 2. The HVAC Trade in conjunction with the General Trade shall determine door and/or panel locations subject to the Architect's approval. Locate items to be made accessible through doors and/or panels so that the doors and/or panels may be installed with not less than 6 inches between an edge and the surface of any intersecting construction or opening.
 - 3. Access doors and panels shall be installed in accordance with the manufacturers written recommendations and Division 08 of these Specifications.

3.15 MAINTENANCE MANUALS

- A. Provide in accordance with Division 01 Section OPERATION AND MAINTENANCE DATA and as stated below.
- B. Include the following information for equipment items:
 - 1. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.
 - 2. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions.
 - 3. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.

4. Servicing instructions and lubrication charts and schedules.
5. Provide a cover sheet for each manual including the project name, Architect's name and contact information, Engineer's name and contact information, and Division 23 contractor's name and contact information.
6. Alphabetical list of all system components, with the name, address, and 24-hour phone number of the company responsible for servicing each item during the first year of operation.
7. Manufacturer's data of each piece of equipment including:
 - a. Installation instructions.
 - b. Drawings and Specifications.
 - c. Parts list, including recommended items to be stocked.
 - d. Complete wiring diagrams.
 - e. Marked or changed prints locating all concealed parts and all variations from the original system design.
 - f. Test and inspection certificates.

3.16 RECORD DOCUMENTS

- A. Provide in accordance with Division 01 Section PROJECT RECORD DOCUMENTS and as stated below.
- B. Indicate installed conditions for the following:
 1. Ductwork.
 2. Duct Accessories
 3. HVAC Equipment.
 4. Automatic Temperature Control Panels, Control Devices, and Sensors.
 5. Approved substitutions, Contract Modifications, and actual equipment and materials installed.

3.17 DEMONSTRATION AND TRAINING

- A. Provide in accordance with Division 01 Section DEMONSTRATION AND TRAINING and as stated below.
- B. After the tests and adjustments have been made, approved factory-authorized system representatives and the Contractor shall fully instruct Owner in all details of operation and maintenance of equipment installed under this Contract. Dates and times of such instructions shall be as directed by Owner, including any necessary weekend or after-hours instruction.
- C. The following is a list systems that require Demonstration and Training, refer to the individual specification sections for additional training requirements:
 1. HVAC Equipment.
 2. Duct Accessories

END OF SECTION 230500

SECTION 230510
BASIC ELECTRICAL 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.
- B. All Division 23 Specification Sections also apply to this Section.

1.2 SUMMARY

- A. Section includes the following:
 - 1. Disconnect Switches
 - 2. Fuses
 - 3. Electrical Requirements - General

1.3 SUBMITTALS

- A. Product Data:
 - 1. For each type of disconnect switch. Include dimensions and electrical characteristics, ratings, and finishes. Also include dimensioned plans, elevations, sections, and details, Include the following:
 - a. Wiring Diagrams: Power wiring.
 - 2. For each type of fuse. Include electrical characteristics and ratings.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain disconnect switches of a single type through one source from a single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a qualified testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.
- C. Comply with NFPA 70.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store disconnect switches and fuses indoors in clean, dry space with uniform temperature to prevent condensation. Protect disconnect switches and fuses from exposure to dirt, fumes, water, corrosive substances, and physical damage.

- B. If stored in areas subject to weather, cover disconnect switches and fuses to protect them from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and flammable materials from inside equipment; install electric heating of sufficient wattage to prevent condensation.

1.6 COORDINATION

- A. Coordinate layout and installation of disconnect switches 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 features of disconnect switches with pilot devices and control circuits to which they connect.
- C. Coordinate features, accessories, and functions of each disconnect switch with ratings and characteristics of supply circuit, motor, required control sequence, and duty cycle of motor and load.

PART 2 - PRODUCTS

2.1 DISCONNECT SWITCHES

- A. Acceptable Manufacturers:
 - 1. Square D
 - 2. Cutler Hammer
 - 3. General Electric
 - 4. Siemens
- B. Heavy Duty Safety Switches: Provide surface-mounted, heavy-duty type, sheet-steel enclosed safety switches of types, sizes and electrical characteristics indicated on the drawings.
- C. Provide switches with quick-make, quick-break type operation, with switchblades that are visible in the 'OFF' position with door open.
- D. Operating handle shall be an integral part of the enclosure base the operating position shall be easily recognizable and pad-lockable in OFF position.
- E. Current carrying parts shall be constructed of 98% conductivity copper, with silver-tungsten type switch contacts and positive pressure type reinforced fuse clips.
- F. Enclosures shall meet environmental conditions of installed location.
 - 1. Indoor Locations: NEMA 250, Type 1
- G. Provide motor and motor starter disconnects with horsepower ratings suitable to the loads.

- H. Fusible Switches: Heavy duty switches, with positive pressure type reinforced fuse clips and fuses of classes and current ratings indicated.
 - 1. Non-fused disconnect switches may be used provided that the equipment nameplate makes no reference to "maximum fuse size", "maximum overcurrent protection", "fuse size" or "MFS".
- I. Provide disconnect switches having the capability to have auxiliary contacts mounted as required.
- J. Disconnects shall be finished in manufacturer's standard gray finish unless otherwise noted on drawings.
- K. Disconnect switches specified as being an integral part of a piece of equipment shall come factory installed and wired.

2.2 FUSES

- A. Acceptable Manufacturers:
 - 1. Bussman Division of Cooper Industries, Inc.
 - 2. Shawmut Division of Gould, Inc.
 - 3. Littlefuse, Inc.
- B. All fuses shall be Class RK1, time delay type.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and surfaces to receive disconnect switches for compliance with requirements, installation tolerances, and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 ELECTRICAL REQUIREMENTS - GENERAL

- A. In general, rigid conduit or tubing shall be used, but equipment that requires movement or that would transmit vibration to conduit shall be wired with flexible (liquid tight) steel conduit not exceeding 18" in length.
- B. All equipment shall be grounded with a green-covered ground wire run inside the conduit and connected to equipment frame on one end and to grounding system on the other end.
- C. All electrical work required in Division 23 shall conform to all applicable requirements of Division 26 of these Specifications, and shall comply with the latest edition of the National Electric Code.

- D. The HVAC Trade shall assign all low-voltage and line-voltage Electrical Control Work required under this Contract to the Automatic Temperature Control contractor, who shall perform this work with qualified electricians employed by that contractor.
- E. The HVAC Trade shall co-operate with the contractor for Electrical Work in making all necessary tests and in receiving, storing and setting all motor-driven equipment, electrical devices, and controls furnished and/or installed under these Contracts.
- F. Single phase equipment controls and wiring shall be as follows:
 - 1. HVAC Trade shall retain the services of an ATC contractor, who shall furnish and install all control devices, such as motor sentinel switches, PE switches, thermostats, etc.
 - 2. The Electrical Trade shall complete all power wiring and connections for single phase equipment, through the disconnect and/or the thermal cutouts and local control stations to the equipment as required.
 - 3. The HVAC Trade will furnish a THERMAL OVERLOAD SWITCH for all single phase motors except where units are furnished with built-in Thermal Protection, in which case he will furnish a single pole switch.

3.3 CONTROL WIRING INSTALLATION

- A. Install wiring between enclosed controllers according to Division 26.
- B. Bundle, train, and support wiring in enclosures.
- C. Connect hand-off-automatic switch and other automatic control devices where applicable.
 - 1. Connect selector switches to bypass only manual control and automatic control devices that have no safety functions when switch is in hand position.
 - 2. Connect selector switches in both hand and automatic positions for safety-type control devices such as low and high pressure cutouts, high temperature cutouts, and motor overload protectors.

3.4 CONNECTIONS

- A. Conduit installation requirements are specified in other Division 26. Drawings indicate general arrangement of conduit, fittings, and specialties.
- B. Ground equipment according to Division 26.

3.5 DISCONNECT SWITCHES

- A. For each HVAC equipment item being furnished on the project the HVAC Trade shall:
 - 1. Review/coordinate with the equipment manufacturer to determine whether a disconnect switch will be furnished with it.
 - 2. Review the electrical drawings and/or coordinate with the Electrical Trade to determine whether the Electrical Trade will be providing a disconnect switch for the equipment item.

- B. A disconnect switch shall be provided for each HVAC equipment item that has a 1-phase or 3-phase power connection. The HVAC Trade shall provide a disconnect switch for an equipment item unless one of the following occur:
 - 1. The equipment manufacturer is required to furnish or provide a disconnect switch or a combination motor starter/disconnect for the equipment item.
 - 2. The electrical drawings require the Electrical Trade to provide a disconnect switch for the equipment item.
- C. Mount disconnect switch to the equipment item it serves. If a disconnect switch cannot be mounted to the equipment item it serves or the drawings indicate the disconnect switch to be mounted in a different location, mount switch in a location within 50 feet and within eyesight of the equipment item. Provide miscellaneous steel as required to mount the disconnect switch.
 - 1. Bolt disconnect switches to equipment casing or to wall, or mount on free-standing lightweight structural steel channels and bolted to floor, equipment rails or roof curb.

3.6 FUSES

- A. Fuses: Fuses shall be provided for each HVAC equipment item having power connection and requiring fuses. If fuses are not furnished with the HVAC equipment item, then the HVAC Trade shall provide all the necessary fuses for proper operation of the equipment and the electrical circuit.
 - 1. Install fuses in each fusible switch. Comply with requirements in Division 26.

3.7 IDENTIFICATION

- A. Identify disconnect switches, components, and control wiring according to Division 23 Section 230553 "Identification for HVAC Piping and Equipment."

3.8 PIPING AND DUCTWORK COORDINATION

- A. The HVAC Trade shall not run ductwork or piping above switchboards or panelboards in accordance with the National Electric Code Article 384. Before ductwork or piping is installed coordinate the exact locations with the Electrical Trade. Failure to comply with this requirement shall be cause for the ductwork and piping to be removed and relocated at no additional cost to the Owner.

END OF SECTION 230510

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.
- B. All Division 23 Specification Sections also 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.

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. Efficiency: NEMA Premium efficiency, as defined in NEMA MG 1.
 - 1. Electric motors shall comply with the requirements of the Energy Policy Act of 1992.
 - 2. Motors that are single-speed, polyphase, 1-500 horsepower, 2, 4, and 6 pole, squirrel cage induction type, NEMA Design A or B, continuous rated shall be NEMA Premium efficiency electric motors.
 - a. NEMA Premium efficiency electric motors must meet or exceed the nominal energy efficiency levels presented below.
 - 1) The NEMA Premium efficiency levels are contained in NEMA Standards Publication MG 1- 2006, in Tables 12-12 and 12-13, respectively.

- D. Comply with IEEE 841 for severe-duty motors.

2.2 MOTOR CHARACTERISTICS

- A. Duty: Continuous duty at ambient temperature of 104°F 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.

2.3 SINGLE PHASE MOTORS

- A. Bearings: Pre-lubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
- B. 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.
- C. Electronic Commutation (EC) Motors: Each EC motor shall be specifically designed for its particular application. EC motors shall be permanently lubricated, shall have heavy-duty ball bearings to match the load, and shall be prewired to the specific voltage and phase. EC motors shall have internal motor circuitry to convert AC power supplied to DC power in order to properly operate the motor. EC motors shall be capable of having their speed controlled down to 20% of full speed (80% turndown). EC motor speed shall be controlled by either a potentiometer dial mounted on the motor or by a 0-10 VDC signal. Each EC motor shall have a minimum efficiency of 85% at all speeds.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 230513

SECTION 230548.13
VIBRATION 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.
- B. All Division 23 Specification Sections also apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Spring hangers.

1.3 DEFINITIONS

- A. IBC: International Building Code.
- B. ICC-ES: ICC-Evaluation Service.

1.4 SUBMITTALS

- A. Product Data: Include rated load, rated deflection, and overload capacity for each vibration isolation device. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of isolation device component used.

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATORS

- A. Manufacturers - subject to compliance with requirements, provide products by one of the following:
 - 1. Amber/Booth Company, Inc.
 - 2. Kinetics Noise Control
 - 3. Mason Industries
 - 4. Vibration Eliminator Co., Inc.
 - 5. Vibration Isolation
 - 6. Vibration Mountings & Controls, Inc.

- B. 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.

2.2 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 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 VIBRATION CONTROL DEVICE INSTALLATION

- A. 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.
- B. 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 pre-stressed 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.

3.3 ADJUSTING

- A. 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.
- B. Adjust active height of spring isolators.

3.4 VIBRATION CONTROLS SCHEDULE

1. Spring Hangers - provide spring hangers for the following:
 - a. Each in-line exhaust fan.

END OF SECTION 230548.13

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.
- B. All Division 23 Specification Sections also apply to this Section.

1.2 SUMMARY

- A. Section Includes
 - 1. Balancing Air Systems:
 - a. Constant volume air 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. Certified TAB reports.
- B. 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 Contractor Qualifications: Engage a TAB entity certified by NEBB, AABC, or TABB.
 - 1. TAB Field Supervisor: Employee of the TAB contractor and certified by NEBB, AABC, or TABB.
 - 2. TAB Technician: Employee of the TAB contractor and who is certified by NEBB, AABC, or TABB as a TAB technician.
- B. Certify TAB field data reports and perform the following:
 - 1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
 - 2. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.
- C. TAB Report Forms: Use standard TAB contractor's forms published by AABC or NEBB.
- D. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation."

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 (7) days advance notice to the Contractor and Owner prior to commencement of TAB work. Include scheduled test dates and times. Provide seven (7) days advance notice to any changes in the scheduled dates and times.
- B. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

1.8 TAB SPECIALISTS

- A. Subject to compliance with requirements, engage one of the following independent TAB contractors to provide the TAB work:
 - 1. Kahoe Air Balance Company
 - 2. Northstar Environmental, Ltd.
 - 3. Professional Balance Company
 - 4. WAE Balancing, Inc.

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. Notify contractor, Architect and Engineer immediately upon discovery of any deficiencies.
- 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. Notify contractor immediately upon discovery of any balancing devices not present that will prevent balancing of the system.
- C. Examine the approved submittals for HVAC systems and equipment.
- D. Verify that transfer ducts or penetrations in plenum walls exist to enable air flow through plenum as indicated or required.
- E. Examine equipment performance data including fan curves.
- F. Obtain and examine start-up test reports to verify that start-up testing, cleaning, and adjusting of HVAC equipment and systems have been performed prior to the commencement of TAB work.
- G. 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.
- H. Examine suspended equipment, such as in-line fans, etc., and verify that they are accessible and their controls are connected and functioning.
- I. Examine operating safety interlocks and controls on HVAC equipment.
- J. Report deficiencies discovered before and during performance of TAB procedures to the contractor, Architect and Engineer.

3.2 PREPARATION

- A. Prepare a TAB plan that includes strategies and step-by-step procedures.
- B. Complete system-readiness checks. Verify the following:
 - 1. Permanent electrical power wiring is complete.
 - 2. Automatic temperature-control systems are operational.
 - 3. Equipment and duct access doors are securely closed.
 - 4. Balancing dampers are open.
 - 5. Windows and doors can be closed so indicated conditions for system operations can be met.

3.3 GENERAL PROCEDURES FOR TESTING, ADJUSTING AND BALANCING

- A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Total System Balance," NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems," or SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing," and the requirements contained in this Section.
- B. Mark equipment and balancing devices, including damper control positions and fan speed control levers and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.
- C. 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. Determine the best locations in main and branch ducts for accurate duct airflow measurements.
- C. 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.
- D. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- E. Check dampers for proper position to achieve desired airflow path.
- F. Check for airflow blockages.
- G. Verify that air duct system is sealed as specified in Division 23 Section 233113 "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 at outlet of supply fans or inlet of exhaust fans using Pitot-tube traverse measurements.
 - 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. For each fan on the project, make adjustment of fan speed higher or lower than scheduled speed in order to achieve design airflow rates. 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.
 - a. 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 at terminal outlets and inlets without making adjustments and calculate the total airflow for that zone.
 - a. Measure terminal outlets using a direct reading hood or outlet manufacturer's written instructions and calculating factors.
 2. Adjust volume dampers until the proper airflow rate for that zone is achieved.
 3. Re-measure each sub-main and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.
- C. 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 TOLERANCES

- A. Set HVAC system's **air flow rates and water flow rates** within the following tolerances:
 1. Supply, Return, Relief and Exhaust Fans and Equipment with Fans: Zero to plus 5 percent of scheduled design flow.
 2. Air Outlets and Inlets: Plus, or minus 10 percent of design flow indicated.
 3. Heating Water Pump Flow Rate: Zero to plus 5 percent of scheduled design flow.
 4. Cooling Water Pump Flow Rate: Zero to plus 5 percent of scheduled design flow.
 5. Terminal Unit Cooling Water Flow Rate: Plus, or minus 10 percent of design flow indicated.
 6. Terminal Unit Heating Water Flow Rate: Plus, or minus 10 percent of design flow indicated.

3.7 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.
 - 3. Not all components listed below apply to this project. Provide data for each existing component, or component furnished to the jobsite as applicable.
- B. Final Report Contents - in addition to certified field report data, include the following:
 - 1. Field test reports (start-up reports) prepared by system and equipment installers.
 - 2. Other information relative to equipment performance such as fan curves and pump curves; 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.
 - 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 **fan 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. Variable frequency drive settings for variable air volume systems.
 - f. Settings for supply air, static pressure controller.
 - g. Other system operating conditions that affect performance.

D. Fan Test Reports - for all fans external to air handling units, rooftop units and terminal equipment such as 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.
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.
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. Voltage at each connection.
 - e. Amperage for each phase.
 - f. Discharge static pressure in inches wg.
 - g. Suction static pressure in inches wg.

E. Rectangular Duct Traverse Reports - for main supply and return ducts for each system, include a diagram with a grid representing the duct cross-section and record the following:

1. Report Data:
 - a. System and air handling unit number.
 - b. Location and zone.
 - c. Traverse air temperature in degree F.
 - d. Duct static pressure in inches wg.
 - e. Duct size in inches.
 - f. Duct area in sq. ft.
 - g. Indicated air flow rate in cfm.
 - h. Indicated velocity in fpm.
 - i. Actual air flow rate in cfm.
 - j. Actual average velocity in fpm.
 - k. Barometric pressure in psig.

F. Air Terminal Device Reports - for each diffuser, register and grille, include the following:

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 square feet.
- j. Design air flow rate in cfm.

2. Test Data (Indicated and Actual Values):

- a. Air flow rate in cfm.
- b. Air velocity in fpm.
- c. Preliminary air flow rate in cfm.
- d. Preliminary velocity in fpm.
- e. Final air flow rate in cfm.
- f. Final velocity in fpm.

G. Instrument Calibration Reports

1. Report Data:

- a. Instrument type and make.
- b. Serial number.
- c. Application.
- d. Dates of use.
- e. Dates of calibration.

3.8 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 233113
METAL DUCTS

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.
- B. All Division 23 Specification Sections also apply to this Section.

1.2 SUMMARY

- A. Section Includes
 - 1. Single-wall rectangular ducts and fittings.
 - 2. Sealants and gaskets.
 - 3. Hangers and supports.

1.3 PERFORMANCE REQUIREMENTS

- A. Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in the "Duct Schedule" article in this Section.

1.4 SUBMITTALS-*

- A. Product data - for each type of the following products:
 - 1. Liners and adhesives.
 - 2. Sealants and gaskets.
- B. Shop Drawings - plans, drawn to scale at a minimum of $\frac{1}{4}" = 1'-0"$, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
 - 2. Factory and shop fabricated ducts and fittings.
 - 3. Duct layout indicating sizes, configuration, liner material, and static pressure classes.
 - 4. Elevation of top of ducts.
 - 5. Dimensions of main duct runs from building grid lines.
 - 6. Fittings.
 - 7. Reinforcement and spacing.
 - 8. Seam and joint construction.
 - 9. Penetrations through fire rated and other partitions.
 - 10. Equipment installation based on equipment being used on Project.
 - 11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.

12. Hangers and supports, including methods for duct and building attachment and vibration isolation.
13. Suspended ceiling components.
14. Structural members to which duct will be attached.
15. Size and location of ceiling grid modules for acoustical tile.
16. Items penetrating finished ceiling including the following:
 - a. Lighting fixtures.
 - b. Air outlets and inlets.
 - c. Speakers.
 - d. Sprinklers.
 - e. Access panels.
 - f. Bulkheads.
 - g. Perimeter moldings.

PART 2 - PRODUCTS

2.1 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static pressure class unless otherwise indicated.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-4, "Transverse (Girth) Joints," for static pressure class, applicable sealing requirements, materials involved, duct support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-5, "Longitudinal Seams - Rectangular Ducts," for static pressure class, applicable sealing requirements, materials involved, duct support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 2, "Fittings and Other Construction," for static pressure class, applicable sealing requirements, materials involved, duct support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.2 SHEET METAL MATERIALS

- A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
 1. Galvanized Coating Designation: G90 (Z275).
 2. Finishes for Surfaces Exposed to View: Mill phosphatized.

- C. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
 - 1. Where black and galvanized steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.
- D. Tie Rods: Galvanized steel, 1/4 inch minimum diameter for lengths 36 inches or less; 3/8 inch minimum diameter for lengths longer than 36 inches.

2.3 SEALANT AND GASKETS

- A. General Sealant and Gasket Requirements: Surface burning characteristics for sealants and gaskets shall be a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested according to UL 723; certified by an NRTL. Also, sealants and gaskets shall conform to UL 181A for metal ducts and UL 181B for flexible air ducts and flexible air connectors.
 - 1. Closure systems used to seal ductwork listed and labeled in accordance with UL 181A shall be marked "181A-P" for pressure sensitive tape, "181A-M" for mastic, or "181A-H" for heat sensitive tape. Closure systems used to seal flexible air ducts and flexible air connectors shall comply with UL 181B shall be marked "181B-FX" for pressure sensitive tape, or "181B-M" for mastic.
- B. Water Based Joint and Seam Sealant:
 - 1. Type: Vinyl Acetate.
 - 2. Solids Content: 69.2 percent.
 - 3. Weight: 11.6 .2 lbs./gallon
 - 4. Color: Grey.
 - 5. Odor: Mild/Wet; Bland/Dry.
 - 6. VOC: 22 gms./ltr.
 - 7. Viscosity: 140,000-180,000 CPS # 7 Brookfield, 20 RPM at 70°F.
 - 8. Flammability: Non-Flammable.
 - 9. Effect of Freezing: No damage - 3 Cycles.
 - 10. Service: Indoor and outdoor use.
 - 11. Storage Life: 6 Months at 70°F.
 - 12. Cure Time: 48 hours.
 - 13. Method of Application:
 - a. Brush, trowel, putty knife or caulking gun.
 - 14. Product: Sealant shall be equivalent to Duro Dyne DDS-181.
- C. Flanged Joint Sealant: Comply with ASTM C 920.
 - 1. General: Single-component, acid-curing, silicone, elastomeric.
 - 2. Type: S.
 - 3. Grade: NS.
 - 4. Class: 25.
 - 5. Use: O.
 - 6. For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- D. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

2.4 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Cadmium plated steel rods and nuts.
- B. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1 (Table 4-1M), "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct."
- C. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- D. Trapeze and Riser Supports:
 - 1. Supports for Galvanized steel Ducts: Galvanized steel shapes and plates.

PART 3 - EXECUTION

3.1 DUCTWORK - GENERAL

- A. Do not install ductwork in transformer vaults, elevator equipment rooms or electrical equipment rooms unless the ductwork serves HVAC equipment located in that room and is dedicated to provide cooling and/or heating to that room. Do not install ductwork adjacent to or above any surface of electrical controls, panels, switches, terminals, boxes or similar electrical equipment. Drip-pan protection shall not be permitted, except where detailed.

3.2 PROTECTION OF DUCT

- A. Immediately after fabrication, the duct shall be cleaned of all dirt, dust and debris. The ends of the duct section shall then be securely covered with plastic and strapping tape. The duct shall then be completely covered with cloth or plastic.
- B. When each duct section transported to the job site, the covering over the ends of each duct shall be maintained to prevent the entrance of dirt, dust and debris. In addition, all ducts shall be covered with plastic or cloth.
- C. Immediately after the duct arrives at the job site and prior to being installed, the covering over the ends of each duct shall be maintained to prevent the entrance of dirt, dust and debris. In addition, all ducts shall be covered with plastic or cloth.
- D. When each duct is installed, the plastic covering shall be removed. Once installed, the duct section shall be inspected for the existence of dirt or dust; if discovered, the duct section shall be cleaned of all dirt and dust. Unless the next section of duct is in the process of being installed, the end of the duct shall securely covered with plastic and strapping tape.

3.3 DUCT INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.
- B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- C. Install ducts with fewest possible joints.
- D. Install factory or shop fabricated fittings for changes in direction, size, and shape and for branch connections.
- E. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- F. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- G. Install ducts with a minimum clearance of 1 inch plus allowance for insulation thickness.
- H. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
- I. Where ducts pass through non-fire rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.
- J. Where ducts pass through fire rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Division 23 Section "Air Duct Accessories" for fire and smoke dampers.

3.4 DUCT SEALING

- A. Seal ducts for duct static pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- B. Closure systems used to seal metal ductwork shall be installed in accordance with the manufacturer's installation instructions.
- C. Unlisted duct tape is not permitted as a sealant on any metal ducts.
- D. Duct connections to flanges of air distribution system equipment shall be sealed and mechanically fastened.
 - 1. Mechanical fasteners for use with flexible non-metallic air ducts shall comply with UL 181B and shall be marked "181B-C."

3.5 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Hangers and Supports."
- B. Ducts shall be supported directly from the building substrate. Ducts are not permitted to be supported from other ducts, pipes, conduits, or cable tray.
- C. Building Attachments: Structural-steel fasteners appropriate for construction materials to which hangers are being attached.
- D. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1 (Table 4-1M), "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.
- E. Hangers Exposed to View: Threaded rod and angle or channel supports.
- F. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.
- G. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.6 CONNECTIONS

- A. Make connections to equipment with flexible connectors complying with Division 23 Section "Air Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.7 PAINTING

- A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized steel primer. Paint materials and application requirements are specified in Division 09 painting Sections.

3.8 DUCT SCHEDULE

- A. Duct Material - fabricate ducts with galvanized sheet steel.
- B. Duct Pressure Class, SMACNA Seal Class, and SMACNA Leakage Class: Fabricate ducts for the following pressure, seal and leakage classes:
 - 1. General Exhaust Air Ductwork
 - a. Upstream of Exhaust Fan:
 - 1) Pressure Class: Negative 2-inches wg.

- 2) Seal Class: C.
- 3) SMACNA Leakage Class for Rectangular: 24.
- 4) SMACNA Leakage Class for Round and Flat Oval: 12.

b. Downstream of Exhaust Fan:

- 1) Pressure Class: Positive 2-inches wg.
- 2) Seal Class: C.
- 3) SMACNA Leakage Class for Rectangular: 24.
- 4) SMACNA Leakage Class for Round and Flat Oval: 12.

2. Transfer Air Ductwork

- a. Pressure Class: Positive 1-inch wg.
- b. Seal Class: C.
- c. SMACNA Leakage Class for Rectangular: 24.
- d. SMACNA Leakage Class for Round and Flat Oval: 12.

C. Intermediate Reinforcement

- 1. Galvanized steel Ducts: Match duct material.

END OF SECTION 233113

SECTION 233300
AIR DUCT ACCESSORIES

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.
- B. All Division 23 Specification Sections also apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Manual volume dampers.
 - 2. Flange connectors.
 - 3. Turning vanes.
 - 4. Flexible connectors.
 - 5. Duct security bars.
 - 6. Duct accessory hardware.

1.3 SUBMITTALS

- A. Product Data - submit manufacturer's published data for each type of product indicated.
 - 1. Manual volume dampers.
 - 2. Flange connectors.
 - 3. Turning vanes.
 - 4. Duct mounted access doors.
 - 5. Flexible connectors.
 - 6. Duct accessory hardware.
- B. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise

indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
 - 1. Galvanized Coating Designation: G90 (Z275).
 - 2. Exposed-Surface Finish: Mill phosphatized.
- C. Reinforcement Shapes and Plates: Galvanized steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless steel ducts.
- D. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.2 MANUAL VOLUME DAMPERS

- A. Standard, Steel, Manual Volume Dampers
 - 1. Manufacturers - subject to compliance with requirements, provide products by one of the following:
 - a. Air Balance Inc.; a division of Mestek, Inc.
 - b. American Warming and Ventilating; a division of Mestek, Inc.
 - c. Elgen
 - d. Flexmaster U.S.A., Inc.
 - e. McGill AirFlow LLC.
 - f. METALAIRE, Inc.
 - g. Nailor Industries Inc.
 - h. Pottorff; a division of PCI Industries, Inc.
 - i. Ruskin Company.
 - j. Vent Products Company, Inc.
 - 2. Standard leakage rating.
 - 3. Suitable for horizontal or vertical applications.
 - 4. Frames:
 - a. Hat-shaped, galvanized steel channels, 0.064-inch minimum thickness.
 - b. Mitered and welded corners.
 - c. Flanges for attaching to walls and flangeless frames for installing in ducts.
 - 5. Blades:
 - a. Multiple or single blade.
 - b. Parallel- or opposed-blade design.
 - c. Stiffen damper blades for stability.
 - d. Galvanized steel, 0.064 inch thick.
 - 6. Blade Axles: Galvanized steel or stainless steel.
 - 7. Bearings:
 - a. Oil impregnated bronze bearings, molded synthetic bearings or stainless steel sleeve.
 - b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.

- 8. Tie Bars and Brackets: Galvanized steel.

2.3 FLANGE CONNECTORS

- A. Manufacturers - subject to compliance with requirements, provide products by one of the following:
 - 1. Ductmate Industries, Inc.
 - 2. Nexus PDQ; Division of Shilco Holdings Inc.
 - 3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Description: Roll-formed, factory fabricated, slide-on transverse flange connectors, gaskets, and components.
- C. Material: Galvanized steel.
- D. Gauge and Shape: Match connecting ductwork.

2.4 TURNING VANES

- A. Manufacturers - subject to compliance with requirements, provide products by one of the following:
 - 1. Ductmate Industries, Inc.
 - 2. Duro Dyne Inc.
 - 3. METALAIR, Inc.
 - 4. SEMCO Incorporated.
 - 5. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
- C. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 4-3, "Vanes and Vane Runners," and 4-4, "Vane Support in Elbows."
- D. Vane Construction: Single wall.

2.5 DUCT MOUNTED ACCESS DOORS

- A. Manufacturers - subject to compliance with requirements, provide products by one of the following:
 - 1. American Warming and Ventilating; a division of Mestek, Inc.
 - 2. Cesco Products; a division of Mestek, Inc.
 - 3. Ductmate Industries, Inc.
 - 4. Elgen
 - 5. Flexmaster U.S.A., Inc.
 - 6. Greenheck Fan Corporation
 - 7. McGill AirFlow, LLC
 - 8. Nailor Industries Inc.
 - 9. Pottorff; a division of PCI Industries, Inc.

10. Ventfabrics, Inc.
 11. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Duct mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 7-2 (7-2M), "Duct Access Doors and Panels," and 7-3, "Access Doors - Round Duct."
1. Door:
 - a. Double wall, rectangular.
 - b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
 - c. Vision panel.
 - d. Hinges and Latches: 1-by-1-inch butt or piano hinge and cam latches.
 - e. Fabricate doors airtight and suitable for duct pressure class.
 2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
 3. Number of Hinges and Locks:
 - a. Access Doors Less Than 12 Inches Square: No hinges and two sash locks.
 - b. Access Doors up to 18 Inches Square: Two hinges and two sash locks.
 - c. Access Doors up to 24 by 48 Inches: Three hinges and two compression latches with outside and inside handles.
 - d. Access Doors Larger than 24 by 48 Inches: Four hinges and two compression latches with outside and inside handles.

2.6 FLEXIBLE CONNECTORS

- A. Manufacturers - subject to compliance with requirements, provide products by one of the following:
1. Ductmate Industries, Inc.
 2. Duro Dyne Inc.
 3. Ventfabrics, Inc.
 4. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Materials: Flame-retardant or noncombustible fabrics.
- C. Coatings and Adhesives: Comply with UL 181, Class 1.
- D. Metal-Edged Connectors: Factory fabricated with a fabric strip having a minimum width of 5-3/4 inches attached to two strips of 2-3/4-inch wide, 0.028-inch thick, galvanized sheet steel or 0.032-inch thick aluminum sheets. Provide metal compatible with connected ducts.
- E. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.
1. Minimum Weight: 26 oz./sq. yd.
 2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
 3. Service Temperature: Minus 40° to plus 200°F.

2.7 DUCT ACCESSORY HARDWARE

- A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct insulation thickness.
- B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.
- B. Install duct accessories of materials suited to duct materials; use galvanized steel accessories in galvanized steel and fibrous glass ducts, stainless steel accessories in stainless steel ducts, and aluminum accessories in aluminum ducts.
- C. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Install volume dampers a minimum of 5-feet from the diffuser, register or grille in which it is controlling airflow. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.
 - 1. Volume damper shall be constructed of the same material as the duct in which it is to be installed.
- D. Install turning vanes in all mitered rectangular duct elbows with an angle greater than 45°.
- E. Set dampers to fully open position before testing, adjusting, and balancing.
- F. Install test holes at fan inlets and outlets and elsewhere as indicated.
- G. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
 - 1. Downstream from equipment.
 - 2. Upstream from turning vanes.
- H. Install access doors with swing against duct static pressure.
- I. Access Door Sizes: Access doors shall be sized as large as possible and practical, but shall not be less than 12 x 6 inches and shall not be greater than 25 x 25 inches.
- J. Label access doors according to Division 23 Section 230553 "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.
- K. Install flexible connectors to connect ducts to equipment.

- L. Install duct test holes where required for testing and balancing purposes.

3.2 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Operate dampers to verify full range of movement.
2. Inspect locations of access doors and verify that purpose of access door can be performed.
3. Inspect turning vanes for proper and secure installation.

END OF SECTION 233300

SECTION 233423
HVAC POWER VENTILATORS

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.
- B. All Division 23 Specification Sections also apply to this Section.

1.2 SUMMARY

- A. Section Includes
 - 1. In-line centrifugal fans.

1.3 PERFORMANCE REQUIREMENTS

- A. Project Altitude: Base fan-performance ratings on actual Project site elevations.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Also include plans, elevations, sections, details, and attachments to other work. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
- B. In addition, include the following:
 - 1. Certified fan performance curves with system operating conditions indicated.
 - 2. Certified fan sound-power ratings.
 - 3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
 - 4. Material thickness and finishes, including color charts.
 - 5. Dampers, including housings, linkages, and operators.
 - 6. Roof curbs.
 - 7. Fan speed controllers.
 - 8. Wiring Diagrams: For power, signal, and control wiring.
- C. Operation and Maintenance Data: For each power ventilator, 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, by a qualified testing agency, and marked for intended location and application.

- B. AMCA Compliance: Fans shall have AMCA Certified performance ratings and shall bear the AMCA Certified Ratings Seal.
- C. UL Standards: Power ventilators shall comply with UL 705. Power ventilators for use for restaurant kitchen exhaust shall also comply with UL 762.

1.6 COORDINATION

- A. Coordinate size and location of structural steel support members.

PART 2 - PRODUCTS

2.1 IN-LINE CENTRIFUGAL FANS

- A. Manufacturers - subject to compliance with requirements, provide products by one of the following:
 - 1. Greenheck Fan Corporation
 - 2. Loren Cook Company
 - 3. PennBarry
 - 4. Twin City Fan & Blower
- B. Housing: Square, minimum 18 gauge galvanized steel or aluminum, bolted construction with integral inlet and outlet duct collars. Bolted access doors shall be located on three sides sealed with closed cell neoprene gasketing. Housing shall be pre-drilled to accommodate universal mounting feet for vertical or horizontal installation.
- C. Direct-Drive Units: Motor mounted in airstream; factory wired to disconnect switch located on outside of fan housing. Units shall contain a fan wheel, inlet cone, and motor.
- D. Fan Wheels: Aluminum, with backward inclined or airfoil blades welded to or machined cast into an aluminum hub. Fan wheel shall be statically and dynamically balanced.
- E. Motors:
 - 1. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 23 Section 230513 "Common Motor Requirements for HVAC Equipment."
 - a. Motor Sizes: Minimum size as indicated in the schedule on the Drawings. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
 - b. Provide electronically commutated (EC) motors where indicated or scheduled.
 - 1) All EC motors shall be suitable for variable speed control via 0-10vdc, or 4-20mA control signal.
 - 2) EC motors intended for constant volume applications shall be equipped with a manually adjusted speed control positioning device.
 - c. Electrical Devices and Wiring: Comply with requirements for electrical devices and connections specified in Division 26.
 - 2. Enclosure Type: Open drip-proof (ODP) or totally enclosed, fan cooled (TEFC).

- F. Bearings: Bearings shall be designed and individually tested specifically for use in air handling applications. Bearings shall be heavy duty construction and shall be the regreasable ball type in a pillow-block cast iron housing selected for a minimum L50 life in excess of 200,000 hours at maximum cataloged operating speed.
- G. Isolation: Blower and motor shall be mounted on rubber isolators that isolate them from the fan housing.
- H. Accessories
 - 1. Speed Controller (for direct-drive fans only): Solid-state control to reduce speed from 100 to less than 50 percent.
- I. Capacities and Characteristics: Refer to the schedule on the drawings.

2.2 SOURCE QUALITY CONTROL

- A. Certify sound power level ratings according to AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.
- B. Certify fan performance ratings, including flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests according to AMCA 210, "Laboratory Methods of Testing Fans for Aerodynamic Performance Rating." Label fans with the AMCA-Certified Ratings Seal.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install power ventilators level and plumb.
- B. Support suspended units from structure using threaded steel rods and spring hangers having a static deflection of 1 inch. Vibration control devices are specified in Division 23 Section 230548.13 "Vibration Controls for HVAC Piping and Equipment."
- C. Install units with clearances for service and maintenance.

3.2 CONNECTIONS

- A. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Division 23 Section 233300 "Air Duct Accessories."
- B. Install ducts adjacent to power ventilators to allow service and maintenance.
- C. Ground equipment according to Division 26 Sections.
- D. Connect wiring according to Division 26 Sections.

3.3 FIELD QUALITY CONTROL

A. 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.

B. Tests and Inspections:

1. Verify that shipping, blocking, and bracing are removed.
2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal overload protection is installed in motors, starters, and disconnect switches.
3. Verify that cleaning and adjusting are complete.
4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
5. Adjust belt tension.
6. Adjust damper linkages for proper damper operation.
7. Verify lubrication for bearings and other moving parts.
8. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
9. Disable automatic temperature control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
10. Shut unit down and reconnect automatic temperature control operators.
11. Remove and replace malfunctioning units and retest as specified above.

C. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Prepare test and inspection reports.

3.4 ADJUSTING

A. Adjust damper linkages for proper damper operation.

B. Adjust belt tension.

C. Comply with requirements in Division 23 Section 230593 "Testing, Adjusting and Balancing for HVAC" for testing, adjusting, and balancing procedures.

D. Replace fan and motor pulleys as required to achieve design airflow.

E. Lubricate bearings.

3.5 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain power ventilators. Refer to Division 01 for additional requirements.

END OF SECTION 233423

SECTION 233713
DIFFUSERS, REGISTERS, AND GRILLES

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.
- B. All Division 23 Specification Sections also apply to this Section.

1.2 SUMMARY

- A. This Section includes ceiling and wall mounted diffusers, registers, and grilles.

1.3 SUBMITTALS

- A. Product data - for each type of product indicated, include the following:
 - 1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static pressure drop, and noise ratings.
 - 2. Diffuser, Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.
 - 3. Color Chart: For diffusers, registers, and grilles with factory applied color finishes for color and finish selection by Architect.

1.4 QUALITY ASSURANCE

- A. Product Options: Drawings indicate size, profiles, performance, and dimensional requirements of diffusers, registers and grilles, and are based on the specific equipment indicated. Refer to Division 01 for additional requirements.

PART 2 - PRODUCTS

2.1 GRILLES

- A. Manufacturers - subject to compliance with requirements, provide products by one of the following:
 - 1. Anemostat; a Mestek Company
 - 2. Krueger
 - 3. Price Industries
 - 4. Titus
 - 5. Tuttle & Bailey
 - 6. Greenheck

B. Fixed Blade Louvered Return/Exhaust Grille

1. Material: Steel.
2. Finish: Except for the following areas, all grilles shall have a baked enamel finish in a custom color selected by the Architect.
 - a. Grilles attached to exposed ductwork shall have a primed finish compatible for field painting.
3. Duct Connection: Refer to the Drawings.
4. Face Blade Arrangement: Fixed horizontal spaced 3/4 inch apart.
5. Frame: 1-1/4 inches wide.
6. Mounting: Countersunk screw or lay in. Coordinate with plans.
7. Damper Type: None.
8. Accessories: None.

2.2 SOURCE QUALITY CONTROL

- A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install diffusers, registers, and grilles level and plumb.
- B. Ceiling Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
- C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.3 ADJUSTING

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 233713

SECTION 233733
LOUVERS

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.
- B. All Division 23 Specification Sections also apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Extruded Aluminum Stationary Wall 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. Standard Free Area: Free area of a louver 48-inches wide by 48-inches high, identical to that provided.
- C. Maximum Standard Airflow: Airflow at point of beginning water penetration through a louver 48-inches wide by 48-inches high, identical to that provided.
- D. Drainable-Blade Louver: Louver designed to collect and drain water to exterior at sill by means of gutters in front edges of blades and channels in jambs and mullions.

1.4 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide exterior metal louvers capable of withstanding the effects of loads and stresses from wind and normal thermal movement without evidencing permanent deformation of louver components including blades, frames, and supports; noise or metal fatigue caused by louver blade rattle or flutter; or permanent damage to fasteners and anchors.
- B. Air Performance, Water-Penetration, and Air Leakage Ratings: Provide louvers complying with performance requirements indicated, as demonstrated by testing manufacturer's stock units 48-inches wide by 48-inches high. Test units according to AMCA 500.

1.5 SUBMITTALS

- A. Product Data: For each type of product specified; include plans; elevations; sections; and details showing profiles, angles, and spacing of louver blades. Show unit dimensions related to wall openings and construction; free area for each size indicated; profiles of frames at jambs, heads, and sills; and anchorage details and locations.

1.6 QUALITY ASSURANCE

- A. Source Limitations: Obtain louvers and vents through one source from a single manufacturer where alike in one or more respects regarding type, design, or factory applied color finish.
- B. SMACNA Standard: Comply with SMACNA's "Architectural Sheet Metal Manual" recommendations for fabrication, construction details, and installation procedures.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers - subject to compliance with requirements, provide products by one of the following:
 - 1. American Warming and Ventilating, Inc.
 - 2. Arrow United Industries
 - 3. Greenheck Fan Corporation
 - 4. Ruskin Manufacturing; Tomkins Industries, Inc.

2.2 EXTRUDED ALUMINUM STATIONARY WALL LOUVERS

- A. Fabrication: Hidden Support Style.
 - 1. Basis Of Design: ELF6375X as manufactured by Ruskin Company
 - 2. Frame:
 - a. Frame Depth: 6 inches.
 - b. Material: Extruded aluminum, Alloy 6063-T5.
 - c. Wall Thickness: 0.081 inch nominal.
 - 3. Blades:
 - a. Style: Horizontal "J".
 - b. Material: Formed aluminum, Alloy 6063-T5.
 - c. Wall Thickness: 0.081 inch nominal.
 - d. Angle: 37-1/2 degrees.
 - e. Centers: 5-29/32 inches nominal.
 - 4. Gutters: Drain gutter in head frame.
 - 5. Downspouts: Downspouts in jambs to drain head.
 - 6. Sill: Steeply angled integral sill eliminating areas of standing or trapped moisture where mold or mildew may thrive and effect indoor air quality.
 - 7. Fabrication:
 - 8. Mullion/Hidden Intermediate Support Style - Design incorporates visible mullions or frames at the perimeter of the louver and at section joints only. Rear-mounted hidden blade supports are utilized where required and do not interrupt the louver blade sightlines. The rear-mounted blade support depth varies depending on louver height and the design wind load.
 - 9. Assembly:
 - a. Factory assembled louver components. Welded construction.

B. Performance Data

1. Performance Ratings: AMCA licensed.
 - a. Based on testing 48 inch by 48 inch size unit in accordance with AMCA 500.
2. Free Area: 55 percent, nominal.
3. Maximum Recommended Air Flow through Free Area: 1010 feet per minute.
4. Maximum Pressure Drop (Intake): .175 inches w.g.
5. Water Penetration: Maximum of 0.01 ounces per square foot of free area at an air flow of 1010 feet per minute free area velocity when tested for 15 minutes.

C. Accessories

1. Bird Screen:
 - a. Aluminum: Aluminum, 1/2 inch mesh by 0.063 inch, intercrimp.
 - b. Frame: Removable, rewireable.

D. Finishes

1. Baked Enamel.
2. Color: Custom selected by Architect.

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.
- 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 louver units 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. Repair finishes damaged by cutting, welding, soldering, and grinding. Restore finishes so no evidence remains of corrective work. Return items that cannot be refinished in the field to the factory, make required alterations, and refinish entire unit or provide new units.
- F. Protect galvanized and nonferrous-metal surfaces from corrosion or galvanic action by applying a heavy coating of bituminous paint on surfaces that will be in contact with concrete, masonry, or dissimilar metals.
- G. Install concealed gaskets, flashings, joint fillers, and insulation, as louver installation progresses, where weathertight louver joints are required. Comply with Division 7 Section "Joint Sealants" for sealants applied during louver installation.

3.4 ADJUSTING, CLEANING, AND PROTECTING

- A. Periodically clean exposed surfaces of louvers that are not protected by temporary covering to remove fingerprints and soil during construction period. Do not let soil accumulate until final cleaning.
- 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. Protect louvers from damage during construction. Use temporary protective coverings where needed and approved by louver manufacturer. Remove protective covering at the time of Substantial Completion.
- D. 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. Clean and 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 233733

DIVISION 26

SECTION 260000
ELECTRICAL INDEX

SECTION	DESCRIPTION	PAGE NO.
260100	Basic Electrical Requirements	1 - 17
260519	Low Voltage Electrical Power Conductors and Cables	1 - 7
260526	Grounding and Bonding for Electrical Systems	1 - 7
260529	Hangers and Supports for Electrical Systems	1 - 5
260533	Raceways and Boxes for Electrical Systems	1 - 11
260544	Sleeves and Seals for Electrical Systems	1 - 9
260553	Identification for Electrical Systems	1 - 4
260573	Overcurrent Protective Device Coordination Study	1 - 3
260923	Lighting Controls	1 - 8
262416	Panelboards	1 - 10
262726	Wiring Devices	1 - 6
262813	Fuses	1 - 4
262816	Enclosed Switches and Circuit Breakers	1 - 4
265100	Interior Lighting	1 - 11
265600	Exterior Lighting	1 - 9

SECTION 260100
BASIC ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this and the other sections of Division 26.
- B. All Division 26 Specification Sections apply to this section.
- C. Division 09 FINISHES Sections.
- D. Division 31 EARTHWORK Sections.

1.2 SUMMARY

- A. This Section includes general administrative, procedural requirements, construction materials and construction methods for electrical installations. The following requirements are included in this Section to expand the requirements specified in Division 01 - reference individual sections for further expansion of these requirements:
 - 1. Abbreviations and Acronyms
 - 2. Definitions
 - 3. Permits, Codes, and Inspections
 - 4. Visiting Premises
 - 5. Project Drawings and Specifications
 - 6. Nameplate Data
 - 7. Soil Materials
 - 8. Coordination
 - 9. Substitutions
 - 10. Excavation, Backfill and Restoration
 - 11. Submittals
 - 12. Quality Assurance and Testing
 - 13. Temporary
 - 14. Delivery, Storage, and Handling
 - 15. Cutting and Patching
 - 16. Installations
 - 17. Final Cleaning
 - 18. Warranties
 - 19. Maintenance Manuals
 - 20. Record Documents
 - 21. Demonstration and Training

1.3 ABBREVIATIONS AND ACRONYMS

- A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.

51. ISO - International Organization for Standardization; www.iso.org.
52. ITU - International Telecommunication Union; www.itu.int/home.
53. LPI - Lightning Protection Institute; www.lightning.org.
54. MCA - Metal Construction Association; www.metalconstruction.org.
55. MFMA - Metal Framing Manufacturers Association, Inc.; www.metalframingmfg.org.
56. MHIA - Material Handling Industry of America; www.mhia.org.
57. MPI - Master Painters Institute; www.paintinfo.com.
58. NAAMM - National Association of Architectural Metal Manufacturers; www.naamm.org.
59. NBI - New Buildings Institute; www.newbuildings.org.
60. NCAA - National Collegiate Athletic Association (The); www.ncaa.org.
61. NCMA - National Concrete Masonry Association; www.ncma.org.
62. NECA - National Electrical Contractors Association; www.necanet.org.
63. NEMA - National Electrical Manufacturers Association; www.nema.org.
64. NETA - InterNational Electrical Testing Association; www.netaworld.org.
65. NFHS - National Federation of State High School Associations; www.nfhs.org.
66. NFPA - National Fire Protection Association; www.nfpa.org.
67. NICET - National Institute for Certification in Engineering Technologies.
68. NRMCA - National Ready Mixed Concrete Association; www.nrmca.org.
69. NSPE - National Society of Professional Engineers; www.nspe.org.
70. NSSGA - National Stone, Sand & Gravel Association; www.nssga.org.
71. OSHA - Occupational Safety & Health Administration; www.osha.gov.
72. PCI - Precast/Prestressed Concrete Institute; www.pci.org.
73. PLASA - PLASA; (Formerly: ESTA - Entertainment Services and Technology Association); www.plasa.org.
74. RoHS – Restriction of Hazardous Substances
75. SCTE - Society of Cable Telecommunications Engineers; www.scte.org.
76. SIA - Security Industry Association; www.siaonline.org.
77. SMPTE - Society of Motion Picture and Television Engineers; www.smpie.org.
78. SPIB - Southern Pine Inspection Bureau; www.spib.org.
79. SRCC - Solar Rating & Certification Corporation; www.solar-rating.org.
80. SSINA - Specialty Steel Industry of North America; www.ssina.com.
81. SSPC - SSPC: The Society for Protective Coatings; www.sspc.org.
82. STI - Steel Tank Institute; www.steeltank.com.
83. TIA - Telecommunications Industry Association (The); (Formerly: TIA/EIA - Telecommunications Industry Association/Electronic Industries Alliance); www.tiaonline.org.
84. TIA/EIA - Telecommunications Industry Association/Electronic Industries Alliance; (See TIA).
85. UL - Underwriters Laboratories Inc.; www.ul.com.
86. UNI - Uni-Bell PVC Pipe Association; www.uni-bell.org.
87. USGBC - U.S. Green Building Council; www.usgbc.org.
88. USITT - United States Institute for Theatre Technology, Inc.; www.usitt.org.
89. WASTEC - Waste Equipment Technology Association; www.wastec.org.

1.4 DEFINITIONS

A. Basic Contract definitions are included in the Conditions of the Contract.

1. Approved: When used to convey Architect's action on Contractor's submittals, applications, and requests, 'approved' is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.
2. Backfill and Fill Materials: Materials complying with ASTM D2487 soil classification groups GW, GP, GM, SM, SW, and SP; free of clay, rock, or gravel larger than 2 inches in any dimension; debris; waste; frozen materials; and vegetable and other deleterious matter.

3. Concealed: Embedded in masonry or other construction, installed behind wall furring or within double partitions or installed within hung ceilings.
4. Conduit: The inclusion of all fittings, hangers, supports, sleeves, etc.
5. Contractor: As stated herein shall mean Electrical Contractor.
6. Directed: A command or instruction by Architect. Other terms including 'requested,' 'authorized,' 'selected,' 'required,' and 'permitted' have the same meaning as 'directed.'
7. Equal: Equivalent as approved by the Architect or their representative.
8. Furnish: Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.
9. Indicated: Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including 'shown,' 'noted,' 'scheduled,' and 'specified' have the same meaning as 'indicated.'
10. Install: Unload, temporarily store, unpack, assemble, erect, place, anchor, apply, work to dimension, finish, cure, protect, clean, and similar operations at Project site.
11. Project Site: Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.
12. Provide: Furnish and install, complete and ready for the intended use.
13. Regulations: Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.
14. Sub-base Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, crushed slag, or natural or crushed sand.
15. Subgrade: Compacted soil immediately below the slab or pavement system.
16. Wiring: The inclusion of all raceways, fittings, conductors, connectors, tape, junction and outlet boxes, connections, splices, and all other items necessary and/or required in connection with such work.

1.5 PERMITS, CODES, AND INSPECTIONS

- A. Contractor shall obtain and pay for all permits and inspections required by laws, ordinances, rules and regulations having jurisdiction for work included under this Contract, and shall submit approval certificates to the Architect.
- B. The electrical installation shall comply fully with
 1. All local, county and state laws, ordinances and regulations having jurisdiction and as applicable to the electrical installations.
 2. All requirements of electric, telephone, and CATV utility companies.
 3. All approved published instructions set forth by equipment manufacturers.
- C. The Electrical installation and all components shall be in compliance with the code and/or standard requirements of the latest revision or state-adopted edition of:
 1. American Society for Testing and Materials (ASTM)
 2. Americans with Disabilities Act (ADA)
 3. FM Global (Factory Mutual) Approval Guide
 4. Institution of Electrical and Electronic Engineers (IEEE)
 5. International Building Code (IBC)
 6. International Fire Code (IFC)
 7. International Energy Conservation Code (IECC)
 8. Legislative Act 235 (1965) - Handicapped
 9. Legislative Act 287 (1974) - Excavation
 10. National Electric Code (NEC)

11. National Electrical Contractor's Association (NECA)
 12. National Electrical Manufacturer's Association (NEMA)
 13. National Electrical Safety Code (NESC)
 14. National Fire Protection Association (NFPA)
 15. National Safety Code
 16. Occupational Safety and Health Act (OSHA)
 17. Underwriter's Laboratories, Inc. (UL)
- D. Submit certificates issued by approved authorized agencies to indicate conformance of all work with the above requirements, as well as any additional certificates as may be required for the performance of this contract work.
- E. Should any change in Drawings or Specifications be required to comply with governmental regulations, the Contractor shall notify Architect prior to execution of the work. The work shall be carried out according to the requirements of such code in accordance with the instruction of the Architect and at no additional cost to the Owner.
- F. Certificate of Inspection: The Contractor shall procure and pay for the Certificate of Inspection from the municipality-approved inspection agency and deliver it to the Architect before final payment is made.

1.6 VISITING PREMISES

- A. The Bidder shall visit the project site before submitting his bid, in order to familiarize himself with existing conditions that may affect his work. It is the Contractor's responsibility to analyze existing conditions. Sufficient allowances shall be provided in the Contractor's bid to cover work, due to existing conditions, that will be required to complete this contract work.
- B. By submission of a bid, the Contractor is attesting that responsible personnel did in fact visit the site during the bidding period and verified all existing pertinent conditions.
- C. Contractor shall verify all measurements and dimensions at the site prior to submitting a bid.

1.7 PROJECT DRAWINGS AND SPECIFICATIONS

- A. Contractor shall carefully examine the Drawings and Specifications of all trades and report all discrepancies to the Architect in writing to obtain corrective action. No departures from the Contract Documents will be made without prior written approval from the Architect.
- B. Questions or disputes regarding the intent or meaning of Contract Documents shall be resolved by the interpretation of the Architect. The Architect's interpretation is final and binding.
- C. The Drawings and Specifications are not intended to define all details, finish materials, and special construction that may be required or necessary. The Contractor shall provide all installations complete and adequate as implied by the project documents.
- D. Drawings are diagrammatic only and do not show exact routes and locations of equipment and associated wiring. The Contractor shall verify the work of all other trades and shall arrange his work to avoid conflicts. In the event of a conflict, the Contractor shall obtain corrective action from the Architect.
- E. All work shall be considered new, unless noted otherwise.

- F. Prior to the submitting of bids, the Contractor shall familiarize himself with all conditions affecting the proposed installation of equipment by all trades that will require electrical connections and shall make provisions as to the cost thereof. Failure to comply with the intent of this paragraph shall in no way relieve the Contractor of performing all necessary work required for final electrical connections and equipment.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All materials and equipment for which Underwriter's Laboratories have established standards shall bear a UL label of approval.
- B. When two or more items of same material or equipment are required, they shall be of the same manufacturer. Product manufacturer uniformity does not apply to raw materials, bulk materials, wire, conduit, fittings, sheet metal, steel bar stock, welding rods, solder, fasteners, and similar items used in work, except as otherwise indicated.
- C. Provide products that are compatible within systems and other connected items.
- D. In all cases where a device, function or item of equipment is herein referred to in the singular, such reference shall apply to as many such items as are required to complete the installation.
- E. All listed materials and equipment shown on drawings and/or specified herein, are indicative of complete and whole units and shall be furnished as such.
- F. In certain instances specific manufacturer/model/type and catalog numbers are set out herein or on the drawings for the purpose of indicating required criteria for quality, function, sound level and acceptable physical size. Specifications, performance data, and descriptive data published by the designated manufacturer shall be taken as minimum requirements for the item to be provided.
- G. Comply with manufacturer's printed instructions and recommendations as minimum criteria for the installation of equipment.
- H. Where proprietary names are used, whether or not followed by the words "or as approved", they shall be subject to substitution only as approved by the Architect.
- I. All materials and equipment provided under this Contract shall be completely satisfactory and acceptable in operation, performance and capacity. No approval, either verbal or written, of any drawing, descriptive data or samples of such materials, equipment and/or appurtenances, shall relieve this Contractor of his responsibility to turn over all items in perfect working order at completion of the work.
- J. All material and equipment to be furnished under this contract shall be new and shall conform to the grade, quality and standards specified herein. Items of equipment shall be the latest standard product as advertised in printed catalogues by reputable manufacturers for the purpose intended and shall have replacement parts available.

2.2 NAMEPLATE DATA

- A. Provide factory-installed, permanent operational data nameplate on each item of power operated equipment, indicating manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliances, and similar essential data.

2.3 SOIL MATERIALS

- A. Provide in accordance with Division 31 EARTHWORK Sections.

PART 3 - EXECUTION

3.1 GENERAL

- A. All construction under this contract shall be completed in a neat and craftsman-like manner. Work that, in the judgement of the Architect, is not satisfactorily installed shall be removed and replaced to the Architect's satisfaction, at the Contractor's expense.
- B. Throughout construction, all work areas and storage areas shall be kept clean. The Contractor shall keep all items clean of dirt, rust, dust and fingermarks.
- C. The Contractor shall furnish, set, erect, and maintain all scaffolding, aerial equipment and ladders required in the installation of this Contract work.
- D. Install temporary platforms so as to be supported only by the existing steel truss framework.
- E. Painting: Provide in accordance with Division 09 FINISHES Sections and as stated below.
 - 1. Except in Mechanical Rooms, Electrical Rooms, attics, and chase spaces all exposed items provided or installed under this Contract shall be painted.
 - 2. Unless painting is provided by others as elsewhere specified, all painting for items furnished or installed under this Contract shall be the responsibility of this Contractor.
 - 3. Factory-painted equipment cabinets and trim shall not be field-painted except for touching up scratches or damage where necessary to achieve like-new finish. Touching up shall be done after equipment is in its final location.
 - 4. Paint for metal surfaces shall be Rust-o-leum or as approved, one prime coat and two finish coats of color selected by Architect.
 - 5. Items to be painted shall be cleaned and degreased and shall be free of dirt, rust and corrosion prior to application of paint. All paint shall be applied in accordance with all the manufacturer's recommendations (i.e. temperature, dew point, ventilation).
 - 6. All patchwork performed under this Contract shall be painted. Color shall match the color of adjacent walls, ceilings and floors in which patchwork occurs. Area to be painted shall extend a minimum of 24" all around patchwork; however, final limit shall be set by the Architect. Blend new paint work with existing painted surfaces. Where existing finish is stained or varnished woodwork, all damaged or patched surfaces shall be restored to match the existing adjacent surface, as approved. Paint, stain, varnish and method of application shall be as set out in the specifications for General Construction, or as otherwise approved. Except where painting of patchwork is provided by others, as elsewhere specified, all painting of patchwork required under this Contract shall be the responsibility of this Contractor.

3.2 COORDINATION

A. Sequence of Work

1. Provide in accordance with Division 01 Section SUMMARY.

B. Utility

1. The Contractor shall cooperate fully with local utility companies with respect to their services.
2. The Contractor shall be responsible for all coordination and scheduling of construction with all utility companies as necessary for the performance of this Contract work.
3. The actual amount of the charges will be determined by the electric utility company at the time of the installation, and shall be paid directly by the Owner.
4. Coordinate the shut-off and disconnection of electrical service with the Owner and the utility company.

C. Outages and Disruptions

1. Continuity of operation of all essential HVAC, plumbing and electrical items, including electrical service, lighting, outlets, power and controls for heating and cooling equipment, auxiliary systems, fire alarm, emergency lighting and power, program, sound, alarms and telephones shall be provided as required for occupancy of the premises during the construction period.
2. 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:
 - a. Notify Owner no fewer than fourteen days in advance of proposed interruption of electric service.
 - b. Indicate method of providing temporary electric service.
 - c. Do not proceed with interruption of electric service without Owner's written permission.
3. Provide temporary wiring and connections to maintain existing systems in service during construction.
4. The schedule and timing of any interruption of water, gas or electrical service or disruption of occupied areas that may affect use of the premises by the Owner and the public, shall be coordinated with the Owner and Architect. Temporary or interim use feeders and facilities shall be provided by the Contractor, as approved and/or directed, to minimize the duration and extent of outages or interruptions.
5. In areas where the construction work will interfere unduly with use of the premises, the Owner may direct that construction work be performed during time periods other than indicated above or on Saturdays, Sundays, or Holidays. Judgment as to whether such undue interference may exist shall rest solely with the Owner. Also, the Owner may require that temporary or interim use feeders and facilities shall be provided by the Contractor as approved and/or directed, to minimize the duration and extent of outages or interruptions.
6. Preparatory work shall be performed as completely as possible in each instance prior to scheduled service outages.
7. Contractor shall be responsible for any and all premium time/overtime required to perform outages and cutovers of services. Coordinate with Owner and Architect.
8. Contractor shall be responsible for any and all premium time/overtime required to complete the work in the various areas within the allotted time, as well as any premium/overtime required to install work through unaffected or remote areas from the work as necessary to

maintain continuity of services and occupancy of the existing buildings, as required.
Coordinate with Owner and Architect.

D. New Work

1. Coordinate electrical equipment installation with other building components.
2. Sequence, coordinate, and integrate installations of electrical materials and equipment for efficient flow of the work.
3. Arrange for chases, slots, and openings in building structure during progress of construction to allow for electrical installations.
4. Coordinate the installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
5. Coordinate installation of large equipment requiring positioning prior to closing in the building.
6. Coordinate connection of electrical services with equipment provided under other sections of the specifications.
7. Coordinate requirements for access panels and doors where electrical items requiring access are concealed behind finished surfaces. Verify all dimensions by field measurements.
8. Coordinate connection of electrical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.
9. Coordinate the cutting and patching of building components to accommodate installation of electrical equipment and materials.
10. Coordinate the installation of electrical materials and equipment above ceilings with suspension system, mechanical equipment and systems, and structural components.

E. Cooperation and Coordination With Other Trades

1. This Electrical Contractor must cooperate completely and coordinate work with the contractors of other trades providing equipment under this division and other divisions of the specifications. This is particularly important in connection with Divisions 21, 22, and 23 - Mechanical.
2. Interference drawings shall be prepared as a combined effort of all trades. The Electrical Contractor shall prepare floor plans, reflected ceiling plans, elevations, sections, and details to conclusively coordinate and integrate all installations on mylar backgrounds prepared by the Mechanical Contractor. The Mechanical Contractor shall start their drawings immediately upon award of contract. Drawings shall be at 1/4" = 1'0" scale based on sheet size and plan location and orientation as shown on the architectural drawings. All interference drawings shall be capable of being overlaid to coordinate interferences and for printing. All congested areas and mechanical room plans shall be drawn at 3/8" = 1'0" scale.
3. After the Mechanical Contractor has finished, electronic files will be forwarded to the Plumbing trade who will show and coordinate the plumbing work with the other trades. After the Plumbing trade has finished, electronic files will be forwarded to the Electrical trade who will show and coordinate their work on the combined plans.
4. Interference plans and elevations shall show in detail the location of the following items that require coordination because of size and proximity to other equipment and systems. Drawings shall show in order of installation priority within the allotted space the items prioritized in the following paragraph entitled "Space Priority".
 - a. In addition, show electrical work in equipment rooms.
 - b. On the interference drawings, show all electrical conduits that are 1-1/2" and larger.

- c. Indicate locations where space is limited, and where sequencing and coordination of installations are of importance to the efficient flow of the work.
 - d. Proposed locations of major systems, equipment and material.
 - e. Work in pipe spaces, chases, and trenches.
 - f. Exterior wall penetrations.
 - g. Fire-rated wall and floor penetrations.
 - h. Ceilings that contain piping, ductwork, or equipment in congested arrangement.
 - i. Equipment connections and support details.
 - j. Exterior underground lines in common excavation.
 - k. Sizes and location of required concrete pads and bases.
 - l. Indicate scheduling, sequencing, movement, and positioning of large equipment into the building during construction.
 - m. Prepare floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.
 - n. Prepare reflected ceiling plans to coordinate and integrate installations, air outlets and inlets, light fixtures, communications systems components, sprinklers, and other ceiling-mounted devices.
 - o. Clearances for servicing equipment, including space for equipment disassembly required for periodic maintenance.
5. Electronic files of the finished interference drawings shall be submitted to the Architect for record before actual installation work begins. Each trade shall make completed interference drawings available to their craft for installation of the work.
 6. Individual trade interference drawings may be used as shop drawings and/or as record drawings at the completion of the project.
 7. The coordination drawings shall be reviewed and approved by the Owner and Architect, and shall be signed by both the Owner and the Architect.

F. Cooperation and Coordination With Subcontractors

1. The Electrical Contractor shall give their subcontractors the option to attend construction and coordination meetings to aid in overall electrical construction coordination.

G. Space Priority

1. Ensure equitable use of available space for materials and equipment installed above ceilings. Allocate space in the order of priority as listed below. Items are listed in the order of priority, with items of equal importance listed under a single priority number.
 - a. Gravity flow piping systems
 - b. Vent piping systems
 - c. Ceiling recessed lighting fixtures
 - d. Concealed air terminal units, fans
 - e. Air duct systems
 - f. Sprinkler systems piping
 - g. Forced flow piping systems
 - h. Electrical conduit, wiring, control wiring
2. Order of priority does not dictate installation sequence. Installation sequence shall be as mutually agreed by all affected trades.
3. Change in order of priority is permissible by mutual agreement of all affected trades.
4. The work of a particular trade shall not infringe upon the allocated space of another trade without permission of the contractor for the affected trade.
5. The work of a particular trade shall not obstruct access for installation, operation and maintenance of the Work, materials and equipment of another trade.

3.3 SUBSTITUTIONS

- A. Provide in accordance with Division 01 Section SUBSTITUTION PROCEDURES and as stated below.
- B. Where the contractor proposes substitute equipment, contractor to submit complete product data indicating compliance with all requirements of the documents, including performance rating, size and resistance to wear and deterioration equivalent to the specified item at least ten (10) days prior to the bid date. In instances where substituted equipment requires additional material or work beyond that shown or required by the specified item, said additional material or work shall be the responsibility of this Contractor, regardless of the trade involved.

3.4 EXCAVATION, BACKFILL, AND RESTORATION

- A. Provide in accordance with Division 31 EARTHWORK Sections and as follows.
- B. Conditions Affecting Excavations - the following project conditions apply:
 - 1. Subsurface conditions were investigated during the design of the Project. Reports of these investigations are available for information only; data in the reports are not intended as representations or warranties of accuracy or continuity of conditions. The Owner will not be responsible for interpretations or conclusions drawn from this information. Contact specific utility company immediately for instructions regarding uncharted or incorrectly charted utilities.
 - 2. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by excavation operations.
 - 3. Locate existing underground utilities in excavation areas. If utilities are indicated to remain, support and protect services during excavation operations.
 - 4. Maintain and protect existing building services that transit the area affected by excavation.
 - 5. Remove existing underground utilities indicated to be removed.
 - 6. Use of explosives is not permitted.
 - 7. Where excavation has reached required sub-grade elevations, if unsuitable bearing materials are encountered, continue excavation until suitable bearing materials are reached. The Contract Sum may be adjusted by an appropriate Contract Modification.
 - 8. Where surface excavation cannot be used, provide directional boring or horizontal directional drilling for routing conduit below grade. Provide auger type boring machine for soil removal during boring process.

3.5 SUBMITTALS

- A. Provide in accordance with Division 01 Section SUBMITTAL PROCEDURES and as stated below.
- B. Submit for approval a complete Material Source of Supply and contractor list for all electrical work required under this project. Shop drawing submittals will not be reviewed until a complete Material Source of Supply and contractor list is received. Submit this listing as a part of the submittal requirement specified in Division 01.
- C. Submittal of shop drawings, product data, and samples will be accepted only when submitted by the Contractor. Data submitted from contractors and material suppliers directly to the Architect will not be processed.

- D. Prepare and submit detailed shop drawings for materials, systems and equipment as listed herein, including locations and sizes of all openings in floor decks, walls and floors.
- E. The work described in any shop drawing submission shall be carefully checked for all clearances (including those required for maintenance and servicing), field conditions, maintenance of architectural conditions and proper coordination with all trades on the job. Each submitted shop drawing shall include a certification that all related job conditions have been checked and that no conflict exists.
- F. All shop drawings shall be stamped by the Contractor, indicating approval, and space shall be provided for the Engineer's stamp and the Architect's stamp.
- G. All drawings shall be submitted sufficiently in advance of field requirements to allow ample time for checking and resubmittal as may be required. All submittals shall be complete and contain all required and detailed information.
- H. Acceptance of any submitted data or shop drawings for material, equipment apparatus, devices, arrangement and layout shall not relieve the Contractor from responsibility of furnishing all items of proper dimensions, weight, capacities, sizes, quantity and quality as intended by the Contract. Such acceptance shall not relieve Contractor from responsibility for errors, omissions or inadequacies of any sort on submitted data or shop drawings.
- I. Each shop drawing shall contain job title and reference to the applicable drawing and specification article, including the contractor's drawings, specifications and verification of compatibility with the systems involved.
- J. Individual shop drawing submittals shall be provided for each specific material, system or equipment as identified herein. Submittals provided in other than this manner will be return without review.
- K. All nameplate data shall be complete at time of equipment submittals - refer to other sections for identification requirements.
- L. For each room or area of the building containing switchboards, panelboards, transformers, and/or emergency generators, coordination drawings are required to be submitted for review and acceptance at the time of the equipment submittal.
- M. Equipment shall not be ordered or purchased until the shop drawing approval is received.
- N. Shop Drawings shall show conformance with specified electrical characteristics, or Contractor shall assume responsibility for all deviations including all additional costs involved for the deviations.
- O. The following is a list of some important material, equipment and systems that require shop drawing approval, refer to each section of this specification for additional submittal requirements:
 - 1. Low Voltage Electrical Power Cables
 - 2. Grounding and Bonding Equipment
 - 3. Hangers and Supports
 - 4. Raceways and Boxes
 - 5. Lighting Controls
 - 6. Panelboards
 - 7. Wiring Devices
 - 8. Fuses
 - 9. Enclosed Switches and Circuit Breakers
 - 10. Light Fixtures

P. Product Options:

1. The product manufacturers listed in each section are either the product the design is based on or a product that the Engineer feels would be an acceptable substitution if that product can meet the intent of the written specifications and the scheduled capacities. The Electrical Contractor is responsible for ensuring that the substituted product complies with the intent of the specifications, the scheduled capacities and the drawings. Substitutions of manufacturers not listed are not permitted unless prior approval is obtained from the Engineer as required by Part 3.3, SUBSTITUTIONS, of this specification section.
2. It will be the responsibility of the Electrical Contractor to pay any and all costs associated with any approved substitutions that impact the architectural layout, structure, electrical system(s), mechanical systems, and/or the plumbing systems, due to an increase in physical dimensions, weight, electrical requirements, connection sizes, etc., between the approved substitution item and the equipment item scheduled and/or indicated as the basis of design.

3.6 QUALITY ASSURANCE AND TESTING

- A. Provide in accordance with Division 01 Section QUALITY REQUIREMENTS.
- B. Provide products that are listed and labeled by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Refer to all Division 26 specification sections for additional testing requirements.

3.7 TEMPORARY

- A. Provide in accordance with Division 01 Section TEMPORARY FACILITIES AND CONTROLS and as stated below.
- B. The Electrical Contractor shall provide temporary electric services to the construction areas at locations acceptable to the General Contractor. The service to be provided shall be from the existing electrical system and shall be 1 phase, 3 wire, 240/120V, 100 ampere minimum with the necessary distributing facilities. The service shall be installed within fifteen (15) days after written request has been made to the Electrical Contractor, with copies to the Architect and Owner by any contractor requiring such service.
- C. The Electrical Contractor shall provide temporary electric services to the construction trailers at locations acceptable to the General Contractor. The service to be provided shall be from the existing electrical system and shall be 1 phase, 3 wire, 240/120V, 100 ampere minimum with the necessary distributing facilities. The service shall be installed within fifteen (15) days after written request has been made to the Electrical Contractor, with copies to the Architect and Owner, by any contractor requiring such service.
- D. Power consumption shall not disrupt Owner's need for continuous service.
- E. The Contractor shall provide power outlets for construction operations, branch wiring, distribution boxes. Each individual contractor will provide flexible power cords as required.
- F. Power required for tools and operating equipment used for the installation of equipment, that exceeds the power available, shall be temporarily installed and removed by the Contractor requiring it.

- G. Provide wiring and connections for temporary heating equipment required for construction purposes and to prevent building freeze up.
- H. Distribution wiring and equipment/devices used for temporary services shall not be installed as part of the permanent building distribution system.
- I. Permanent distribution wiring and equipment/devices shall not be used for temporary services.
- J. The Contractor shall provide temporary lights and all associated wiring as required by the individual prime contractors.
- K. Contractor to remove all temporary wiring and temporary lighting.

3.8 DELIVERY, STORAGE, AND HANDLING

- A. Provide in accordance with Division 01 Section PRODUCT REQUIREMENTS and as stated below.
- B. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.
- C. Deliver products to the project properly identified with names, model numbers, types, grades, compliance labels, and other information needed for distinct identification; adequately packaged and protected to prevent damage during shipment, storage and handling.
- D. Store equipment and materials at the site, unless off-site storage is authorized in writing. Protect stored equipment and materials from damage.
- E. Coordinate deliveries of electrical materials and equipment to minimize construction site congestion. Limit each shipment of materials and equipment to the items and quantities needed for the smooth and efficient flow of installations.

3.9 CUTTING AND PATCHING

- A. Provide in accordance with Division 01 Section EXECUTION.

3.10 INSTALLATIONS

- A. Provide in accordance with Division 01 Section EXECUTION and as stated below.
- B. Verify all dimensions by field measurements.
- C. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.
- D. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible.
- E. Install systems, materials, and equipment to conform with approved submittal data, including coordination drawings, to greatest extent possible.

- F. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the Work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, refer conflict to the Architect.
- G. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components.
- H. Install electrical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. Connect equipment for ease of disconnecting, with minimum of interference with other installations.
- I. Install access panel or doors where units are concealed behind finished surfaces.
- J. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.
- K. Obtain written approval of locations of all electrical devices from the Owner and Architect prior to rough-in. The owner reserves the right to move any or all electrical devices prior to rough-in, at no additional cost.
- L. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.
- M. Obtain approval from the Architect before drilling or cutting structural members.
- N. Holes cut into reinforced concrete beams or in concrete shall not cut reinforcing bars. If the Contractor cuts into any reinforcing bars, stop work and notify the Architect immediately.
- O. Refer to equipment specifications in Divisions 02 through 33 for rough-in requirements for equipment furnished under other contracts.
- P. Door swings may vary from plans. Make note of actual door swings at time of rough-in. Do not install switches or other items behind the swing of any door.
- Q. The installation shall be subject to such revisions as may be necessary to overcome building obstructions.
- R. Provide connections to all electrically operated equipment furnished under other sections and/or divisions of this project specification. Verify all power connections with submitted manufacturer's written recommendations prior to installation and prior to energizing circuit.
- S. Inspect areas and conditions under which electrical connections for equipment that will be installed and notify the Architect in writing of conditions detrimental to proper completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the Contractor.
- T. Verify that equipment is ready for electrical connection, wiring, and energization.
- U. Install all in-line power control, protection, and disconnection devices furnished by others that are not an integral part of the equipment. These devices shall be located in accordance with the Contractor furnishing the devices and the requirements of the NEC.
- V. Provide for proper rotation of all three phase motors.

- W. Work improperly placed because of Contractor's failure to obtain the above information shall be relocated and reinstalled as directed, without additional costs to the Contract. No charges shall be made in location of equipment without prior written approval.

3.11 FINAL CLEANING

- A. Provide in accordance with Division 01 Section CLOSEOUT PROCEDURES.

3.12 WARRANTIES

- A. Provide in accordance with Division 01 Section CLOSEOUT PROCEDURES and as stated below.
- B. Refer to individual equipment specifications for additional warranty requirements. If a contradiction exists, the most demanding requirements shall prevail.
- C. Compile and assemble the warranties specified in Division 26 into a separated set of vinyl covered, three ring binders, tabulated and indexed for easy reference.
- D. Provide complete warranty information for each item to include date of beginning of warranty or bond; duration of warranty or bond; and names, address, and telephone numbers and procedures for filing a claim and obtaining warranty services.
- E. Submit a single warranty stating that all portions of the work are in accordance with Contract requirements. Warrant all work against faulty and improper material and workmanship for a period of one (1) year from date of final acceptance by the Owner, except that where guarantees or warranties for longer terms are specified herein, such longer term shall apply. Within 24 hours after notification, correct any deficiencies that occur during the warranty period at no additional cost to Owner, all to the satisfaction of the Owner and Architect. Obtain similar warranties from subcontractors, manufacturers, suppliers and sub-trade specialists.
- F. Any material, equipment or appurtenance whose operation or performance does not comply with the requirements of the Contract Documents or that are damaged prior to acceptance will be held as defective and shall be removed and properly replaced at no additional cost to the Owner.

3.13 MAINTENANCE MANUALS

- A. Provide in accordance with Division 01 Section OPERATION AND MAINTENANCE DATA and as stated below.
- B. Include the following information for equipment items:
 - 1. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.
 - 2. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions.
 - 3. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.

4. Servicing instructions and lubrication charts and schedules.
5. Provide a cover sheet for each manual including the project name, Architect's name and contact information, Engineer's name and contact information, and Division 26 contractor's name and contact information.
6. Alphabetical list of all system components, with the name, address, and 24-hour phone number of the company responsible for servicing each item during the first year of operation.
7. Manufacturer's data of each piece of equipment including:
 - a. Installation instructions.
 - b. Drawings and Specifications.
 - c. Parts list, including recommended items to be stocked.
 - d. Complete wiring diagrams.
 - e. Marked or changed prints locating all concealed parts and all variations from the original system design.
 - f. Test and inspection certificates.

3.14 RECORD DOCUMENTS

- A. Provide in accordance with Division 01 Section PROJECT RECORD DOCUMENTS and as stated below.
- B. Indicate installed conditions for the following:
 1. Raceway systems, size and location, for both exterior and interior.
 2. Locations of control devices.
 3. Distribution and branch electrical circuitry.
 4. Fuse and circuit breaker size and arrangements.
 5. Equipment locations (exposed and concealed), dimensioned from prominent building lines.
 6. Approved substitutions, Contract Modifications, and actual equipment and materials installed.
 7. Engage the services of a Land Surveyor or Professional Engineer registered in the state in which the project is located as specified in Division 01 to record the locations and invert elevations of underground installations.

3.15 DEMONSTRATION AND TRAINING

- A. Provide in accordance with Division 01 Section DEMONSTRATION AND TRAINING and as stated below.
- B. After the tests and adjustments have been made, approved factory-authorized system representatives and the Contractor shall fully instruct Owner in all details of operation and maintenance of equipment installed under this Contract. Dates and times of such instructions shall be as directed by Owner, including any necessary weekend or after-hours instruction.
- C. The following is a list systems that require Demonstration and Training, refer to the individual specification sections for additional training requirements:
 1. Lighting Controls
 2. Panelboards
 3. Enclosed Switches and Circuit Breakers

END OF SECTION 260100

SECTION 260519
LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this and the other sections of Division 26.
- B. All Division 26 Specification Sections apply to this section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Copper building wire rated 600 V or less.
 - 2. Metal clad cable, Type MC, rated 600 V or less.
 - 3. Connectors, splices, and terminations rated 600 V and less.

1.3 SUBMITTALS

- A. Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections:
 - 1. Product Data: Submit manufacturer's data for electrical wires, cables and connectors.

PART 2 - PRODUCTS

2.1 COPPER BUILDING WIRE

- A. Description: Flexible, insulated, drawn copper current-carrying conductor with an overall insulation layer and jacket, rated 600 V or less.
- B. Manufacturers - subject to compliance with requirements, provide products of one of the following:
 - 1. Cerro Wire
 - 1. Colonial Wire and Cable Company
 - 2. Encore Wire Corporation
 - 3. General Cable Corporation
 - 4. Nehring Electrical Works Company
 - 5. Okonite Company
 - 6. Service Wire Company
 - 7. Southwire Company

C. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. RoHS compliant.
3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

D. Conductors: Copper, complying with ASTM B 3 for bare annealed copper and with ASTM B 8 for stranded conductors.

E. Conductor Insulation:

1. Type THHN/THWN-2: Comply with UL 83.

2.2 METAL CLAD CABLE, TYPE MC

A. Description: A factory assembly of one or more current-carrying insulated conductors in an overall metallic sheath.

B. Manufacturers - subject to compliance with requirements, provide products of one of the following:

1. AFC Cable Systems
2. Encore Wire Corporation
3. Okonite Company
4. Service Wire Company
5. Southwire Company

C. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. Comply with UL 1569.
3. RoHS compliant.
4. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

D. Circuits: Single circuit and multi-circuit with color-coded conductors as required.

E. Conductors for branch circuits, #8AWG and smaller: Copper, complying with ASTM B 3 for bare annealed copper and with ASTM B 8 for stranded conductors

F. Conductors for feeders, #6 and larger: Copper, complying with ASTM B 3 for bare annealed copper and with ASTM B 8 for stranded conductors

G. Ground Conductor: Insulated.

H. Conductor Insulation: Type THHN/THWN-2: Comply with UL 83.

I. Armor: Steel, interlocked.

J. Jacket: PVC applied over armor.

2.3 CONNECTORS AND SPLICES

- A. Description: Factory-fabricated connectors, splices, and lugs of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use. Use connectors with temperature ratings equal to or greater than those of the wires upon that are used.
- B. Manufacturers - subject to compliance with requirements, provide products of one of the following:
 - 1. 3M Electrical Products
 - 2. AFC Cable Systems
 - 3. Burndy
 - 4. Hubbell Power Systems
 - 5. Ideal Industries
 - 6. ILSCO
 - 7. NSi Industries
 - 8. O-Z/Gedney
 - 9. TE Connectivity
 - 10. Thomas and Betts Corporation
- C. Jacketed Cable Connectors: For steel and aluminum jacketed cables, zinc die-cast with set screws, designed to connect conductors specified in this Section.
- D. Lugs: One piece, seamless, designed to terminate conductors specified in this Section.
 - 1. Material: Match conductor material.
 - 2. Termination: Compression.

2.4 COLOR CODING

- A. Color Coding of Conductors - factory applied the entire length of conductors, provide the following:
 - 1. 208/120V through 240V Conductors:
 - a. Phase A: Black
 - b. Phase B: Red
 - c. Phase C: Blue
 - d. Neutral: White
 - 2. Travelers for 3 way/4 way switches shall be purple.

PART 3 - EXECUTION

3.1 DELIVERY, STORAGE AND HANDLING

- A. Each length, bundle, or reel of wire and cable delivered to job site shall bear manufacturer's name, catalog number and trademark, UL label, type letters, size, length and manufacturing date.
- B. Deliver wire and cable properly packaged in factory fabricated type containers, or wound on NEMA specified type wire and cable reels.

- C. Minimum wire size shall be #12 AWG for all wiring, with the following exceptions:
 - 1. If the distance between the panelboard and the first circuit load is greater than 100 feet, the minimum wire size shall be #10 AWG.
 - 2. All emergency lighting circuit wiring shall be #10 AWG or larger.
 - 3. Conductors and cables for communications and signal systems shall be as described in respective specification sections and as recommended and approved by manufacturer.
- D. Provide dedicated neutrals for all single-phase branch circuits.
- E. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.
- F. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- G. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- H. Pull conductors simultaneously where more than one is being installed in same raceway.
- I. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- J. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."
- K. MC cable shall be neatly trained and supported clear of ceiling tile and ceiling grid by means of metallic straps or clips. The use of nylon tie wraps to support MC cable from the structure is prohibited. Supports for MC cable shall be independent from supports for other systems (i.e. light fixtures, ceiling grid, mechanical systems) and the supports for the MC cable shall be directly connected to the structure.
- L. Provide adequate length of conductors within electrical enclosures and train the conductors to terminal points with no excess. Bundle multiple conductors, with conductors larger than #10 AWG cabled in individual circuits. Make terminations so there is no bare conductor at the terminal.
- M. Conductor/cable supports for vertical runs shall be provided in top cabinet or pull box of all feeders in accordance with NEC requirements.

3.5 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- B. Splices:
 - 1. Keep conductor splices to minimum.
 - 2. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

3. Splicing of #10 wires and smaller shall be made with Scotchlok or as approved.
4. Splicing of #8 wire and larger shall be made by means of compression type connectors and installed with a proper tool and then insulated to same dielectric value as the original insulation with plastic tape.
5. Splices are not permitted in conductors larger than #10, except where specifically called for.
6. All splicing shall be made in outlet boxes or junction boxes.

- C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

3.6 IDENTIFICATION

- A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."

3.7 SLEEVE AND SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Seals for Electrical Systems".

3.8 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Section 260544 "Sleeves and Seals for Electrical Systems".

3.9 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

- B. Perform each of the following visual and electrical tests:

1. Inspect exposed sections of conductor and cable for physical damage and correct connection according to the single-line diagram.
2. Test bolted connections for high resistance using one of the following:
 - a. A low-resistance ohmmeter.
 - b. Calibrated torque wrench.
 - c. Thermographic survey.
3. Inspect compression-applied connectors for correct cable match and indentation.
4. Inspect for correct identification.
5. Inspect cable jacket and condition.
6. Insulation-resistance test on each conductor for ground and adjacent conductors. Apply a potential of 500-V dc for 300-V rated cable and 1000-V dc for 600-V rated cable for a one-minute duration.
7. Continuity test on each conductor and cable.
8. Uniform resistance of parallel conductors.

- C. Cables will be considered defective if they do not pass tests and inspections.

3.3 FIELD QUALITY CONTROL

- A. Inspect each installed fixture and pole for damage or corrosion. Replace damaged fixtures, poles, and components.
- B. Verify normal operation of each fixture after fixtures have been installed and circuits have been energized. Replace or repair malfunctioning fixtures and components.
- C. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify normal transfer to battery power source and retransfer to normal.
- D. Verify operation of photoelectric controls.

3.4 ADJUSTING AND CLEANING

- A. Remove protective wrapping on fixtures.
- B. Clean fixtures upon completion of installation. Use methods and materials recommended by manufacturer. Lenses and louvers with dust, dirt, scratches, or fingerprints shall not be acceptable.

3.5 STARTUP SERVICE

- A. Burn-in LED fixtures prior to occupancy by Owner for a minimum of 100 hours at full light output.

3.6 GROUNDING

- A. Provide equipment grounding connections for all lighting fixtures. Tighten connections to comply with tightening torques specified in UL Standard 486A to assure permanent and effective grounds.
- B. Ground metal poles and support structures according to Division 26 Section 260526 "Grounding and Bonding for Electrical Systems."

END OF SECTION 265600

D. Prepare test and inspection reports to record the following:

1. Procedures used.
2. Results that comply with requirements.
3. Results that do not comply with requirements, and corrective action taken to achieve compliance with requirements.

END OF SECTION 260519

SECTION 260526
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this and the other sections of Division 26.
- B. All Division 26 Specification Sections apply to this section.

1.2 SUMMARY

- A. This Section includes solid grounding of electrical systems and equipment. It includes basic requirements for grounding for protection of life, equipment, circuits, and systems. Grounding requirements specified in this Section may be supplemented in other sections of these Specifications.

1.3 SUBMITTALS

- A. Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections:
 - 1. Product data for ground rods, connectors and connection materials, and grounding fittings.
 - 2. Qualification Data: For testing agency and testing agency's field supervisor.
 - 3. Field quality control reports.

1.4 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Certified by NETA.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with UL 467 for grounding and bonding materials and equipment.
- C. Materials: Copper with 98% conductivity.

2.2 MANUFACTURERS

- A. Manufacturers - subject to compliance with requirements, provide products of one of the following:
1. B-Line Systems Inc.
 2. Burndy Corporation
 3. Erico International
 4. ILSCO
 5. O-Z/Gedney
 6. Thomas and Betts Corporation

2.3 CONDUCTORS

- A. Comply with Division 26 Section 260519 " Low Voltage Electrical Power Conductors and Cables".
- B. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction, green insulation.
- C. Bare Copper Conductors: Stranded Conductors: ASTM B 8.
- D. Copper Bonding Conductors:
1. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
 2. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
 3. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
- E. Grounding Bus: Pre-drilled rectangular bars of annealed copper, 24 inch long, 1/4 inch by 4 inches in cross section, with 9/32-inch holes spaced 1-1/8 inches apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V and shall be Lexan or PVC, impulse tested at 5000 V.

2.4 CONNECTORS

- A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.
- B. Welded Connectors:
1. Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.
 2. Manufacturers - subject to compliance with requirements, provide products of one of the following:
 - a. nVent ERICO Cadweld
 - b. Hubbell Continental Industries thermOweld
- C. Bus-Bar Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar or compression type, copper or copper alloy, with two wire terminals.

- D. Beam Clamps: Mechanical type, terminal, ground wire access from four directions, with dual, tin-plated or silicon bronze bolts.
- E. Cable-to-Cable Connectors: Compression type, copper or copper alloy.
- F. Bonding Strap: Soft copper, 0.05 inch thick and 2 inches wide, except as indicated.
- G. Flexible Jumper Strap: Flexible flat conductor, 480 strands of 30-gauge bare copper wire; 3/4" wide, 9-1/2" long. Protect braid with copper bolt hole ends with holes sized for 3/8" diameter bolts.
- H. Water Pipe Clamps: Mechanical type, die-cast zinc alloy, two pieces with stainless steel bolts.
- I. Conduit Hubs: Mechanical type, terminal with threaded hub.

2.5 GROUNDING ELECTRODES

- A. Ground Rods: 13-mil copper-bonded steel, 3/4 inch by 8 feet.

2.6 ACCESSORIES

- A. Provide electrical insulating tape, heat-shrinkable insulating tubing, welding materials, bonding straps, as recommended by accessories manufacturers for type services indicated.

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Equipment Grounding
 - 1. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
 - a. Feeders and branch circuits.
 - b. Lighting circuits.
 - c. Receptacle circuits.
 - d. Single-phase motor and appliance branch circuits.
 - e. Three-phase motor and appliance branch circuits.
 - f. Flexible raceway runs.
 - g. Metal-clad cable runs.
 - 2. 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. Install bonding jumper to bond across flexible duct connections to achieve continuity.
 - 3. Water Heater Cables: Install a separate insulated equipment grounding conductor to each electric water heater. Bond conductor to heater units, piping, connected equipment, and components.

4. Poles Supporting Outdoor Lighting Fixtures: In addition to grounding conductor installed with branch circuit conductors, install a grounding electrode at each pole connected to ground lug in pole handhole.
- B. Grounding and Bonding for Gas Piping: Bond each above-ground portion of gas piping system downstream from equipment shutoff valve.
- C. Telecommunications Grounding
1. Install ground bus in rooms housing service equipment and elsewhere as indicated on drawings. Install horizontally, on insulated spacers 2 inches minimum from wall, 6 inches above finished floor unless otherwise indicated.
 2. Provide a #3/0 AWG green insulated copper conductor, unless noted otherwise, from the grounding electrode system to each ground bus location.
- D. Fence Grounding
1. Metallic Fences: Comply with requirements of IEEE C2.
 2. Fence Grounding: Install at maximum intervals of 300 feet except as follows:
 - a. Fences within 100 Feet of Buildings, Structures, Walkways, and Roadways: Ground at maximum intervals of 100 feet.
 - b. Barbed Wire: Strands shall be bonded to the grounding conductor.
 3. Gates and Other Fence Openings: Ground fence on each side of opening.
 - a. Bond across openings, with and without gates, except at openings indicated as intentional fence discontinuities. Use No. 2 AWG wire and bury it at least 18 inches below finished grade.
 - b. Connect flexible bonding jumper between gate post and gate frame.
 4. 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.
 5. Fences Enclosing Electrical Power Distribution Equipment: Ground as required by IEEE C2 unless otherwise indicated.
 6. Grounding Method: At each grounding location, drive a grounding rod vertically until the top is 6 inches below finished grade. Connect rod to fence with No. 6 AWG conductor. Connect conductor to each fence component at grounding location.
- E. Service Grounding
1. Connect equipment grounding conductors and grounding electrode conductors to the ground bus.
 2. Install a main bonding jumper between the neutral and ground buses.
 3. Metallic Water Service Pipe:
 - a. Provide insulated copper ground conductors, sized as indicated, from the building main service equipment, or the ground bus, to main metallic water service entrances to the building. Connect ground conductors to the main metallic water service pipes by means of ground clamps. Where a dielectric main water fitting is installed, connect the ground conductor to the street side of the fitting. Do not install a grounding jumper around dielectric fittings.
 - b. Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.

4. Grounding Triad: 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.

F. Overhead Line Grounding

1. Comply with ANSI C2, "National Electrical Safety Code" for "Single-Grounded Systems," using two electrodes in parallel if a single electrode resistance to ground exceeds 25 ohms.
2. Provide No. 4 AWG minimum, soft-drawn copper conductor, unless noted otherwise.
3. Grounding Conductor Protection: Protect grounding conductors running on the surface of wood poles with molding of a type manufactured for this purpose. Extend from grade level up to and through communications and transformer spaces.
4. Drive ground rods to a depth of 12 inches below finished grade in undisturbed earth. Use exothermic welds for underground connections and connections to rods.
5. Lightning Arresters: Separate arrester grounds from other ground conductors.
6. Secondary Neutral and Tank of Transformer: Interconnect and connect to ground.

- G. For raceways used as the ground path, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to the ground bus in the housing.

3.2 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. Terminate insulated equipment grounding conductors with pressure-type grounding lugs.
- B. 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 bonding so vibration is not transmitted to rigidly mounted equipment. Use braided type bonding jumpers for flexible bonding and grounding connections.
 3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.
- C. 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 are 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.
 6. Tighten grounding and bonding connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque tightening values for connectors and

bolts. Where manufacturer's torquing requirements are not indicated, tighten connections to comply with torque tightening values specified in UL 486A and UL 486B.

7. Exothermic Welded Connections:

- a. Comply with manufacturer's written recommendations.
- b. Use for connections to structural steel and for underground connections.
- c. Install at connections to ground rods.
- d. Comply with AWS Code for procedures, appearance, and quality of welds; and methods used in correcting welding work.
- e. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.

8. Provide connections as follows:

- a. Equipment Grounding Conductor Terminations: Bolted connectors.
- b. Pipe Grounding Conductor Terminations: Bolted connectors.
- c. Underground Connections: Welded connectors.
- d. Connections to Structural Steel: Welded connectors.
- e. Connections to Ground Rods at Test Wells: Bolted connectors.

D. Ground Rods: Drive rods until tops are 2 inches 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. Use exothermic welds for all below-grade connections.

E. Underground Grounding Conductors: Install bare copper conductor, No. 3/0 AWG, unless noted otherwise. Bury at least 24 inches below grade.

F. Cleaning And Adjusting: Restore surface features at areas disturbed by excavation and reestablish original grades except as otherwise indicated. Where sod has been removed, replace it as soon as possible after backfilling is completed. Restore areas disturbed by trenching, storing of dirt, cable laying, and other Work to their original condition. Include necessary topsoiling, fertilizing, liming, seeding, sodding, sprigging, or mulching. Restore disturbed paving as required.

3.3 FIELD QUALITY CONTROL

A. Independent Testing Organization: Arrange and pay for the services of a qualified independent electrical testing organization to perform tests described below.

B. Tests and Inspections:

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
3. Test completed grounding system at service disconnect enclosure grounding terminal at individual ground rods. Make tests at ground rods before any conductors are connected.
 - a. Measure ground resistance no fewer 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.
- c. Prepare test and inspection reports.
- d. Excessive Ground Resistance: If resistance to ground exceeds 5 ohms, notify Engineer promptly and include recommendations to reduce ground resistance.
- e. Provide approved method to reduce ground resistance and retest.

C. Grounding system will be considered defective if it does not pass tests and inspections.

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 Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this and the other sections of Division 26.
- B. All Division 26 Specification Sections apply to this section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Steel slotted support systems.
 - 2. Aluminum slotted support systems.
 - 3. Nonmetallic slotted support systems.
 - 4. Conduit and cable support devices.
 - 5. Support for conductors in vertical conduit.
 - 6. Structural steel for fabricated supports and restraints.
 - 7. Mounting, anchoring, and attachment components, including powder-actuated fasteners, mechanical expansion anchors, concrete inserts, clamps, through bolts, toggle bolts, and hanger rods.
 - 8. Fabricated metal equipment support assemblies.

1.3 SUBMITTALS

- A. Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections:
 - 1. Product Data: Submit manufacturer's data on supporting devices including catalog cuts, specifications, and installation instructions.

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Preformed steel channels and angles with minimum 13/32-inch diameter holes at a maximum of 8 inches o.c. in at least one surface.
 - 1. Manufacturers - subject to compliance with requirements, provide products of one of the following:
 - a. B-Line/Eaton
 - b. Caddy/Pentair
 - c. Flex-Strut, Inc.

- d. G-Strut/Gregory Industries, Inc.
 - e. Haydon Corporation
 - f. Jet Stream International
 - g. Madison Electric Products
 - h. Minerallac Company
 - i. Power-Strut/Atkore
 - j. Superstrut/Thomas & Betts
 - k. Unistrut/Aatkore
 - l. Westrut/Wesanco
2. Standard: Comply with MFMA-4 factory fabricated components for field assembly.
 3. Material for Channel, Fittings, and Accessories: Steel.
 4. Channel Width: Selected for applicable load criteria.
 5. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
 6. Connect with machine bolts to form rigid supports.
 7. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- C. 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 made of malleable iron.
- D. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M steel plates, shapes, and bars; black and galvanized.
- E. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
1. Manufacturers - subject to compliance with requirements, provide products of one of the following:
 - a. B-Line/Eaton
 - b. Empire Industries
 - c. Hilti, Inc.
 - d. MKT Anchoring Systems
 - e. Ramset/ITW
 - f. Rawlplug
 - g. Red Head/ITW
 - h. Simpson Strong-Tie Company
 2. 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.
 3. Mechanical Expansion Anchors: Insert-wedge-type, stainless steel, for use in hardened portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
 4. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.
 5. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.

6. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM F 3125/F 3125M, Grade A325 (Grade A325M).
7. Toggle Bolts: Stainless steel springhead type.
8. Hanger Rods: Threaded steel.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Maximum Support Spacing and Minimum Hanger Rod Size for Raceways: Space supports for EMT, IMC, and RMC as scheduled in NECA 1, where its Table 1 lists maximum spacings that are less than those stated in NFPA 70. Minimum rod size shall be 1/4 inch in diameter.
- B. Boxes, Enclosures and Cabinets:
 1. Install surface mounted cabinets with minimum of four anchors.
 2. In wet and damp location use steel channel supports to stand cabinets one inch off wall.
 3. Use sheet metal channel to bridge studs above and below cabinets recessed in hollow partitions.
- C. Metal Items for Use Outdoors or in Damp Locations: Hot-dip galvanized steel.
- D. Use vibration and shock resistant fasteners for attachments to concrete slabs.
- E. Provide vibration and shock resistant fasteners for all moving equipment where the energy of the vibration is of sufficient magnitude to produce perceptible vibration or structure transmitted noise in occupied areas. Isolation equipment shall be selected, installed and adjusted in accordance with manufacturer's recommendations. All equipment and material shall be installed so as to operate without objectionable noise or vibration as determined by Architect and Owner. Should such objectionable noise or vibration be produced and transmitted to occupied portions of the building by apparatus, piping or other parts of this work, any necessary changes as approved shall be made by the Contractor.

3.2 SUPPORT INSTALLATION

- A. Unless otherwise indicated, fasten all electrical items and their supporting hardware securely to the building structure.
- B. Coordinate with the building structural system and other electrical work, including raceway and wiring work, as necessary to interface installation of supporting devices with other work.
- C. Raceway Support Methods:
 1. In addition to methods described in NECA 1, conduit may be supported by openings through structure members, according to NFPA 70.
 2. Strength of each support shall be adequate to carry present and future load multiplied by a safety factor of at least four. Where this determination results in a safety allowance of less than 200 pounds, provide additional strength until there is a minimum of 200 pounds safety allowance in the strength of each support.
 3. Support individual horizontal raceways by separate pipe hangers.
 4. Support parallel runs of horizontal raceways together on trapeze-type hangers.

5. Install individual and multiple (trapeze) raceway hangers and riser clamps as necessary to support raceways.
 6. Provide U-bolts, clamps, attachments, and other hardware necessary for hanger assembly and for securing hanger rods and conduits.
 7. Secure raceways to steel slotted supports with spring nuts using spring friction action for retention in support channel.
 8. Spring steel fasteners may be used only for 3/4" raceways above suspended ceilings. For hanger rods with spring steel fasteners, use 1/4 inch diameter or larger threaded steel. Use spring steel fasteners that are specifically designed for supporting single conduits or tubing.
 9. In vertical runs, arrange support so the load produced by the weight of the raceway and the enclosed conductors is carried entirely by the conduit supports with no weight load on raceway terminals. Install simultaneously with installation of conductors.
- D. 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 pounds.
- E. 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 thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.
 5. To Steel: Beam clamps (MSS SP-58, 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.
- F. Install hangers, supports, clamps and attachments to support raceways, boxes, enclosures and cabinets properly from building structure.
- G. Install supports with spacings indicated and in compliance with NEC requirements.
- H. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.
- I. Do not fasten supports to pipes, ducts, mechanical equipment, and conduit.
- J. Do not weld conduit, pipe straps, or items other than threaded studs to steel structures.
- K. The use of clips or clip-on type supports is not acceptable.

3.3 CONCRETE BASES

- A. Unless otherwise indicated, construction of all concrete equipment foundations required for equipment furnished under Division 26 of specifications shall be this Contractor's responsibility. Foundations shall be sufficient size to suit equipment furnished, as approved.
- B. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.
- C. Use 3000-psi, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Section 033000 "Cast-in-Place Concrete."
- D. All exposed surfaces, except those that have steel protection, shall be finished with cement mortar, troweled smooth, with chamfered corners.
- E. Anchor equipment to concrete base as follows:
 - 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.

3.4 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.
- B. Touchup: Comply with requirements in Section 099113 "Exterior Painting", Section 099123 "Interior Painting" and/or Section 099600 "High-Performance Coatings 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 Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this and the other sections of Division 26.
- B. All Division 26 Specification Sections apply to this section.
- C. Division 08 Section "OPENINGS" for Access Doors.

1.2 SUMMARY

- A. This Section includes raceways for electrical wiring. Types of raceways in this section include the following:
 - 1. Conduits and fittings
 - 2. Boxes, enclosures, and cabinets
 - 3. Surface raceways
 - 4. Handholes and boxes for underground cabling
 - 5. Access doors

1.3 SUBMITTALS

- A. Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections:
 - 1. Product Data - submit manufacturer's data for the following:
 - a. Conduits and fittings
 - b. Boxes, enclosures, and cabinets
 - c. Surface raceways
 - d. Handholes
 - e. Access doors

PART 2 - PRODUCTS

2.1 METAL CONDUITS AND FITTINGS

- A. Manufacturers - subject to compliance with requirements, provide products of one of the following:
 - 1. AFC Cable Systems/Konkore
 - 2. Allied Tube & Conduit
 - 3. Anamet Electrical, Inc.
 - 4. Arlington
 - 5. Bridgeport

6. Calconduit
7. Crouse-Hinds/Eaton
8. Electri-Flex
9. Flexotek
10. KonKore
11. Korkap
12. NEC, Inc.
13. O-Z/Gedney
14. Patriot Aluminum Products
15. Perma-Cote
16. Phoenix
17. Picoma Industries, Inc.
18. Plasti-Bond
19. RACO/Hubbell
20. Republic Conduit
21. Southwire Company
22. Teddico Electrical Products
23. Thomas & Betts/ABB
24. Topaz Electric
25. Western Tube
26. Wheatland Tube

- B. Metallic Conduit: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1. Electrical Metallic Tubing (EMT): Comply with ANSI C80.3 and UL 797.
2. Flexible Metal Conduit (FMC): Comply with UL 1; zinc-coated steel.
3. Liquid-tight Flexible Metal Conduit (LFMC): Flexible steel conduit with PVC jacket and complying with UL 360.
4. Rigid Metal Conduit (RMC): Comply with ANSI C80.1 and UL 6.
5. Intermediate Metal Conduit (IMC): Comply with ANSI C80.6 and UL 1242.
6. PVC-Coated Rigid Steel Conduit: Comply with NEMA RN 1. Minimum 0.040 inch thick PVC coating.

- C. Metal Fittings: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application. Comply with NEMA FB 1 and UL 514B.

1. Fittings for EMT: Steel, compression type.
2. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
3. Fittings for FMC:
 - a. Straight Terminal Connectors: One piece body, female end with clamp and deep slotted machine screw for securing conduit, and male threaded end provided with locknut.
 - b. 45° or 90° Terminal Angle Connectors: Two-piece body construction with removable upper section, female end with clamp and deep slotted machine screw for securing conduit, and male threaded end provided with locknut.
4. Fittings for LFMC: Cadmium plated, steel fittings with compression type steel ferrule and neoprene gasket sealing rings, with insulated, or non-insulated throat.
5. Fittings for RMC: Threaded.
6. Fittings for IMC: Threaded.
7. Fittings for PVC-Coated Conduit: PVC coated, minimum thickness of 0.040 inch, with overlapping sleeves protecting threaded joints.

8. Joint Compound for IMC and RMC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 NONMETALLIC CONDUITS AND FITTINGS

- A. Manufacturers - subject to compliance with requirements, provide products of one of the following:
 1. AFC Cable Systems
 2. Allied Tube & Conduit
 3. Anamet Electrical, Inc.
 4. Cantex, Inc.
 5. Electri-Flex
 6. FRE Composites
 7. Heritage Plastics
 8. JM Eagle
 9. Kraloy
 10. National Pipe & Plastics
 11. RACO/Hubbell
 12. Southern Pipe, Inc.
 13. Teddico Electrical Products
 14. Thomas & Betts, Corporation
 15. Topaz Electric
 16. United Fiberglass
- B. Nonmetallic Conduit: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 1. Rigid Nonmetallic Conduit (RNC): Type EPC-40-PV or EPC-80-PV, complying with NEMA TC 2 and UL 651 unless otherwise indicated.
 2. Liquidtight Flexible Nonmetallic Conduit (LFNC): Comply with UL 1660.
 3. Electrical Nonmetallic Tubing (ENT): Comply with NEMA TC 13 and UL 1653.
- C. Nonmetallic Fittings: Listed and labeled for type of conduit, location, and use.
 1. Fittings for ENT and RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.
 2. Solvents and Adhesives: Provide product and installation as recommended by conduit manufacturer.

2.3 SURFACE RACEWAYS

- A. Manufacturers - subject to compliance with requirements, provide products of one of the following:
 1. Hubbell, Inc.
 2. MonoSystems, Inc.
 3. Panduit Corp.
 4. Wiremold/Legrand
- B. Listing and Labeling: Surface raceways shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

- C. Surface Metal Raceways: Galvanized steel with snap-on covers complying with UL 5. Manufacturer's standard enamel finish in color selected by Architect.
- D. Surface Nonmetallic Raceways: Two- or three-piece construction, complying with UL 5A, and manufactured of rigid PVC with texture and color selected by Architect from manufacturer's standard colors. Product shall comply with UL 94 V-0 requirements for self-extinguishing characteristics.
- E. Fittings and Accessories: Dividers, end caps, covers, cutouts, wiring harnesses, devices, mounting materials, and other fittings shall match and mate as required for complete system.

2.4 BOXES, ENCLOSURES, AND CABINETS

- A. Manufacturers - subject to compliance with requirements, provide products of one of the following:
 - 1. Adalet
 - 2. Appleton Electric/Emerson
 - 3. Cope
 - 4. Crouse-Hinds/Eaton
 - 5. FSR Inc.
 - 6. Hoffman/Pentair
 - 7. Kraloy
 - 8. Milbank Manufacturing
 - 9. OZ/Gedney
 - 10. RACO/Hubbell
 - 11. Spring City Electrical Manufacturing
 - 12. Steel City/Thomas & Betts Company
 - 13. Topaz Electric
 - 14. Wiegmann/Hubbell
- B. Device Boxes:
 - 1. Provide size as required by drawings, minimum 2-1/8 inches deep. Boxes shall be one-piece type, gangable boxes are prohibited.
 - 2. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
 - 3. Cast Metal Outlet and Device Boxes: Comply with NEMA FB 1, aluminum, Type FD, with gasketed cover.
 - 4. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 pounds. Outlet boxes designed for attachment of luminaires weighing more than 50 pounds shall be listed and marked for the maximum allowable weight.
- C. Pull and Junction Boxes:
 - 1. Sheet Metal Pull and Junction Boxes: NEMA OS 1.
 - 2. Cast Metal Pull and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum with gasketed cover.
 - 3. Boxes shall have screwed or bolted on covers of material same as box and shall be of size and shape to suit application.
- D. Accessories:
 - 1. Provide accessories as required for each installation.

2. Provide box supports, mounting ears and brackets, box extension rings, fixture studs, cable clamps and metal straps for supporting boxes, that are compatible with boxes being used to fulfill installation requirements for individual wiring situations.
3. Provide corrosion-resistant box knockout closures, conduit locknuts and malleable iron conduit bushings, offset connectors, of types and sizes to suit respective installation requirements and applications.
4. Provide stainless steel screws and hardware unless noted otherwise.

2.5 HANDHOLES AND BOXES FOR UNDERGROUND WIRING

- A. Manufacturers - subject to compliance with requirements, provide products of one of the following:
 1. Armormat
 2. Martin Enterprises
 3. NewBasis
 4. Oldcastle Enclosure Solutions
 5. Quazite/Hubbell
- B. General Requirements for Handholes and Boxes:
 1. Boxes and handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.
 2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover:
 1. Material: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel, fiberglass, or a combination of the two.
 2. Standard: Comply with SCTE 77.
 - a. For installations in parking lots, roadways, etc., provide Tier 15 enclosure
 - b. For all other installations, provide Tier 5 enclosure.
 3. Configuration: Designed for flush burial with open bottom unless otherwise indicated.
 4. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
 5. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
 6. Cover Legend: Molded lettering, refer to drawings for labeling.
 7. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
 8. Dimension: Minimum 11 inches wide by 18 inches long x 24 inches deep, unless noted otherwise on the drawings.

2.6 ACCESS DOORS

- A. Manufacturers - subject to compliance with requirements, provide products by one of the following:
 1. Babcock-Davis
 2. JL Industries, Inc.
 3. Karp Associates, Inc.
 4. Milcor

5. Nystrom, Inc.

B. General:

1. Provide access door and frame assemblies manufactured as integral units ready for installation.
2. Provide factory fabricated and assembled units, complete with attachment devices and fasteners ready for installation. Joints and seams shall be continuously welded steel, with welds ground smooth and flush with adjacent surfaces.
3. Refer to Section 083113 'Access Doors and Frames' for additional requirements.

C. Materials:

1. Face of door flush with frame, with exposed flange and concealed hinge.
2. Uncoated Steel Sheet for Door: Nominal 0.060 inch, 16 gage, factory finished.
3. Frame Material: Same material and thickness as door.
4. Latch and Lock: Cam latch, screwdriver operated
5. Fire Rated Units:
 - a. Insulated flush panel doors, with continuous piano hinge and self-closing mechanism.
 - b. Fire-Resistance Rating: Not less than that of adjacent construction.
 - c. Provide with UL label.

PART 3 - EXECUTION

3.1 APPLICATION

A. Raceways:

1. Minimum Raceway Size: 3/4-inch trade size.
2. Indoor Installations: Apply raceway products as specified below unless otherwise indicated:
 - a. Exposed: EMT.
 - b. Concealed in Ceilings and Interior Walls and Partitions: EMT or MC cable. Provide Type MC cable only for concealed branch circuit wiring in drywall partitions and above accessible ceilings. MC cable shall terminate in a junction box above the finished ceiling of space served by circuiting. All homeruns from branch panelboards shall be routed to space served in EMT conduit, unless otherwise specified. MC cable will not be used as the homerun from space served to panelboard of origin, unless otherwise specified.
 - c. Concealed in masonry walls: PVC.
 - d. Final connection to recessed and semi-recessed lighting fixtures, not to exceed 72": FMC.
 - e. Damp or Wet Locations: RMC.
 - f. Corrosive Environments: LFMC.
 - g. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.

3. Outdoor Installations - apply raceway products as specified below unless otherwise indicated:
 - a. Exposed Conduit: RMC.
 - b. Concealed Conduit, Aboveground: RMC.
 - c. Underground Conduit: RNC, Type EPC-40-PVC, direct buried or concrete encased.
 - d. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
4. Raceway Fittings: Compatible with raceways and suitable for use and location.
 - a. EMT: Use compression, steel fittings. Comply with NEMA FB 2.10.
 - b. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.
 - c. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
 - d. Damp or Wet Locations: Watertight fittings.
 - e. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.

B. Boxes, Enclosures, and Cabinets

1. Provide boxes, enclosures and cabinets and associated covers and fittings of materials and NEMA types suitable for each location and in conformance with the following requirements, unless drawings indicate a more stringent requirement:
 - a. Interior Dry Locations: Sheet steel, NEMA type 1.
 - b. Locations Exposed to Weather or Dampness: Cast metal, NEMA type 3R, with threaded hub(s) and gasketed weatherproof cover.

C. Access Doors:

1. Where installed in a fire-rated wall or ceiling, provide access door assembly with panel door, frame, hinge, and latch from manufacturer listed in the UL "Building Materials Directory" for rating shown.

3.2 INSTALLATION

A. General

1. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems".
2. Complete installation of raceways, boxes, enclosures, and cabinets before starting conductor installation.
3. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch trade size and insulated throat metal bushings on 1-1/2-inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.
4. Support conduit within 12 inches of boxes, enclosures or cabinets to which attached and within 12 inches of change of direction.
5. Do not install aluminum boxes or fittings in contact with concrete or earth.

6. Install raceways square to boxes, enclosures and cabinets and terminate with locknuts. Install locknuts hand tight plus 1/4 turn more.
7. Do not rely on locknuts to penetrate nonconductive coatings on boxes, enclosures and cabinets. Remove coatings in the locknut area prior to assembling conduit to ensure a continuous ground path.
8. Prevent foreign matter from entering raceways, boxes, enclosures and cabinets by using temporary closure protection.
9. Upon completion of installation of raceways, boxes, enclosures and cabinets, inspect interiors and clear all blockages and remove burrs, dirt, and construction debris.

B. Raceways

1. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed.
2. Make bends in raceway using either large-radius preformed elbows or field bending. Use only equipment specifically designed for material and size involved. Make bends and offsets so the inside diameter is not effectively reduced.
3. Run parallel raceways together.
4. Cut conduit perpendicular to the length. For conduits 2-inch trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.
5. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200 pound tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.
6. Do not run raceways exposed on floors.
7. Do not run raceways exposed on roofs.
8. Where raceways terminate at locations subject to moisture, provide insulating bushings to protect conductors.
9. Where terminations are subject to vibration, use bonding bushings or wedges to ensure electrical continuity.
10. Indoor Raceways:
 - a. Conceal conduit within finished walls, ceilings, and floors except in equipment rooms and attics/crawl spaces, unless otherwise indicated.
 - b. Do not fasten conduits onto the bottom side of a metal deck roof.
 - c. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
 - d. Install conduits parallel or perpendicular to building lines.
 - e. Where a ceiling is scheduled to be exposed to structure, all conduit shall be secure to structure to provide a clean, organized appearance. Where routed between structural elements, install conduit as high as practical.
 - f. Where conduit is installed concealed in masonry walls, transition PVC conduit within masonry wall to otherwise-specified interior or exterior raceway.
 - g. Terminations:
 - 1) Where raceways are terminated with locknuts and bushings, align the raceway to enter squarely and install the locknuts with dished part against the box.
 - 2) Where terminations cannot be made secure with one locknut, use two locknuts, one inside and one outside the box.
 - 3) Where terminating in threaded hubs, screw the raceway or fitting tight into the hub so the end bears against the wire protection shoulder.
 - 4) Where chase nipples are used, align the raceway so the coupling is square to the box, and tighten the chase nipple so no threads are exposed.

- h. Stub-Ups to Above Recessed Ceilings:
 - 1) Use EMT for raceways.
 - 2) Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
 - i. Expansion Joint Fittings:
 - 1) Install in each run of EMT conduit that is located where environmental temperature change may exceed 100°F and that has straight-run length that exceeds 100 feet.
 - 2) Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
 - a) Indoor Spaces Connected with Outdoors without Physical Separation: 125°F temperature change.
 - b) Attics: 135°F temperature change.
 - 3) Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per degree F of temperature change for metal conduits.
 - 4) Install expansion fittings at all locations where conduits cross building or structure expansion joints.
 - 5) Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.
11. Underground Raceways (including conduits under concrete floor slab):
- a. Install at a minimum depth of 3'-0" below finished grade to top of raceway unless noted otherwise.
 - b. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Section 312000 "Earth Moving" for pipe less than 6 inches in nominal diameter.
 - c. Provide conduit rack in trench prior to concrete pour or backfill.
 - d. Where indicated on the drawings, provide a minimum 3" concrete encasement for PVC conduit for underground raceways. Provide concrete encasement reinforced with a minimum of four No. 4 reinforcing steel rods spaced 2" in from each corner under roadways or any area subject to vehicular traffic. Reinforcing rods shall extend continuously throughout the width of the raceway in order to avoid raceway shear.
 - e. 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 of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Section 312000 "Earth Moving."
 - f. Where underground raceways end in a 90 degree bend and a vertical riser conduit, the 90 degree bend and riser conduit shall be PVC. PVC conduit shall rise to 6" above finished floor or finished grade then transition to specified exposed raceway. Arrange stub-ups so curved portions of bends are not visible above finished slab.
 - g. Provide watertight connections.

- h. Provide underground warning tape in accordance with Section 260553 "Identification for Electrical Systems."
- i. Where underground raceways are installed for electrical systems operating at 600 volts or greater, underground raceways shall be field heated and bent, concrete-encased, with a minimum radius of 10 feet.

12. Raceway Sealants:

- a. Install raceway sealing fittings at accessible locations according to NFPA 70 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 according to NFPA 70.
- b. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:
 - 1) Where an underground service raceway enters a building or structure.
 - 2) Conduit extending from interior to exterior of building.
 - 3) Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 - 4) Where otherwise required by NFPA 70.

- 13. 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.
- 14. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.

C. Boxes, Enclosures and Cabinets:

- 1. Locations shown on Contract Drawings are approximate unless dimensioned.
- 2. Mount at heights indicated on Drawings. If mounting heights are not individually indicated, give priority to ADA requirements. Install with height measured to top of box unless otherwise indicated.
- 3. Provide support of junction and pull boxes from building structure. Do not support boxes by conduits.
- 4. Position recessed boxes, enclosures and cabinets to allow for surface finish thickness.
- 5. Mount boxes, enclosures and cabinets with fronts straight and plumb.
- 6. Install surface-mounted cabinets with minimum of four anchors.
- 7. Locate and install to allow access. Where installation is otherwise inaccessible, coordinate locations and sizes and provide required access doors.
- 8. Coordinate masonry cutting to achieve neat openings.
- 9. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.
- 10. Locate so that cover or plate will not span different building finishes.
- 11. Do not install boxes back-to-back in walls. Provide minimum 6 inch separation. Provide minimum 24 inch separation in acoustic-rated walls.
- 12. Coordinate mounting heights and locations of wall outlets mounted where counters, benches, and backsplashes are to be installed. Install outlets 6" above tops of counters and benches.
- 13. Coordinate mounting heights and locations of wall outlets where wall-mounted heating units are to be installed.
- 14. Cap unused knockout holes where blanks have been removed and plug unused conduit hubs.

15. Mount outlet boxes for switches and receptacles with the long axis vertical unless noted otherwise. Three or more gang boxes shall be mounted with the long axis horizontal.
16. Electrically ground metallic boxes, enclosures and cabinets.
17. Where wiring to an item that includes a grounding conductor, provide a grounding terminal in the interior of the box, enclosure or cabinet.

D. Surface Raceways:

1. Install surface raceways only where indicated on Drawings.
2. Install surface raceway with a minimum 2-inch radius control at bend points.
3. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches and with no less than two supports per straight raceway section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.

E. Installation of Underground Handholes and Boxes:

1. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.
2. Unless otherwise indicated, support units on a 6" deep level bed of crushed stone or gravel, graded from 1/2-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.
3. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch above finished grade.
4. Field-cut openings for 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.

F. Installation of Access Doors

1. Set frames accurately in position and securely attached to supports, with face panels plumb and level in relation to adjacent finish surfaces.
2. Adjust hardware and panels after installation for proper operation.

G. Sleeve and Sleeve Seal Installation for Electrical Penetrations

1. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Seals for Electrical Systems".
2. Install firestopping at penetrations of fire rated floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Seals for Electrical Systems".

3.3 PROTECTION

A. Protect coatings, finishes, and cabinets from damage and deterioration.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to painted finishes using matching corrosion inhibiting touch-up coating recommended by the manufacturer.
3. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 260533

SECTION 260544
SLEEVES AND SEALS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this and the other sections of Division 26.
- B. All Division 26 Specification Sections apply to this section.
- C. Division 07 THERMAL AND MOISTURE PROTECTION Sections.

1.2 SUMMARY

- A. Section Includes:
 - 1. Sleeves for raceway and cable penetration of non-fire-rated construction walls and floors
 - 2. Sleeve seal systems and fittings
 - 3. Grout
 - 4. Sealants
 - 5. Firestopping

1.3 SUBMITTALS

- A. Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
 - 1. Product data for the following products:
 - a. Sealants
 - b. Firestopping

PART 2 - PRODUCTS

2.1 SLEEVES

- A. Wall Sleeves
 - 1. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, plain ends.
 - 2. Cast iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
- B. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw fastening the sleeve to the board.

2.2 SLEEVE SEAL SYSTEMS AND FITTINGS

- A. Description: Provide modular mechanical type seals, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between pipe and sleeve, connected with bolts and pressure plates that cause rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.
- B. Material:
 - 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.
- C. Manufacturers - subject to compliance with requirements, provide products of one of the following:
 - 1. Advance Products and Systems Inc.
 - 2. Calpico
 - 3. GPT Industries
 - 4. MetraFlex

2.3 GROUT

- A. Description: Non-shrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.
- B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

2.4 SILICONE SEALANTS

- A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.
 - 1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.
 - 2. Color: As selected by the Architect from manufacturer's standard colors.
- B. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, non-shrinking foam.
- C. Manufacturers - subject to compliance with requirements, provide products of one of the following:
 - 1. 3M
 - 2. Adfast
 - 3. Dow Corning Corporation
 - 4. GE Construction Sealants
 - 5. Pecora Corporation

6. Rectorseal
7. Sika Corporation
8. Soudal USA
9. Tremco, Inc.

2.5 FIRESTOPPING

A. General:

1. 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.
2. Equipment used shall be in accordance with the firestop manufacturer's written installation instructions.
3. Color: Red.

B. Performance Requirements

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

C. Penetration Firestopping Systems

1. 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.
2. 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 .
 - a. F-Rating: Not less than the fire-resistance rating of constructions penetrated.
3. 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.
 - a. F-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated.
 - b. T-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated except for floor penetrations within the cavity of a wall.
 - c. W-Rating: Provide penetration firestopping systems showing no evidence of water leakage when tested according to UL 1479.

4. Penetrations in Smoke Barriers: Penetration firestopping systems with ratings determined per UL 1479, based on testing at a positive pressure differential of 0.30-inch wg.
 - a. L-Rating: Not exceeding 5.0 cfm/sq. ft. of penetration opening at and no more than 50-cfm cumulative total for any 100 sq. ft. at both ambient and elevated temperatures.
5. Exposed Penetration Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, per ASTM E 84.
6. 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.
 - a. Permanent forming/damming/backing materials.
 - b. Substrate primers.
 - c. Collars.
 - d. Steel sleeves.

D. Fill Materials

1. 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.
2. Latex Sealants: Single-component latex formulations that do not re-emulsify after cure during exposure to moisture.
3. Firestop Devices: Factory assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.
4. Intumescent Composite Sheets: Rigid panels consisting of aluminum foil faced intumescent elastomeric sheet bonded to galvanized steel sheet.
5. Intumescent Putties: Non-hardening, water-resistant, intumescent putties containing no solvents or inorganic fibers.
6. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.
7. 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 non-shrinking, homogeneous mortar.
8. 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.
9. Silicone Foams: Multicomponent, silicone based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, non-shrinking foam.
10. Silicone Sealants: Single-component, silicone based, neutral curing elastomeric sealants.

E. Mixing

1. 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.

- F. Manufacturers - subject to compliance with requirements, provide products of one of the following:
1. 3M
 2. A/D Fire Protection Systems
 3. Emerson/Nelson
 4. Hilti
 5. Nuco Inc.
 6. PFP Partners
 7. RectorSeal
 8. Specified Technologies Inc.
 9. Tremco, Inc.

PART 3 - EXECUTION

3.1 GENERAL

- A. Contractor shall provide sleeves where raceways pass through walls, floors, and ceilings.
- B. Where piping or raceways pass through waterproofed floors or walls, design of sleeves shall be such that waterproofing can be flashed into and around the sleeves.
- C. Where items pass through roofs, coordinate the installation with the roofing installer and provide an approved penetration to maintain the roof warranty.

3.2 SLEEVE INSTALLATION

- A. Sleeves for Conduits Penetrating Above-Grade Concrete and Masonry Unit Floors and Walls
1. Interior Penetrations of Walls and Floors:
 - a. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint.
 - b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall/floor so no voids remain. Tool exposed surfaces smooth; protect material while curing.
 2. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable unless sleeve seal is to be installed.
 3. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during construction of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
 4. Install sleeves for floor penetrations. Extend sleeves installed in floors 6 inches above finished floor level. Install sleeves during construction of floors.
- B. Sleeves for Conduits Penetrating Gypsum Board Assemblies
1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
 2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.

- C. Roof Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- D. Aboveground, Exterior Wall Penetrations: Seal penetrations using stainless steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- E. Underground, Exterior Wall and Floor Penetrations: Install cast iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing sleeve-seal system.

3.3 SLEEVE SEAL SYSTEMS AND FITTINGS INSTALLATION

- A. Provide sleeve seal system for below-grade sleeves through exterior walls.
- B. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.
- C. Install sleeve-seal fittings in new walls and slabs as they are constructed.
- D. Install 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 in accordance with manufacturer's recommended values to ensure that sealing grommets expand to make watertight seal.
- E. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.
- F. Secure nailing flanges to concrete forms.
- G. Using grout, seal the space around outside of sleeve seal fittings.

3.4 SEALANTS

- A. General
 - 1. Comply with joint sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
 - 2. Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- B. Preparation
 - 1. 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:
 - a. 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.

- b. 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.
 - c. Remove laitance and form-release agents from concrete.
 - d. 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.
 2. 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.
 3. 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.
- 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.
- G. 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.
- H. 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.

3.5 FIRESTOPPING

A. General

1. Where conduits, conduit sleeves, wireways and other electrical raceways or cables pass through fire partitions, fire walls, fire floors, or smoke walls, provide a fire or smoke stopping that provides an effective barrier against the spread of fire, smoke or gases.
2. Provide firestopping with fire-resistance ratings indicated for floor or wall assembly in which penetration occurs.
3. Install materials in accordance with printed instructions of the UL Fire Resistance Directory and per manufacturer's published instructions.
4. All cables that are installed in conduit sleeves or in wireways through fire or smoke floors or partitions shall be provided with an equally rated re-enterable UL listed fire and smoke rated silicone RTV foam in the opening.
5. Keep areas of work accessible until inspection by applicable code authorities.

B. Preparation

1. Surface Cleaning: Before installing penetration firestopping systems, clean out openings immediately to comply with manufacturer's written instructions and with the following requirements:
 - a. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of penetration firestopping materials.
 - b. 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.
 - c. Remove laitance and form-release agents from concrete.

C. Install penetration firestopping systems to comply with manufacturer's written installation instructions and published drawings for products and applications.

D. 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.

E. 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.

F. 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.

- G. 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 260544

SECTION 260553
IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this and the other sections of Division 26.
- B. All Division 26 Specification Sections apply to this section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Cable/Conductor Identification Bands
 - 2. Laminated Acrylic or Melamine Plastic Labels
 - 3. Self-Adhesive Labels
 - 4. Underground Line Warning Tape
 - 5. Metal Tags

1.3 SUBMITTALS

- A. Product Data for each type of product. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for electrical identification products.
- B. Samples: For each type of label and sign to illustrate composition, size, colors, lettering style, mounting provisions, and graphic features of identification products.
- C. Identification Schedule: For each piece of electrical equipment and electrical system components to be an index of nomenclature for electrical equipment and system components used in identification signs and labels. Use same designations indicated on Drawings.

PART 2 - PRODUCTS

2.1 ELECTRICAL IDENTIFICATION PRODUCTS

- A. Manufacturers - subject to compliance with requirements, provide products of one of the following:
 - 1. Brady Corporation
 - 2. Champion America
 - 3. Emedco
 - 4. Grafoplast
 - 5. Hellerman Tyton
 - 6. Ideal Industries
 - 7. LEM Products, Inc.
 - 8. Marketing Services, Inc.
 - 9. Panduit

- B. General: Coordinate names, abbreviations and other designations used in electrical identification work, with corresponding designations shown, specified or scheduled. Provide numbers, lettering and wording as indicated or, if not otherwise indicated, as recommended by manufacturers or as required for proper identification and operation/maintenance of the electrical systems and equipment. Comply with ANSI A13.1 pertaining to minimum sizes for letters and numbers.
- C. Cable/Conductor Identification Bands: Provide manufacturer's standard aluminum wrap-around cable/conductor markers, of size required for proper application with stamped or embossed legend, and numbered to show circuit identification.
- D. Laminated Acrylic or Melamine Plastic Labels:
 - 1. Engraved with black letters on white face, unless noted otherwise.
 - 2. Thickness:
 - a. For signs up to 20 sq. in. minimum 1/16 inch thick.
 - b. For signs larger than 20 sq. inch, 1/8 inch thick.
 - 3. Fasteners for Laminated Acrylic or Melamine Plastic Labels:
 - a. Self-tapping stainless steel screws or number 10/32 stainless steel machine screws with nuts and flat and lock washers. Where screws cannot or should not penetrate substrate, provide contact type permanent adhesive.
- E. Self-Adhesive Labels:
 - 1. Vinyl, thermal, transfer-printed, 3-mil-thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for intended use and location.
 - 2. Marker for Labels: Machine-printed, permanent, waterproof, black ink recommended by printer manufacturer.
- F. Underground Line Warning Tape: Permanent, bright-colored, continuous-printed, vinyl tape.
 - 1. Not less than 6 inches wide by 4 mils thick.
 - 2. Compounded for permanent direct-burial service.
 - 3. Embedded continuous metallic strip or core.
 - 4. Printed legend indicating type of underground line.
- G. Metal Tags:
 - 1. Brass, 2 by 2 by 0.05 inch, with stamped identification, punched for use with self-locking cable tie fastener.
 - 2. Fasteners for Metal Tags:
 - a. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.
 - 1) Minimum Width: 3/16 inch.
 - 2) Tensile Strength at 73°F according to ASTM D 638: 12,000 psi.
 - 3) Temperature Range: Minus 40° to plus 185°F.
 - 4) Color: Black.

PART 3 - EXECUTION

3.1 GENERAL

- A. Install identifying devices before installing acoustical ceilings and similar concealment.
- B. Verify identity of each item before installing identification products.
- C. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.
- D. Apply identification devices to surfaces that require finish after completing finish work.
- E. Install signs with approved legend to facilitate proper identification, operation, and maintenance of electrical systems and connected items.

3.2 APPLICATION AND INSTALLATION

- A. Accessible Fittings for Raceways: Using permanent marker, identify the covers of each junction and pull box with the panelboard and circuit number(s) of installed conductors.
- B. Receptacle Faceplates: Using self-adhesive labels applied to face of plate, identify panelboard and circuit number feeding device. Label shall be clear with black lettering.
- C. Cable/Conductor Identification Bands: Apply cable/conductor identification bands indicating circuit number on each cable/conductor in each panelboard.
- D. Contactors: Using permanent marker, identify controlled circuits in contactors.
- E. Labels

1. General

- a. Attach labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
- b. Before applying self-adhesive electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.
- c. Apply labels to exterior of door or cover. In finished areas, install labels to inside face of doors.
- d. Provide labels at locations indicated and at locations for best convenience of viewing without interference with operation and maintenance of equipment.
- e. Unless otherwise indicated, provide a single line of text with 1/2-inch high letters on minimum 1-1/2 inch high sign; where two lines of text are required, use signs minimum 2 inches high.

2. Warning labels - provide the following:

- a. Workspace Clearance Warning at all panelboard locations: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."

3. Emergency Operating Labels: Provide laminated acrylic or melamine plastic labels with white letters on red background with minimum 3/8-inch high lettering for emergency instructions on power transfer, load shedding, or other emergency operations.
 4. Equipment Identification Labels: Provide laminated acrylic or melamine plastic equipment identification labels for each device in the following categories of electrical equipment. Text shall match terminology and numbering of the Contract Documents and shop drawings.
 - a. Contactors.
 - b. Disconnect switches
 - c. Enclosed circuit breakers
 - d. Panelboards
- F. Underground Line Warning Tape: During trench backfilling, for exterior underground power, control, signal, and communication lines, install continuous underground plastic line marker located directly above line at 6 to 8 inches below finished grade. Where width of multiple lines installed a common trench or concrete envelope does not exceed 16 inches overall, use a single line marker. Install underground-line warning tape for direct-buried cables and cables in raceways.

END OF SECTION 260553

SECTION 260573
OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this and the other sections of Division 26.
- B. All Division 26 Specification Sections apply to this section.

1.2 SUMMARY

- A. This Section includes provisions for electrical distribution coordination, short circuit analysis, and shock and flash hazard studies.
- B. Study shall be provided for all new equipment and elsewhere as noted on drawings. Contractor shall provide all required information on existing upstream installations as required to complete the study.

1.3 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
 - 1. Eight bound copies of coordination, short circuit, and shock and flash hazard studies.
 - 2. Electronic copy of studies on CD (8 copies).
 - 3. All flash hazard labels for use on equipment associated with the study (3 copies).
 - 4. Complete SKM database for study on CD for future Owner use (2 copies).

1.4 QUALITY ASSURANCE

- A. Qualifications: Firm engaged in performing studies of this type for at least 5 years.

1.5 SEQUENCE AND SCHEDULING

- A. Contractor shall submit three (3) copies of preliminary coordination and short circuit study prior to submitting distribution equipment submittals. No submittals for switchgear, switchboards, panelboards, transformers, etc., will be approved without prior submittal of coordination and short circuit study.
- B. If preliminary study indicates issues with equipment that will be submitted, preliminary study shall be rerun using alternate equipment with ratings and settings appropriate for the system being installed.
- C. After approval of preliminary coordination study, contractor shall submit distribution equipment submittals for approval, including any necessary revisions indicated by preliminary coordination

and short circuit study.

- D. Provide final bound coordination, short circuit, and shock and flash hazard study. Provide PPE labels for all equipment being provided, and for existing equipment included in study. Provide CD with each copy of study containing all study files and input files.

PART 2 - PRODUCTS

2.1 STUDIES

- A. Provide, in accordance with industry standards, the electrical studies listed in this section.
- B. All studies shall incorporate the actual equipment being provided, and actual cable lengths, conduit types, and wire sizes of feeders being installed. Provide all field survey work necessary to obtain all required information from existing equipment that will be connected to as part of this project, in order to include existing equipment in study. This includes, but is not limited to, nameplate information, catalog numbers, trip unit settings, and relay settings.
- C. All studies shall be performed using analysis software as manufactured by SKM Systems Analysis, Inc.

2.2 ELECTRICAL DISTRIBUTION COORDINATION STUDY

- A. Provide a complete electrical distribution coordination study, based on the equipment being submitted. Submit complete documentation of the coordination of all circuit breakers and fused switches. The study shall provide recommendations for the settings of all adjustable devices (i.e. ground fault, adjustable breakers) to provide maximum coordination and selectivity. This report shall include a composite drawing for each segment of the distribution system showing the time-current curves of all devices, with the devices set as recommended. This shall include the complete characteristic curves for all circuit protection devices.

2.3 SHORT CIRCUIT ANALYSIS

- A. Provide a complete short circuit analysis, based on the actual equipment and conductor lengths provided by the Contractor. Analysis shall include all new equipment on project, and any and all existing equipment to which new equipment or feeders are being connected to.

2.4 EQUIPMENT EVALUATION ANALYSIS

- A. Provide a complete equipment evaluation analysis, based on the actual equipment and conductor lengths provided by the Contractor. Analysis shall include all new equipment on project, and any and all existing equipment to which new equipment or feeders are being connected to. Provide a list of any equipment that is not rated for the available fault current at its location.

2.5 COORINATION STUDY

- A. Provide a complete coordination study, based on the actual equipment provided by the Contractor. Coordination study shall include all relays, adjustable trip circuit breakers, fuses, and all thermal magnetic breakers in distribution equipment down to and including enclosed circuit breakers, and branch circuit breakers in panelboards.
- B. Adjust settings and fuses to obtain the highest level of coordination while maintaining a PPE level of 2 or less at each piece of equipment. Where level 2 PPE cannot be attained, settings shall be adjusted to obtain the lowest arc flash energy level possible.
- C. Provide color TCC curve plots for all equipment in coordination study. TCC's shall include device names and setting for each device on the TCC plot.
- D. Provide a list of recommended settings for use by the Contractor in programming and setting all breakers and fuses.

2.6 SHOCK HAZARD AND FLASH HAZARD ANALYSIS

- A. Provide a complete shock hazard and flash hazard analysis, based on the actual equipment and conductor lengths provided by the Contractor. Provide for all warning signs and classification signage on all distribution equipment as required by NFPA 70E, 2009 Edition.

PART 3 - EXECUTION

3.1 GENERAL

- A. Provide for adjustment and setting of all trip units and relays according to coordination study recommendations.
- B. Install all PPE labels on equipment.

END OF SECTION 260573

SECTION 260923
LIGHTING CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this and the other sections of Division 26.
- B. All Division 26 Specification Sections apply to this section.

1.2 SUMMARY

- A. Section includes a networked lighting control system comprised of the following components:
 - 1. Relay-Based Lighting Control
 - a. System Software Interfaces
 - b. System Backbone and Integration Equipment
 - c. Wired Control Devices
 - 2. Wallbox Timer Switches
 - 3. Relay Panels
 - 4. Emergency Shunt Relays
- B. The lighting control system shall meet all of the characteristics and performance requirements specified herein.
- C. The contractor shall provide, install and verify proper operation of all equipment as specified herein and as shown on applicable drawings.

1.3 DEFINITIONS

- A. BACnet: A networking communication protocol that complies with ASHRAE 135.
- B. BAS: Building automation system.
- C. BMS: Building management system.
- D. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote control, signaling and power-limited circuits.
- E. RS-485: A serial network protocol, similar to RS-232, complying with TIA-485-A.

1.4 SUBMITTALS

- A. Submittal shall be provided including the following items.
1. Bill of Materials necessary to install the networked lighting control system.
 2. Product Data Sheets indicating general device descriptions, dimensions, electrical specifications, wiring details, and nomenclature.
 3. Riser Diagrams showing device wiring connections of system backbone and typical per room/area type.
 4. Information Technology (IT) connection information pertaining to interconnection with facility IT networking equipment and third-party systems.
 5. Other Diagrams and Operational Descriptions - as needed to indicate system operation or interaction with other system(s).
 6. Example Contractor Startup/Commissioning Worksheet (must be completed prior to factory start-up).
 7. Service Specification Sheets indicating general service descriptions, including startup, training, post-startup support, and service contract terms.
 8. Hardware and Software Operation Manuals.

1.5 QUALITY ASSURANCE

- A. Product Qualifications
1. All components and the manufacturing facility where product was manufactured must be RoHS compliant.
 2. In high humidity or cold environments, the sensors shall be conformably coated and rated for condensing humidity and -40°F operation.
 3. All applicable products must be UL Listed or other acceptable national testing organization.

1.6 WARRANTY

- A. All lighting control components shall have a five year warranty.
- B. Provide software support for two years, including software updates. Software updates shall include operating system and new or revised licenses for use of the software.

1.7 EXTRA MATERIALS

- A. Furnish extra materials matching products installed, as described below, packaged with protective covering for storage, and identified with labels clearly describing contents. Deliver replacement stock directed to Owner's storage space.
1. Relay-Based Lighting Controls (Relays, Low Voltage Switches, Occupancy Sensors, Ambient Light Sensors): 1 component for every 20 of each type installed.
 2. Stand-Alone Lighting Controls (Sensor Power Packs, Occupancy Sensors, Timer Switches): 1 component for every 20 of each type installed.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Coordinate lighting control components to form an integrated interconnection of compatible components for optimum performance of lighting control functions.
- B. Communication and low voltage power shall be delivered to each device via standard low voltage cabling as recommended by the system manufacturer.

2.2 MANUFACTURERS

- A. Manufacturers - subject to compliance with requirements, provide products of one of the following:
 - 1. Acuity Brands/nLight
 - 2. Crestron Zum
 - 3. Hubbell NX
 - 4. Legrand/Wattstopper DLM
 - 5. Leviton GreenMAX
 - 6. Lutron Quantum
 - 7. Osram/Encelium

2.3 RELAY-BASED LIGHTING CONTROL

- A. Summary
 - 1. The lighting control system specified in this section shall provide time-based, sensor-based (both occupancy and daylight), and manual lighting control.
 - 2. The system shall be capable of turning lighting loads on/off as well as dimming lights (if lighting load is capable of being dimmed).
 - 3. All system devices shall be networked together enabling digital communication and shall be individually addressable.
 - 4. The system architecture shall be capable of enabling stand-alone groups (rooms) of devices to function in some default capacity even if network connectivity to the greater system is lost.
 - 5. The system architecture shall allow for remote operation via a computer connection.
 - 6. The system shall not require any centrally hardwired switching equipment.
 - 7. The system shall be capable of wireless, wired, or hybrid wireless/wired architectures.
- B. System Performance Requirements
 - 1. System Architecture
 - a. System shall have an architecture that is based upon three main concepts: (1) networkable intelligent lighting control devices, (2) standalone lighting control zones using distributed intelligence, (3) system backbone for remote, time based and global operation between control zones.
 - b. Intelligent lighting control devices shall have individually addressable network communication capability and consist of one or more basic lighting control components: occupancy sensor, photocell sensor, relay, dimming output, contact closure input, analog 0-10V input, and manual wall station capable of indicating switching, dimming, and/or scene control. Combining one or more of these

components into a single device enclosure shall be permissible so as to minimize overall device count of system.

- c. System must be capable of interfacing directly with networked luminaires such that either low voltage network cabling or wireless RF communication is used to interconnect networked luminaires with control components such as sensors, switches and system backbone.
- d. Lighting control zones consisting of one or more networked luminaires and intelligent lighting control devices and shall be capable of providing automatic control from sensors (occupancy and/or photocell) and manual control from local wall stations without requiring connection to a higher-level system backbone; this capability is referred to as "distributed intelligence."
- e. Networked luminaires and intelligent lighting control devices shall support individual (unique) configuration of device settings and properties, with such configuration residing within the networked luminaires and intelligent control devices.
- f. Networked luminaires and intelligent lighting control devices shall have distributed intelligence programming stored in non-volatile memory, such that following any loss of power the lighting control zones shall operate according to their defined default settings and sequence of operations.
- g. Lighting control zones shall be capable of being networked with a higher-level system backbone to provide time based control, remote control from inputs and/or systems external to the control zone, and remote configuration and monitoring through a software interface.
- h. The system may include one or more system controllers that provide time-based control and global system control across multiple control zones and backbone network segments. The system controller also provides a means of connecting the lighting control system to a system software interface and building management systems via BACnet/IP or BACnet MS/TP protocol.
- i. The system may include "communication bridge" devices that route communication from lighting control zones (wired or wireless) to and from the system controller, for purposes of decreasing system wiring requirements.
- j. All system devices shall support remote firmware update, such that physical access to each device is not necessary, for purposes of upgrading functionality at a later date.

C. Wired Networked Devices

1. Wall Switches, Dimmers, Scene Controllers

- a. Devices shall recess into single-gang switch box and fit a standard GFI opening.
- b. Devices with mechanical push-buttons shall provide tactile and LED user feedback.
- c. Devices with mechanical push-buttons shall be furnished with custom button labeling.
- d. Supply faceplates per specification Section 262726 "Wiring Devices".

2. Outdoor Photocell

- a. Relay-based lighting control system shall utilize an external photocell to continuously measure exterior light levels.
- b. The photocell is to be mounted on roof.
- c. The photocell shall be accurate to +/- 5%.
- d. The photocell shall have a range of .2 to 2000 footcandles.

2.4 WALLBOX TIMER SWITCH

- A. Solid state, programmable, with alphanumeric display or preset, multi-button configuration; complying with UL 917.

2.5 RELAY PANELS

- A. Relay panel shall be available with 4, 8, 12 or 16 individual relays per panel, with an equal number of individual 0-10V dimming outputs.
- B. 0-10V dimming outputs shall support a minimum of 100mA sink current per output.
- C. Relay and dimming outputs shall be individually programmable to support all standard sequence of operations as defined in this specification.
- D. Panel shall be UL924 listed for control of emergency lighting circuits.
- E. Panel shall power itself from an integrated 120-277.
- F. Panel shall provide a configurable low-voltage sensor input with the following properties:
 - 1. Configurable to support any of the following input types:
 - a. Indoor Photocell
 - b. Outdoor Photocell
 - c. Occupancy Sensor
 - d. Contact Closure
 - 2. Low voltage sensor input shall provide +24VDC power for the sensor so that additional auxiliary power supplies are not required.
 - 3. Sensor input supports all standard sequence of operations as defined in this specification.
- G. Panel shall provide a contact closure input that acts as a panel override to activate the normally configured state of all relays (i.e., normally open or normally closed) in the panel. This input is intended to provide an interface to alarm systems, fire panels, or BMS system to override the panel.
- H. Panel shall supply current limited low voltage power to other networked devices connected via low voltage network cable.
- I. Panel shall be available with NEMA 1 rated enclosure with the following properties:
 - 1. Surface-mounted or flush-mounted enclosure back box, as shown on drawings.
 - 2. Hinged cover with keyed lock

2.6 EMERGENCY SHUNT RELAY

- A. Description: Normally closed, electrically held relay, arranged for wiring in parallel with manual or automatic switching contacts; complying with UL 924.

B. Manufacturers - subject to compliance with requirements, provide products of one of the following:

1. Hubbell Control Solutions
2. Legrand Wattstopper
3. LVS
4. Signify Bodine

2.7 CABLING

A. Provide all low voltage cabling as recommended by system manufacturer. Cable color shall be orange.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Inspection:

1. Inspect each installed device for damage. Replace damaged devices and components.
2. Review architectural drawings for ceiling construction where applicable and verify details with ceiling installer. Provide hardware and additional supporting devices as necessary to install devices in each area.

B. Project Conditions

1. Only install equipment after the following site conditions are maintained:
 - a. Ambient Temperature: 14° to 105°F.
 - b. Relative Humidity: less than 90% non-condensing
2. Equipment shall not be subjected to dust, debris, moisture, or temperature and humidity conditions exceeding the requirements indicated above, at any point prior to installation.
3. Only properly rated equipment and enclosures, installed per the manufacturer's instructions, may be subjected to dust and moisture following installation.

C. General

1. Install wiring in raceways except where installed above accessible ceilings.
2. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points. Separate power limited and non-power limited conductors according to conductor manufacturer's written instructions.
3. Install and connect the networked lighting control system components according to the manufacturer's installation instructions, wiring diagrams, the project submittals and plans specifications.
4. Mount each relay directly to junction box above the ceiling near the location of the associated low voltage switch (where applicable). Conduit shall terminate within 6" of relay. Provide bushing on end of conduit. Low voltage cable may be coiled, a maximum of 5' of length, between the conduit termination and the sensor.
5. Where four or more relay packs are grouped together in one location, mount relays to a 6" x 6" x 4" deep junction box above accessible ceiling.

3.2 COORDINATION

- A. Review all required installation and pre-startup procedures with the manufacturer's representative through pre-construction meetings.
- B. Coordinate with the owner's representative all network infrastructure requirements of the networked lighting control system.
- C. Coordinate lighting controls and digital graphics with HVAC control contractor.

3.3 SYSTEM STARTUP

- A. Test all field-terminated low voltage control cable prior to system start-up. Pre-terminated cables to be tested at factory.
- B. Upon completion of installation, system startup shall be performed by qualified personnel approved or certified by the manufacturer.
- C. Verify operational communication to all system devices.
- D. Program the network devices into functional control zones to meet the required sequence of operation.
- E. Initial start-up and programming is to occur on-site. Additional programming may occur on-site or remotely over the Internet as necessary.
- F. Install and program software with initial settings of adjustable values.
- G. Provide current licenses for software.

3.4 FIELD QUALITY CONTROL

- A. Clean devices upon completion of installation. Use methods and materials recommended by manufacturer. Devices with dust, dirt, scratches, or fingerprints shall not be acceptable.
- B. The Contractor shall be responsible for final adjustment and testing of all devices.
- C. Manufacturer's Field Service: Engage a factory authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- D. Perform the following tests after devices have been installed, circuits energized, and system start-up is complete:
 - 1. Test for circuit continuity.
 - 2. Verify operation of local override controls.
 - 3. Test sensitivity of each device per manufacturer's recommendations.
 - 4. Verify that dimmers function without producing lamp flicker and without interference with audio and visual equipment.
- E. Replace or repair malfunctioning devices and components, then retest. Repeat procedure until all units operate properly.

3.5 DEMONSTRATION AND TRAINING

- A. Provide onsite meeting with owner, engineer, and qualified technician approved or certified by the manufacturer to verify all system programming preferences.
- B. Provide eight hours of onsite training for owner and designated personnel by qualified technician approved or certified by the manufacturer. Personnel to be trained to adjust, operate, and maintain lighting controls and software for PC-based control systems.

3.6 PROJECT CLOSE-OUT

- A. As-built Drawings: Document installed location of all networked devices.
- B. Provide the following additional documentation to the manufacturer's representative:
 - 1. As-Built floor plan drawings showing daisy-chain wired network control zones outlined, in addition to device address locations required above. All documentation shall remain legible when reproducing\scanning drawing files for electronic submission.
 - 2. As-Built electrical lighting drawings in PDF and CAD format. Architectural floor plans shall be based on as-built conditions.
- C. 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 four visits to site during other-than-normal occupancy hours for this purpose.
- D. Update software to latest version at Project completion. Software updates shall include operating system and new or revised licenses for use of the software.
- E. Provide owner with any hardware, software, computer interface equipment, and/or configuration tools necessary to update, adjust, or modify the system.
- F. Provide owner with updated as-built drawings and/or database file, including device/equipment addresses, locations, etc.

END OF SECTION 260923

SECTION 262416
PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this and the other sections of Division 26.
- B. All Division 26 Specification Sections apply to this section.

1.2 SUMMARY

- A. This Section includes load centers and panelboards, overcurrent protective devices, and associated auxiliary equipment rated 600V and less for the following types:
 - 1. Distribution panelboards.
 - 2. Lighting and appliance branch-circuit panelboards.

1.3 DEFINITIONS

- A. EMI: Electromagnetic interference.
- B. GFCI: Ground fault circuit interrupter.
- C. GFEP: Ground-fault equipment protection.
- D. ICS: Industrial Control Systems
- E. MCOV: Maximum continuous operating voltage.
- F. RFI: Radio frequency interference.

1.4 SUBMITTALS

- A. Product Data - for each type of panelboard, overcurrent protective device, accessory, and component indicated, include:
 - 1. Dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings - for each panelboard, include:
 - 1. Dimensioned plans, elevations, sections, and details.
 - 2. Enclosure types and details for types other than NEMA 250, Type 1.
 - 3. Bus configuration, and current, and voltage ratings.
 - 4. Short-circuit current rating of panelboards and overcurrent protective devices.
 - 5. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices.

- C. Maintenance Manuals - in addition to requirements specified in Division 01 and 26, 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.
- D. Overcurrent Protective Device Coordination Study: Provide in accordance with Section 260573.
- E. Layout Drawings: Prepare layout drawing for each room or area of the building containing panelboards and submit for review at the time of the equipment submittal. Layout drawings shall be based on actual submitted equipment dimensions. Indicate working clearances for each panelboard.

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. Firm with at least 5 years of successful installation experience on projects utilizing panelboards similar to those required for this project.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver panelboard interiors 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.
- B. Remove loose packing and flammable materials from inside panelboards.

1.7 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, and encumbrances to workspace clearance requirements.

1.8 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace panelboard enclosures, buswork, overcurrent protective devices, accessories, and factory installed interconnection wiring that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: One year from date of Substantial Completion.

1.9 EXTRA MATERIALS

- A. Keys: Furnish six spares of each type for panelboard cabinet locks.
- B. Touch-up Paint: For surface mounted panelboards - one half-pint container.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers - subject to compliance with requirements, provide panelboards of the following manufacturer:
 - 1. Eaton
 - 2. GE by ABB
 - 3. Schneider Electric/Square D
 - 4. Siemens Industry, Inc.

2.2 GENERAL

- A. Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.
- B. Refer to Panelboard Schedules on drawings for additional panelboard requirements, including but not limited to, mains type and size, mounting, branch circuit breaker sizes and quantities, SCCR rating, options, etc.
- C. Enclosures
 - 1. Provide flush and surface mounted enclosures as indicated on the drawings.
 - 2. Standard panel dimensions: 6" deep x 20" wide x 84" high (maximum height).
 - 3. Rated for environmental conditions at installed locations:
 - a. Indoor Dry Locations: Steel, Type 1
 - 4. Backbox Finish:
 - a. Flush-mounted cabinets: Galvanized steel.
 - b. Surface-mounted cabinets: Same finish as panel cover.
- D. Incoming Mains
 - 1. Main breaker or main lugs as indicated on drawings.
 - 2. Location shall be convertible between top and bottom.
 - 3. Main lug interiors shall be field convertible to main breaker.
- E. Phase, Neutral, and Ground Buses:
 - 1. Material: Hard-drawn copper, 98 percent conductivity.
 - a. Plating shall run entire length of bus.
 - b. Bus shall be fully rated the entire length.
 - 2. Interiors shall be factory assembled into a unit. Replacing switching and protective devices shall not disturb adjacent units or require removing the main bus connectors.
 - 3. All bus work shall be rated to withstand short circuit stresses at specified voltage as described on the panelboard schedules shown on the drawings.

4. Full-Sized Neutral: Equipped with full-capacity bonding strap for service entrance applications. Mount electrically isolated from enclosure. Do not mount neutral bus in gutter.
5. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.

F. Conductor Connectors: Suitable for use with conductor material and sizes.

1. Material: Hard-drawn copper, 98 percent conductivity.
2. Terminations shall allow use of 75°C rated conductors without derating.
3. Size: Lugs suitable for indicated conductor sizes, with additional gutter space, if required, for larger conductors.
4. Main and Neutral Lugs: Mechanical type, with a lug on the neutral bar for each pole in the panelboard.
5. Ground Lugs and Bus-Configured Terminators: Mechanical type, with a lug on the bar for each pole in the panelboard.
6. Feed-Through Lugs (where indicated on drawings): Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.

G. Panelboard Short-Circuit Current (SCCR) Rating:

1. Fully rated to interrupt symmetrical short-circuit current available at terminals. Panelboards with a Series Short Circuit Rating are not acceptable.
2. Assembly shall be UL listed for 100 percent interrupting capacity.
3. Minimum short circuit current rating of panelboard shall be as specified on the panelboard schedules shown on the drawings. No device within panelboard shall be lower than this rating.

H. Provision for Future Devices: Equip with mounting brackets, bus connections, and necessary appurtenances, for the overcurrent protective device ampere ratings indicated for future installation of devices.

2.3 DISTRIBUTION PANELBOARDS

A. NEMA PB 1, distribution type.

B. Branch overcurrent protective devices shall be bolt-on circuit breakers or plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.

C. Doors/Covers:

1. Secured with flush latch with tumbler lock; keyed alike.
 - a. For doors more than 36 inches high, provide two latches, keyed alike.
2. Finish:
 - a. Indoor Dry Locations: Factory-applied finish in manufacturer's standard gray finish over a rust-inhibiting primer on treated metal surface.

2.4 LIGHTING AND APPLIANCE BRANCH CIRCUIT PANELBOARDS

- A. NEMA PB 1, lighting and appliance branch-circuit type.
- B. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.
- C. Doors/Covers:
 - 1. Hinged Front Cover: Door-in-door construction with concealed hinges. Outer door shall permit full access to the panel interior. Inner door shall permit access to breaker operating handles and labeling, but current carrying terminals and bus shall remain concealed. EZ Trim as manufactured by Eaton is not acceptable.
 - 2. Secured with flush latch with tumbler lock; keyed alike.
 - a. For doors more than 36 inches high, provide two latches, keyed alike.
 - 3. Finish:
 - a. Indoor Dry Locations: Factory-applied finish in manufacturer's standard gray finish over a rust-inhibiting primer on treated metal surface.

2.5 OVERCURRENT PROTECTIVE DEVICES

- A. Molded Case Circuit Breaker (MCCB) with interrupting capacity to meet available fault currents.
 - 1. General
 - a. Circuit breakers shall have quick-make, quick-break operating mechanisms and silver alloy contacts.
 - b. The operating handle shall indicate ON, TRIPPED, and OFF positions.
 - c. Multi-pole units enclosed in a factory assembled to operate as a single unit.
 - d. Circuit breakers shall be electrically and mechanically trip free.
 - e. Circuit breakers shall be UL489 listed.
 - f. Circuit breakers and terminals shall have a UL 60/75°C rating.
 - g. UL listed for reverse connection without restrictive line or load ratings.
 - h. Tandem circuit breakers shall not be used.
 - i. Mechanical style lugs, suitable for number, size, trip ratings, and material of conductors.
 - j. Three-pole breakers with ampere ratings greater than 250 amperes shall have interchangeable rating plugs or electronic adjustable trip units.
 - k. Unless indicated otherwise, circuit breakers 800A frame and below shall have thermal-magnetic trip units and inverse time-current characteristics.
 - 1) Provide all labeling as required by NEC.
 - 2. Thermal Magnetic Circuit Breakers:
 - a. Inverse time-current element for low-level overloads.
 - b. Instantaneous magnetic trip element for short circuits.

- c. Adjustable Trip Circuit Breakers:
 - 1) Provide adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 - 2) Field-adjustable trip settings for magnetic trip element shall be front-mounted.
- 3. Electronic Trip Circuit Breakers:
 - a. RMS sensing.
 - b. Field-replaceable rating plug or electronic trip.
 - c. Ten-event, trip-history log. Each trip event shall be recorded with type, phase, and magnitude of fault that caused the trip.
 - d. Digital display of settings, trip targets, and indicated metering displays.
 - e. Multi-button keypad to access programmable functions and monitored data.
 - f. Integral test jack for connection to portable test set or laptop computer.
 - g. Field-Adjustable Settings:
 - 1) Instantaneous trip.
 - 2) Long- and short-time pickup levels.
 - 3) Long and short time adjustments.
 - 4) Ground-fault pickup level, time delay, and I squared T response.
- 4. Molded Case Circuit Breaker Options and Accessories:
 - a. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position for circuit(s) feeding fire alarm control and extender panel(s).
 - b. Subfeed Circuit Breakers: Vertically mounted.
 - c. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 75 percent of rated voltage.
 - d. GFCI Circuit Breakers: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator. Single- and double-pole configurations with Class A ground-fault protection (6-mA trip).
 - e. GFEP Circuit Breakers: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator. Class B ground-fault protection (30-mA trip).
 - f. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
 - g. Arc-Fault Circuit Interrupter (AFCI) Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.
 - h. Key Interlock Kit: Externally mounted to prohibit circuit breaker operation; key shall be removable only when circuit breaker is in off position.
 - i. Communication Capability: Communication module with functions and features compatible with power monitoring and control system.

2.6 PANELBOARD OPTIONS

A. Integral Surge Protective Device (SPD)

- 1. UL 1449, Type 2 SPD (Permanently connected SPDs intended for installation on the load side of the service disconnect overcurrent device).
- 2. Factory installed integral to electrical distribution equipment.
- 3. Direct bussed connected or breaker fed.
- 4. UL labeled with 200kA Short Circuit Current Rating (SCCR).

5. UL labeled with 20kA I-nominal (I-n) (verifiable at UL.com).
6. Protection modes shall be as follows: Line to Neutral, Line to Ground, and Neutral to Ground.
7. Minimum single-impulse current rating shall be as follows:
 - a. Line to Neutral: 160,000 A.
 - b. Line to Ground: 160,000 A.
 - c. Neutral to Ground: 160,000 A.
8. UL 1449 Voltage Protection Ratings shall not exceed the following:

VOLTAGE	L-N	L-G	N-G	L-L	MCOV
208Y/120	700V	700V	700V	1200V	150V
480Y/277	1200V	1200V	1200V	2000V	320V
9. EMI/RFI Noise Attenuation Using 50-ohm Insertion Loss Test: 55 dB at 100 kHz.
10. The protection status of every surge protective element shall monitored including elements connected across neutral to ground. Diagnostics shall change state if any surge protective element reaches end of life.
11. SPD shall be equipped with the following diagnostics:
 - a. Visual LED diagnostics including a minimum of one green LED indicator per phase, and one red service LED.
 - b. Audible alarm with on/off silence function and diagnostic test function (excluding branch).
 - c. Form C dry contacts
12. SPD shall have a 10 year warranty.

2.7 IDENTIFICATION

- A. Panelboard Label: Manufacturer's name and trademark, voltage, amperage, number of phases, and number of poles shall be located on the interior of the panelboard door.
- B. Breaker Labels: Faceplate shall list current rating, UL and IEC certification standards, and AIC rating.
- C. Circuit Directory: Computer-generated circuit directory card inside panelboard door, mounted in metal frame with transparent protective cover. Circuit directory shall identify specific purpose with detail sufficient to distinguish it from all other circuits.
- D. Service Equipment Label: Panelboards with main service disconnecting devices (maximum of 6) shall be UL labeled for use as service equipment.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify actual conditions with field measurements prior to ordering panelboards to verify that equipment fits in allocated space in, and comply with, minimum required clearances specified in NFPA 70.

- B. Examine panelboards before installation. Reject panelboards that are damaged, 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. 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. Mounting:
 - 1. Panelboards shall be installed such that the center of the grip of the operating handle of any overcurrent devices (switch or circuit breaker) located in the panelboard, when in its highest position, is not more than 6'-7" above finished floor or working platform.
 - 2. Mount panelboard cabinet plumb and rigid without distortion of box.
 - 3. Mount panelboards with minimum of four anchors.
 - 4. Mount surface-mounted panelboards to steel slotted supports 1-5/8 inch in depth. Orient steel slotted supports vertically.
 - 5. Mount flush-mounted panelboards with fronts uniformly flush with wall finish and mating with back box.
 - 6. Install flush-mounted panelboards with an overlapping trim set tight to the wall surface.
 - 7. Use sheet metal channel to bridge studs above and below panelboards recessed in hollow partitions.
- C. Maintain required workspace clearances per NEC 110.26.
- D. Install equipment grounding connections for panelboards with ground continuity to main electrical ground bus.
- E. Make grounding connections and bond neutral for services and separately derived systems to ground.
- F. Install filler plates in unused spaces.
- G. Provision for Future Circuits at Flush Panelboards: Stub four 1-inch empty conduits from panel into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch empty conduits below floor deck (where applicable).
- H. Wiring in Panel Gutters: Arrange conductors neatly in groups and bundle and wrap with wire ties after completion of load balancing.
- I. Install Handle Clamp(s) on circuit breaker(s) feeding fire alarm control and extender panel(s).
- J. Tighten electrical connectors and terminals, including grounding connections, in accordance with manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.3 IDENTIFICATION

- A. Identify field installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 26 Section 260553 "Identification for Electrical Systems."
- B. Panelboard Directory
 - 1. Create a directory to indicate installed circuit loads.
 - 2. All panelboard directories shall reflect the as built electrical configuration of the job, including the approved changes required to balance the panel loads.
 - 3. Each directory entry shall include a description of the connected load(s) and the room number, which corresponds to the location(s) of the connected loads.
 - 4. Incorporate Owner's final room designations.
 - 5. Use a computer or typewriter to create directory; handwritten directories are not acceptable.
 - 6. Obtain approval before installing.
 - 7. Install directory inside panelboard door.
- C. Panelboard Nameplates: Label each panelboard with engraved laminated-plastic nameplate in accordance with Nameplate Detail - Panelboards shown on the drawings.
- D. Distribution Panelboard Device Nameplates: Label each branch circuit device in Distribution Panelboards with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

- A. Inspect for defects and physical damage.
- B. Check panelboard mounting, area clearances, and fit of components.
- C. Check tightness of bolted electrical connections with calibrated torque wrench. Refer to manufacturer's instructions for proper torque values.
- D. Test continuity of each circuit.
- E. Exercise and perform operational tests of all mechanical components and other operable devices in accordance with manufacturer's instruction manual.
- F. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
- G. For circuit breakers 200 amps and larger, perform each visual inspection, mechanical inspection, and electrical test indicated in NETA ATS, Section 7.6. Engage a qualified independent testing agency to perform specified testing and certify compliance with test parameters.

3.5 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

- B. Load Balancing - after Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes as follows:
 - 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.
 - 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.
 - 5. Make changes to color-coded phase wires as required to reflect installed condition.
- C. Set field adjustable switches and circuit breaker trip ranges as indicated on drawings or as specified in Section 260573 "Overcurrent Protective Device Coordination Study".

3.6 CLEANING

- A. Upon completion of installation, inspect interior and exterior of panelboards. Remove paint splatters and other spots, dirt, and debris. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

END OF SECTION 262416

SECTION 262726
WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this and the other sections of Division 26.
- B. All Division 26 Specification Sections apply to this section.

1.2 SUMMARY

- A. The extent of wiring device work is indicated by drawings and schedules. Wiring devices are defined as single discrete units of electrical distribution systems that are intended to carry, but not utilize, electric energy.
- B. This Section includes the following:
 - 1. Receptacles:
 - a. Standard receptacles
 - b. GFCI receptacles
 - c. Weather-resistant GFCI receptacles
 - d. Tamper-resistant receptacles
 - e. Tamper-resistant GFCI receptacles
 - 2. Toggle switches
 - 3. Astronomical time switches
 - 4. Wiring device accessories

1.3 DEFINITIONS

- A. AFCI: Arc-fault circuit interrupter.
- B. BAS: Building automation system.
- C. EMI: Electromagnetic interference.
- D. GFCI: Ground-fault circuit interrupter.
- E. Pigtail: Short lead used to connect a device to a branch-circuit conductor.
- F. RFI: Radio-frequency interference.
- G. SPD: Surge protective device.

1.4 SUBMITTALS

- A. Product data: Submit manufacturer's data for each type of product specified.

PART 2 - PRODUCTS

2.1 GENERAL WIRING-DEVICE REQUIREMENTS

- A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
- B. Comply with the following:
 - 1. NEMA WD 1 and WD 6.
 - 2. NFPA 70.
 - 3. RoHS.
 - 4. UL 498.
- C. Devices that are manufactured for use with modular plug-in connectors may be substituted under the following conditions:
 - 1. Connectors shall comply with UL 2459 and shall be made with stranding building wire.
 - 2. Devices shall comply with requirements in this Section.
- D. Devices for Owner-Furnished Equipment:
 - 1. Receptacles: Match plug configurations.
 - 2. Cord and Plug Sets: Match equipment requirements.
- E. Device Color:
 - 1. Wiring Devices Connected to Normal Power System: White unless otherwise indicated or required by NFPA 70 or device listing.
 - 2. Devices installed in surface raceways shall match the raceway color.
 - 3. The Contractor shall verify color selections with the Architect and Owner prior to ordering any devices.
- F. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.2 RECEPTACLES

- A. Manufacturers - subject to compliance with requirements, provide products of one of the following:
 - 1. Eaton Wiring Devices/Arrow Hart
 - 2. Hubbell
 - 3. Legrand/Pass & Seymour
 - 4. Leviton

B. Standard Receptacles:

1. Provide two pole, three wire, self-grounding, specification grade, heavy duty, 125V, 20A, NEMA Type 5-20R, back and side wired, with green ground screw terminal, automatic ground clamp, fully enclosed in composition case, nylon face, and wrap around bridge for installation strength.

C. Ground Fault Current Interrupter (GFCI) Receptacles:

1. Provide two pole, three wire, self-grounding, specification grade, heavy duty, 125V, 20A, NEMA Type 5-20R, back and side wired, with green ground screw terminal, automatic ground clamp, fully enclosed in composition case, nylon face, and wrap around bridge for installation strength.
2. Provide GFCI-type device. Device shall include indicator light that is lighted when device is tripped. Device shall conduct an automatic test every three seconds, ensuring ground fault protection. If protection is lost, power to the unit is disconnected and indicator light flashes indicating that the unit should be replaced. Device shall be designed for installation in a 2-3/4 inch deep outlet box without an adapter.

D. Weather Resistant GFCI Receptacles:

1. Provide two pole, three wire, self-grounding, specification grade, heavy duty, 125V, 20A, NEMA Type 5-20R, back and side wired, with green ground screw terminal, automatic ground clamp, fully enclosed in composition case, nylon face, and wrap around bridge for installation strength.
2. Listed and labeled as complying with NFPA 70 "Receptacles in Damp or Wet Locations" article.
3. Provide GFCI-type device. Device shall include indicator light that is lighted when device is tripped. Device shall conduct an automatic test every three seconds, ensuring ground fault protection. If protection is lost, power to the unit is disconnected and indicator light flashes indicating that the unit should be replaced. Device shall be designed for installation in a 2-3/4 inch deep outlet box without an adapter.
4. Receptacle shall have internal locking shutter mechanism that opens when the two receptacle blade slots are penetrated simultaneously or receptacle requires the presence of an object in both right and left contacts to energize the device. Receptacle shall be listed to UL and federal specification WC596-F.

E. Tamper-Resistant Receptacles:

1. Provide two pole, three wire, self-grounding, specification grade, heavy duty, 125V, 20A, NEMA Type 5-20R, back and side wired, with green ground screw terminal, automatic ground clamp, fully enclosed in composition case, nylon face, and wrap around bridge for installation strength.
2. Receptacle shall have internal locking shutter mechanism that opens when the two receptacle blade slots are penetrated simultaneously or receptacle requires the presence of an object in both right and left contacts to energize the device. Receptacle shall be listed to UL and federal specification WC596-F.

F. Tamper-Resistant GFCI Receptacles,

1. Provide two pole, three wire, self-grounding, specification grade, heavy duty, 125V, 20A, NEMA Type 5-20R, back and side wired, with green ground screw terminal, automatic ground clamp, fully enclosed in composition case, nylon face, and wrap around bridge for installation strength.

2. Receptacle shall have internal locking shutter mechanism that opens when the two receptacle blade slots are penetrated simultaneously or receptacle requires the presence of an object in both right and left contacts to energize the device. Receptacle shall be listed to UL and federal specification WC596-F.
3. Provide GFCI-type device. Device shall include indicator light that is lighted when device is tripped. Device shall conduct an automatic test every three seconds, ensuring ground fault protection. If protection is lost, power to the unit is disconnected and indicator light flashes indicating that the unit should be replaced. Device shall be designed for installation in a 2-3/4 inch deep outlet box without an adapter.

2.3 TOGGLE SWITCHES

- A. Manufacturers - subject to compliance with requirements, provide wiring devices of one of the following (for each type and rating of wiring device):
 1. Hubbell Inc.
 2. Cooper Wiring Devices
 3. Pass & Seymour
 4. Leviton
- B. General: Provide specification grade, heavy duty, 120V/277V, 20A, back and side wired, with green ground screw terminal, automatic ground clamp, fully enclosed in composition case, nylon face, and having wrap around bridge for installation strength.
- C. Switches with Pilot Light: Provide single-pole toggle switch with lighted toggle.
 1. Where used as an indicator switch, program switch to be illuminated when switch is "ON."
 2. Where used as a night-light switch, program switch to be illuminated when switch is "OFF."

2.4 ASTRONOMICAL TIME SWITCHES

- A. Manufacturers - subject to compliance with the manufacturer's requirements and recommendations, provide products from the following:
 1. Hubbell Inc.
 2. Intermatic
 3. Leviton
 4. Wattstopper
- B. Description:
 1. Solid state, programmable, with alphanumeric display or preset, multi-button configuration; complying with UL 917.
 2. Programs: Eight on-off set points on a 24-hour schedule and an annual holiday schedule that overrides the weekly operation on holidays.

2.5 WIRING DEVICE ACCESSORIES

- A. Manufacturers - subject to compliance with requirements, provide products of one of the following:
 1. Eaton Wiring Devices/Arrow Hart
 2. Hubbell

3. Legrand/Pass & Seymour
 4. Leviton
- B. Wall plates for use in interior, dry locations: single and combination, of types, sizes, and with ganging and cutouts as indicated. Provide .04 inch thick, Type 302 brushed stainless steel flush cover plates.
- C. Wall plates for use in interior, dry locations with surface-mounted devices in unfinished areas: Raised galvanized steel with rounded corners.
- D. Wall plates for use in damp or wet locations:
1. Weatherproof, extra-duty, while-in-use type with gasketed, clear polycarbonate cover and lockable tab.
 2. Weatherproof gasketed die-cast aluminum cover.
- E. Blank cover plates shall match adjacent device plates.

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. Protect installed devices and their boxes. 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 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. Protection
1. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
 2. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
 3. Protect installed components from damage.

4. 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.

E. Device Installation:

1. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
2. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.
3. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
4. Use a torque screwdriver when a torque is recommended or required by the manufacturer.
5. When conductors larger than No. 12 AWG are installed on 20-A circuits, splice No. 12 AWG pigtails for device connections.
6. Tighten unused terminal screws on the device.
7. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.
8. Unless otherwise indicated, mount flush, with long dimension vertical.
9. Install receptacles vertically, with ground pin located at the top. Where horizontal mounting is required due to space constraints, install receptacle with neutral blade located at the top.
10. Group adjacent devices under single, multi-gang wall plates.

- 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.

3.2 FIELD QUALITY CONTROL

A. Tests for Convenience Receptacles:

1. Diagnostic testing: Use a digital wiring analyzer with digital readout or illuminated LED indicators of measurement complying with UL 1436. Perform the followings diagnostic tests, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems.
 - a. Line Voltage: Acceptable range is 105 to 132 V.
 - b. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is not acceptable.
 - c. Ground Impedance: Values of up to 2 ohms are acceptable.
 - d. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
2. Using the test plug, verify that the device and its outlet box are securely mounted.

B. Testing and adjusting for astronomical time switches:

1. The Contractor shall be responsible for final programming and testing of all devices.
2. Verify proper operation of switches.

- C. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

- D. Wiring device will be considered defective if it does not pass tests and inspections.

END OF SECTION 262726

SECTION 262813
FUSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this and the other sections of Division 26.
- B. All Division 26 Specification Sections apply to this section.

1.2 SUMMARY

- A. This Section includes cartridge fuses, rated 600 V and less, for use in switches, panelboards, switchboards, controllers, and motor control centers; and spare fuse cabinets.
 - 1. Class L Time Delay Fuses.
 - 2. Class RK1 Time Delay Fuses
 - 3. Class RK5 Time Delay Fuses
 - 4. Spare Fuse Cabinet.

1.3 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections:
- B. Product Data - include the following for each fuse type indicated:
 - 1. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
 - 2. Let-through current curves for fuses with current limiting characteristics.
 - 3. Time current curves, coordination charts and tables, and related data.
 - 4. Fuse size for elevator feeders and elevator disconnect switches.
- C. Ambient Temperature Adjustment Information. If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses adjusted.
 - 1. For each adjusted fuse, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.
 - 2. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.
- D. Maintenance Data: For tripping devices to include in maintenance manuals specified in Division 01.
- E. Coordination Study: Where fuses of a manufacturer other than those designated herein are selected, submit a full coordination study showing graphically that the substitute fuses coordinate selectively with both upstream and downstream components. Prepare the study under the supervision of a registered professional engineer in accordance with ANSI/IEEE Standard 242-1986, "Recommended Practice for Protection and Coordination of Industrial and Commercial

Power Systems." Include single line diagram, coordinated time/current characteristics, fuse performance curves, and fault current calculations adequate to demonstrate satisfactory component protection and selective coordination of protective devices.

- F. Shop drawing of spare fuse cabinet showing dimensions and features including storage provision for fuse cartons.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Provide fuses from a single manufacturer.
- B. Electrical Component Standard: Components and installation shall comply with NFPA 70 "National Electrical Code."
- C. ANSI Compliance: Comply with applicable requirements of ANSI C97 "Low Voltage Cartridge Fuses 600 Volts or Less".
- D. UL Listing and Labeling: Items provided under this Section shall be listed and labeled by UL.
- E. Comply with NEMA FU 1.
- F. Nationally Recognized Testing Laboratory Listing and Labeling (NRTL): Items provided under this Section shall be NRTL listed and labeled. The term "NRTL" shall be as defined in OSHA Regulation 1910.7.

1.5 PROJECT CONDITIONS

- A. Where ambient temperature to which fuses are directly exposed is less than 40°F or more than 100°F, apply manufacturer's ambient temperature adjustment factors to fuse ratings.

1.6 COORDINATION

- A. Coordinate fuse ratings with HVAC and refrigeration equipment nameplate limitations of maximum fuse size.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver spare fuses stored in locked spare fuse cabinet after cabinet has been installed.

1.8 EXTRA MATERIALS

- A. Maintenance stock - fuses: For types and ratings required, furnish spare fuses, amounting to one unit for every 5 installed units, but not less than one set of 3 of each kind.
- B. Provide three fuse pullers with the spare fuse cabinet.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers - subject to compliance with requirements, provide products by the following:
 - 1. Bussmann Division, Cooper Industries, Inc.
 - 2. Shawmut Division; Gould Inc.
 - 3. Littlefuse, Inc.

2.2 FUSES - GENERAL

- A. General: Provide fuses of types, classes, and current ratings as indicated. Voltage ratings shall be consistent with the circuits on which used.

2.3 CARTRIDGE FUSES

- A. General: Comply with ANSI/IEEE Standard FU1, "Low Voltage Cartridge Fuses." Provide nonrenewable cartridge type fuses.
 - 1. Fuses shall be all of the same manufacturer.
 - 2. Class L Fuses: Comply with UL 198C, "High Interrupting Capacity Fuses, Current Limiting Type.
 - 3. Class RK1 Dual Element Time Delay Fuses: Comply with UL 198E, "Class R Fuses."

2.4 SPARE FUSE CABINET

- A. Cabinet: Wall mounted, 18 gage minimum steel unit with full-length, recessed piano-hinged door with key coded cam lock and pull.
- B. Size: Provide for orderly storage of all spare fuses of this project plus 15 percent spare capacity, minimum.
- C. Finish: Gray baked enamel.
- D. Cabinet Door: Bear the legend in stenciled 1-1/2 inch high letters, "SPARE FUSES."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.
- B. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATION OF FUSES

- A. Fusible Switches - apply the following class and types:
 - 1. 30-600 Amperes: Class RK1, time delay.
 - 2. 601-1,200 Amperes, Motor or Transformer Circuit: Class L, time delay.
- B. Bolted Pressure Switches: Class L, time delay.
- C. Service Protectors: Class L, time delay.
- D. Fusible Switch Panelboards: Class RK1, time delay.
- E. Combination Starters: Class RK1, time delay.
- F. Combination Starters in Motor Control Centers: Class RK1, time delay.
- G. Switches in Switchboards - apply the following classes and types:
 - 1. 60-600 Amperes: Class RK1, time delay.
 - 2. 601 Amperes and Above: Class L, time delay.

3.3 INSTALLATION

- A. Provide fuses in all fuse gaps of all equipment provided under this Contract.
- B. Install fuse so that ratings are readable without removing fuse.
- C. Fuses shall not be installed until equipment is ready to be energized.
- D. Install spare fuse cabinet wall mounted where indicated.

3.4 FIELD QUALITY CONTROL

- A. Prior to energization of fusible devices, test devices for continuity of circuitry and for short-circuits. Replace malfunctioning units with new units, and then demonstrate compliance with requirements.

3.5 IDENTIFICATION

- A. Install labels indicating fuse replacement information on inside door of each fusible device.

END OF SECTION 262813

SECTION 262816
ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this and the other sections of Division 26.
- B. All Division 26 Specification Sections apply to this section.

1.2 SUMMARY

- A. This Section includes circuit and motor disconnects.
- B. Extent of circuit and motor disconnect switch work is indicated by drawings and schedules.
- C. Types of circuit and motor disconnect switches in this section include the following:
 - 1. Equipment disconnects
 - 2. Appliance disconnects
 - 3. Motor circuit disconnects
 - 4. Contactors
- D. Wires/cables, raceways, and electrical boxes and fittings required in connection with circuit and motor disconnect work are specified in other Division 26 sections.

1.3 SUBMITTALS

- A. Product Data: For each type of switch, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Maintenance data for circuit and motor disconnects, for inclusion in Operation and Maintenance Manual specified in Division 01 and Division 26 Section 260100.
- C. Shop Drawings: Submit shop drawings of electrical circuit and motor disconnect switches showing accurately scaled switches, their layouts, and proximity to associated equipment.
- D. Dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings. Include the following:
 - 1. Enclosure types and details for types other than NEMA 250, Type 1.
 - 2. Current and voltage ratings.
 - 3. Short circuit current rating.
 - 4. UL listing for series rating of installed devices.
 - 5. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

- E. Maintenance Data: For enclosed switches and components to include in maintenance manuals specified in Division 01. In addition to requirements specified in Division 01 Section "Closeout Procedures," include the following:
 - 1. Routine maintenance requirements for components.
 - 2. Manufacturer's written instructions for testing and adjusting switches and circuit breakers.
 - 3. Time-current curves, including selectable ranges for each type of circuit breaker.

1.4 QUALITY ASSURANCE

- A. Manufacturers: Firms regularly engaged in manufacture of circuit and motor disconnect switches of types and capacities required, whose products have been in satisfactory use in similar service for not less than 3 years.
- B. Installer's Qualifications: Firm with at least 3 years of successful installation experience with projects utilizing circuit and motor disconnect work similar to that required for this project.
- C. NEC Compliance: Comply with NEC requirements pertaining to construction and installation of electrical circuit and motor disconnect devices.
- D. UL Compliance: Comply with requirements of UL98, "Enclosed and Dead Front Switches". Provide circuit and motor disconnect switches that have been UL listed and labeled.
- E. UL Compliance: Comply with UL Standard 486A, "Wire Connectors and Soldering Lugs for Use With Copper Conductors" including, but not limited to, tightening of electrical connectors to torque values indicated. Provide electrical connection products and materials that are UL-listed and labeled.
- F. NEMA Compliance: Comply with applicable requirements of NEMA Standards Pub No. KS 1, "Enclosed Switches" and 250, "Enclosures for Electrical Equipment (1000 volts maximum).
- G. Product Selection for Restricted Space: Drawings indicate the location where enclosed switches are to be installed. Verify the suitability for installation in this location, including clearances between enclosures, and adjacent surfaces and other items.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with requirements, provide circuit and motor disconnects of one of the following:
 - 1. Square D Company
 - 2. Eaton Corporation
 - 3. General Electric Company
 - 4. Siemens
 - 5. ASCO (Contactors only)

2.2 FABRICATED SWITCHES

A. Heavy Duty Safety Switches

1. Provide surface mounted, heavy duty type, sheet steel enclosed safety switches of types, sizes and electrical characteristics indicated on the drawings.
2. Provide switches with quick-make, quick-break type operation, with switchblades that are visible in the 'OFF' position with door open.
3. Operating handle shall be an integral part of the enclosure base the operating position shall be easily recognizable and pad-lockable in OFF position.
4. Current carrying parts shall be constructed of 98% conductivity copper, with silver-tungsten type switch contacts and positive pressure type reinforced fuse clips.
5. Provide disconnect switches having the capability to have auxiliary contacts mounted as required.

B. Fusible Switches: Heavy duty safety switches as described above, with positive pressure type reinforced fuse clips and fuses of classes and current ratings indicated. See Division 26 Section 262813 "Fuses" for specifications. Where current limiting fuses are indicated, provide switches with non-interchangeable feature suitable only for current limiting type fuses.

C. Enclosures shall meet environmental conditions of installed location.

1. Indoor Locations: NEMA 250, Type 1
2. Outdoor Locations: NEMA 250, Type 3R.
3. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.

D. Finish shall be manufacturer's standard gray finish unless otherwise noted on drawings.

PART 3 - EXECUTION

3.1 INSTALLATION OF CIRCUIT AND MOTOR DISCONNECTS

A. Examine elements and surfaces to receive enclosed switches for compliance with installation tolerances and other conditions affecting performance.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

B. Install circuit and motor disconnect switches as indicated, complying with manufacturer's written instructions, applicable requirements of NEC, NEMA and NECA's "Standard of Installation" and in accordance with recognized industry practices.

C. Coordinate circuit and motor disconnect switch installation work with electrical raceway and cable work, as necessary for proper interface.

D. Install disconnect switches for use with motor driven appliances, and motors and controllers within sight of the controller position unless otherwise indicated.

E. Coordinate layout and installation of switches and components with other construction, including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

F. Install power wiring. Install wiring between switches and control, and indication devices.

- G. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.2 NEUTRAL BAR

- A. When a neutral conductor is required for the load connected to a safety switch, the Contractor shall provide a copper neutral bar in the safety switch. This copper neutral bar shall be furnished by the manufacturer of the disconnect switch and shall be designed to be installed within the particular disconnect switch installed.

3.3 GROUNDING

- A. Install equipment grounding connections for switches with ground continuity to main electrical ground bus.
- B. Provide an equipment grounding kit with all disconnect switches.
- C. Connections shall be tightened in accordance with UL Standard 486A, "Wire Connectors and Soldering Lugs for Use with Copper Conductors".

3.4 FIELD QUALITY CONTROL

- A. Prepare for acceptance tests as follows:
 - 1. Test insulation resistance for each enclosed switch, component, and control circuit.
 - 2. Test continuity of each line- and load-side circuit.
- B. Testing Agency: The Contractor shall perform the following testing or engage a qualified independent testing agency to perform testing.
- C. Testing: After installing enclosed switches and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.
 - 1. Procedures: Perform each visual and mechanical inspection and electrical test indicated in NETA ATS, Section 7.5 for switches 200 amps and larger. 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.

3.5 CLEANING

- A. Upon completion of installation, inspect interior and exterior of enclosures. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

END OF SECTION 262816

SECTION 265100
INTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this and the other sections of Division 26.
- B. All Division 26 Specification Sections apply to this section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Interior lighting fixtures.
 - 2. Exit signs.
 - 3. Emergency lighting units.

1.3 DEFINITIONS

- A. CCT: Correlated color temperature.
- B. CRI: Color Rendering Index.
- C. Fixture: See "Luminaire."
- D. IP: International Protection or Ingress Protection Rating.
- E. LED: Light-emitting diode.
- F. Lumen: Measured output of lamp and luminaire, or both.
- G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.4 SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Arrange in order of fixture designation.
 - 2. Include data on features, accessories, and finishes.
 - 3. Include physical description and dimensions of fixtures.
 - 4. Include installation and attachment details.
 - 5. Include emergency lighting units, including batteries and chargers.
 - 6. Include life, output (lumens, CCT, and CRI), and energy-efficiency data.
 - 7. Include "Lighting Facts".
 - 8. Photometric data and adjustment factors based on laboratory tests, complying with IES "Lighting Measurements Testing and Calculation Guides" for each fixture type. The

adjustment factors shall be for lamps and accessories identical to those indicated for the fixture as applied in this Project.

- a. Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.

B. Shop Drawings

1. Pendant-mounted fixtures:

- a. Detailed scaled shop drawings of all pendant mounted fixture systems containing the following information: support canopy type, support spacing, pendant type, power feed type and locations, fixture joint locations, trim details, closure piece details, end plates, corner details, and continuous louver or lens details, where applicable.
- b. Provide point-by-point computer generated plot diagram of horizontal foot-candles at 30" above finished floor, unless noted otherwise, that shows values of illuminance projected from the arrangement of light fixtures as shown on the drawings, including mounting heights, and as described in the 'LIGHTING FIXTURE SCHEDULE'. Indicate on the computer report the locations, spacing, and heights of fixtures.

2. For nonstandard or custom fixtures.

- a. Include plans, elevations, sections, and mounting and attachment details.
- b. Include details of fixture assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
- c. Include diagrams for power, signal, and control wiring.

C. Samples

1. Manufacturers shall be prepared to submit complete fixture samples for approval by Architect and Engineer. Samples shall be submitted only at the request of the Architect/Engineer. Sample fixtures shall be shipped prepaid by the Contractor and shall be furnished within two weeks of request. Fixtures shall be complete with specified lamps and mounting hardware. Samples shall be evaluated for two weeks prior to acceptance or rejection. Samples shall remain on the project site as an example of materials, workmanship, finish, color, tolerance, performance, and general quality of all other fixtures of the respective type to be installed on the project. Fixtures judged inferior to the sample shall not be accepted. The Architect/Engineer shall be the final judge of fixture acceptance.

1.5 QUALITY ASSURANCE

- A. Luminaire Photometric Data Testing Laboratory Qualifications: Fixture manufacturer's laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.
- B. Each fixture type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among fixtures.
- C. Fixtures must meet the following:
 1. LM-79: Approved Method for Electrical and Photometric Measurement of SSL Products

2. LM-80: Approved Method for Measuring Lumen Maintenance of LED Light Sources
3. L-70: 70% Lumen Maintenance
4. TM-21: Establishes a method for projecting lumen maintenance (and useful lifetime) of LED light sources from available LM-80 data

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver lighting fixtures and accessories in factory fabricated containers or wrappings that properly protect fixtures from debris and physical damage.
- B. Handle lighting fixtures carefully to prevent damage, breaking, and scoring. Do not install damaged fixtures or components; replace with new.
- C. Store lighting fixtures in clean dry place. Protect from weather, dirt, fumes, water, construction debris, and physical damage.

1.7 WARRANTY

- A. Manufacturer and Installer agree to repair or replace components of fixtures that fail in materials or workmanship within specified warranty period.
- B. Warranty Period: Five year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 LIGHTING FIXTURES

- A. Manufacturers
 1. Provide lighting fixtures of types described on the drawings under the 'LIGHTING FIXTURE SCHEDULE'.
 2. Provide lighting fixtures complete with, but not limited to, housings, drivers, and wiring.
 3. Manufacturer and product series are indicated in the 'LIGHTING FIXTURE SCHEDULE' and constitute the type and quality of fixture to be provided. All published specifications of the manufacturer that correspond to the indicated catalog number, shall be considered as part of this specification even though they may not be shown in complete detail.
 4. Manufacturer's product series indicate the general line of fixtures required and may not necessarily include all prefixes and suffixes for options, trim and/or configurations required.
 5. Bid prices shall be based on information in all columns of the 'LIGHTING FIXTURE SCHEDULE'.
 6. Where a conflict exists between the fixture description and the manufacturer's product series, the price shall include the more expensive option. Coordinate conflicts with engineer prior to submitting bid.
 7. The listing of a manufacturer does not guarantee that manufacturer will have a product that meets the requirements put forth in the fixture description. Approval of specific fixtures by an approved manufacturer will be subject to review by the Specifier.
 8. No substitutions shall be accepted unless listed.
 9. The Lumen Output column of the 'LIGHTING FIXTURE SCHEDULE' lists the nominal lumen output for each fixture type. Submitted fixture shall be capable of providing listed lumen output within 10% of listed lumen output.

10. Provide fixtures from a single manufacturer for each fixture type.
11. Pricing for light fixture types shall be through local lighting rep listed only.

B. General

1. Ship fixtures factory assembled, complete in every respect, including all necessary parts, shown or not shown on the drawings, required for a complete installation in accordance with the manufacturer's recommendations.
2. EC to verify and provide fixture mounting options that are compatible with ceiling type as shown on the architectural drawings.
3. All low voltage lighting wiring shall be as recommended by the fixture manufacturer. Low voltage wiring shall be minimum #10 AWG Copper.

C. Listings

1. Provide fixtures for use in damp or wet locations that are UL Listed for the specific installation.
2. Provide fixtures for recessed use in combustible construction that are UL Listed for the specific installation.
3. Fixtures for hazardous locations shall be listed and labeled for indicated class and division of hazard by FMG.

D. Fixture Construction

1. Fixtures shall be designed with metal parts grounded as common unit.
2. Fixture housing shall be formed and supported to prevent warping and sagging.
3. Metal parts shall be free of burrs, sharp corners, and edges.
4. Doors, Frames, and Other Internal Access:
 - a. Smooth operating, free of light leakage under operating conditions, and designed to permit access without use of tools.
 - b. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally when secured in operating position.
 - c. All troffers with hinged doors shall have spring-loaded cam latches.
5. Provide metal trim rings for recessed downlights and wallwash type fixtures, unless noted otherwise.
6. Provide metal flange for recessed linear fixtures mounted in drywall construction, unless noted otherwise.
7. Provide drywall frame kits for recessed fixtures installed in other than suspended grid type acoustical ceiling systems.
8. Finishes:
 - a. Manufacturers' standard, unless otherwise indicated.
 - b. All troffers shall be post-painted or painted after fabrication, including driver covers, doors, and all trim. Fixtures shall be powder-finished with a minimum reflectance of 90%.

E. Light Engines

1. Color temperature shall be 3500K, unless noted otherwise in the 'LIGHTING FIXTURE SCHEDULE'
2. Color Rendering Index: 80 CRI
3. Individual LEDs shall be connected such that a catastrophic loss or the failure of one LED will not result in the loss of the entire light engine.

4. LED light engine shall be suitable for field maintenance or service from below the ceiling with plug-in connectors.
5. LED light engine shall be upgradable.
6. The thermal management (of the heat generated by the LEDs) shall be of sufficient capacity to ensure proper operation of the light engine over the expected useful life.

2.2 DRIVERS

A. Manufacturers

1. Furnished with fixture as tested and recommended by fixture manufacturer as a complete lighting system.
2. All fixtures of the same type shall be furnished with the same manufactured driver type.

B. General:

1. All drivers shall be equipped with a disconnecting means internal to the fixture. The line side terminals of the disconnecting means shall be guarded. Provide Sta-Kon Series LD3 Luminaire Disconnect or equivalent.
2. LED driver shall be rated for dual 120/277 volt operation at 60 Hertz.
3. Drivers shall be electronic-type, labeled as compliant with radio frequency interference (RFI) requirements of FCC Title 47 Part 15, and comply with NEMA SSL 1 "Electronic Drivers for LED Devices, Arrays, or Systems".
4. Drivers shall have a sound rating of "A", have a minimum efficiency of 85%, and be rated for a THD of less than 20 percent at all input voltages.
5. Dimmable LED drivers shall be 0-10V type, 10% minimum, unless noted otherwise on the 'LIGHTING FIXTURE SCHEDULE'.
6. Dimmable LED drivers shall be capable of dimming without LED strobing or flicker across their full dimming range.

C. Emergency Battery Driver

1. General:

- a. Comply with UL 924.
- b. Self-contained, modular, battery-inverter unit factory mounted within fixture body.
- c. Connect emergency battery driver to un-switched normal lighting circuit .

2. Battery:

- a. Sealed, nickel cadmium with minimum 5-year nominal life.
- b. Unit shall operate for a minimum of 90 minutes after power interruption.
- c. Fully automatic current-limiting charger.

3. Battery Operation:

- a. Relay automatically turns lamp(s) on when power supply circuit voltage drops to 80 percent of nominal voltage or below.
- b. Lamp automatically disconnects from battery when voltage approaches deep-discharge level.
- c. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.

- d. Integral time-delay relay to hold unit on for fixed interval when power is restored after an outage.
- e. Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.
- f. Test Switch and Light Emitting Diode Indicator Light: Visible and accessible without opening fixture or entering ceiling space.

2.3 EMERGENCY LIGHTING

A. Manufacturers

- 1. Provide lighting fixtures, of sizes, types and ratings indicated on the Drawings under the 'LIGHTING FIXTURE SCHEDULE' complete with, but not limited to, housings, drivers, and wiring.

B. Exit Signs

- 1. General:
 - a. Comply with UL 924.
 - b. Light-emitting diodes, 70,000 hours minimum of rated lamp life.
 - c. Provide universal mounting kit, unless noted otherwise.
 - d. Provide single face with extra faceplate and color panel. Install extra faceplate where two-sided exit signs are indicated on drawings.
 - e. Provide with removable chevron inserts. Remove chevrons to match arrowhead(s) shown on drawings.
- 2. Battery
 - a. Sealed, nickel cadmium with minimum 5-year nominal life.
 - b. Unit shall operate for a minimum of 90 minutes after power interruption.
 - c. Fully automatic current-limiting charger.
- 3. Battery Operation
 - a. Relay automatically turns lamp(s) on when power supply circuit voltage drops to 80 percent of nominal voltage or below.
 - b. Lamp automatically disconnects from battery when voltage approaches deep-discharge level.
 - c. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
 - d. Integral time-delay relay to hold unit on for fixed interval when power is restored after an outage.
 - e. Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.
 - f. Test Switch and Light Emitting Diode Indicator Light: Visible and accessible without opening fixture or entering ceiling space.

C. Emergency Lighting Units

1. General:
 - a. Self-contained units complying with UL 924.
 - b. Provide complete emergency battery units, including remote heads, as shown on drawings.
2. Battery:
 - a. Sealed, nickel cadmium with minimum 5-year nominal life.
 - b. Unit shall operate for a minimum of 90 minutes after power interruption.
 - c. Fully automatic current-limiting charger.
3. Battery Operation:
 - a. Relay automatically turns lamp(s) on when power supply circuit voltage drops to 80 percent of nominal voltage or below.
 - b. Lamp automatically disconnects from battery when voltage approaches deep-discharge level.
 - c. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
 - d. Integral time-delay relay to hold unit on for fixed interval when power is restored after an outage.
 - e. Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.
 - f. Test Switch and Light Emitting Diode Indicator Light: Visible and accessible without opening fixture or entering ceiling space.

2.4 FIXTURE SUPPORT COMPONENTS

- A. Comply with Division 26 Section 260529 "Hangers and Supports for Electrical Systems" for additional support components not specified below.
- B. Single-Stem Hangers: ½" steel tubing with swivel ball fittings and ceiling canopy. Finish same as fixture.
- C. Hook Hangers: Integrated assembly matched to fixture and equipped with threaded attachment. Provide with secondary safety cable connected to structure.
- D. Aircraft Cable Support: Use cable and anchorages recommended by fixture manufacturer.
- E. Suspension Bars: Provide Caddy Series 517, 520 or equal from fixture manufacturer.
- F. T-Bar Support Clips: Provide Caddy Series 515 or equal from fixture manufacturer.
- G. Ceiling Support System Wires:
 1. General: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated, 12 gauge.
 2. Humid Spaces: ASTM A 580/A 580M, Composition 302 or 304, annealed stainless steel, 12 gauge.

2.5 FIRE RATED CEILING COVERS

- A. Where fire rated ceilings exist, provide a fire rated enclosure over the light fixture housing above the ceiling. Fire rated enclosure shall be the Fire Rated Light Enclosure as manufactured by Tenmat. Coordinate exact type of fire rated enclosure in field with Architect prior to purchase.
1. The test standard for this product shall be ASTM E-119/UL 263.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Inspection

1. Inspect each fixture for damage prior to installation. Replace damaged fixtures and components.
2. Examine areas, structure, and other conditions under which lighting fixtures are to be installed and supported.
3. Review room finish schedule on architectural drawings for ceiling construction in each area and verify details with ceiling installer. Provide hardware and additional supporting devices as necessary to install lighting fixtures in each area.
4. Where lighting fixtures are recessed into ceiling construction, obtain information from the ceiling installer as to the specific type of ceiling to be installed, and provide recommended hardware and trim.
5. Review architectural drawings for fire rated ceiling assemblies and provide fire rated fixture enclosures as required.

B. General

1. Install fixtures plumb, square, and level with ceiling and walls, and secure according to manufacturer's printed instructions and approved shop drawings.
2. Install lighting fixtures at locations and heights as indicated on drawings. Where mounting heights are not indicated, coordinate with architect prior to rough-in.
3. Install lighting fixtures in strict conformance with manufacturer's recommendations and instructions.
4. Install fixtures after building is enclosed, weathertight, and environmental conditions are nominally the same as expected for the completed spaces.
5. Recessed fixtures in suspended lay-in type grid ceilings shall have final connection of flexible metal conduit not exceeding 72".
6. Install recessed fixtures to eliminate light leakage between fixture frame and finished surface.
7. Install fire rated enclosures around light fixtures in fire rated ceilings. Mount enclosure prior to installation of finished ceiling.
8. Tighten connectors and terminals, including set screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL and NEC.
9. Adjust fixtures that require field adjustment or aiming.
10. Install remote drivers in accordance with manufacturer's recommendations.

C. Supports

1. Provide fixtures and/or fixture outlet boxes with hangers to properly support fixture weight.
2. Able to maintain fixture position after cleaning or maintenance.
3. Provide support for fixture without causing deflection of ceiling or wall.
4. Fixture-mounting devices shall be capable of supporting a horizontal force of 100 percent of fixture weight and a vertical force of 400 percent of fixture weight.
5. Provide all necessary additional or auxiliary supporting steel for fixtures not mounted on building framework, and where necessary to span ceiling channels of suspended ceiling construction.
6. Support all fixtures directly from the building structure. Do not utilize any of the following items for support.
 - a. Acoustic materials.
 - b. Gypsum-base materials.
 - c. Mechanical or plumbing items or equipment.
 - d. Ceiling grid system.
 - e. Ceiling grid system hangers.
7. Metal decking shall not be pierced for fixture support.

D. Flush-Mounted Fixtures in Grid-Type Suspended Ceilings

1. Install a minimum of two ceiling support system wires for each fixture from structural members. Locate not more than 6 inches from fixture corners.
2. Fasten fixtures to ceiling grid members at or near each fixture corner with support clips that are UL listed for the application.
3. For 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 ¾ inch metal channels spanning and secured to ceiling tees.

E. Flush-Mounted Fixtures in Drywall Ceilings

1. Install a minimum of two ceiling support system wires for each fixture from structural members to fixture frame or frame kit.
2. Install drywall frames where required. Brace frames temporarily to prevent distortion during handling.
3. Install trim ring or flange flush with finished surface, where applicable.
4. Where fixtures are specified as trimless and utilizing a spackle flange, provide supporting structure along entire perimeter of fixture for support of flange.
5. Coordinate installations with ceiling installer.

F. Wall-Mounted Fixtures

1. Attached to junction box or as recommended by fixture manufacturer.
2. Do not attach fixtures directly to gypsum board.

G. Pendant-Mounted Fixtures

1. Rigidly align continuous rows of linear pendant lighting fixtures for in-line appearance.
2. Install intermediate supports along the length of linear pendant-mounted fixtures as recommended by fixture manufacturer.
3. Install pendant mounted fixtures in unfinished spaces near obstructions, such as ducts or pipes, suspended so the bottom of the fixture is at the same height as the bottom of the obstruction. All fixtures in the space should be located at the height of the lowest fixture,

minimum 8'-0" above the finished floor, unless noted otherwise. Do not install fixtures until the locations of the obstructions are installed or coordinated.

4. Do not use ceiling grid as support for pendant fixtures. Connect support wires or rods to building structure.

H. Surface Mounted Fixtures

1. Secured to outlet box. Outlet box to be supported directly to structure.
2. Support fixtures that are centered in acoustical ceiling tile, independently with metal suspension bar spanning an electrical outlet box and clipped to the ceiling grid tees.
3. Support fixtures that are centered on ceiling grid structure independent of ceiling grid, using support clips that wrap around grid. The support clip shall include means for fixture mounting. Provide a wire hanger from clip to structure.
4. Support surface-mounted fixtures greater than 2' in length at a point in addition to the outlet box.

3.2 COORDINATION

- A. Coordinate layout and installation of lighting fixtures and supports with other construction that penetrate ceilings or are supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.
- B. Sequence lighting fixture installation with other work to reduce the possibility of damage to fixtures during remainder of construction period.

3.3 FIELD QUALITY CONTROL

- A. Inspect each installed fixture for damage. Replace damaged fixtures and components.
- B. Verify normal operation of each fixture after fixtures have been installed and circuits have been energized. Replace or repair malfunctioning fixtures and components.
- C. During warranty period, replace fixtures that show any signs of corrosion.
- D. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify normal transfer to battery power source and retransfer to normal.

3.4 ADJUSTING AND CLEANING

- A. Remove protective wrapping on fixtures before installation of furniture, but after interior finish work, such as painting and carpeting, is completed.
- B. Clean fixtures upon completion of installation. Use methods and materials recommended by manufacturer. Lenses and louvers with dust, dirt, scratches, or fingerprints shall not be acceptable.

3.5 STARTUP SERVICE

- A. Burn-in LED fixtures prior to occupancy by Owner for a minimum of 100 hours at full light output.

3.6 GROUNDING

- A. Provide equipment grounding connections for all lighting fixtures. Tighten connections to comply with tightening torques specified in UL Standard 486A to assure permanent and effective grounds.

END OF SECTION 265100

SECTION 265600
EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this and the other sections of Division 26.
- B. All Division 26 Specification Sections apply to this section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Exterior lighting fixtures.
 - 2. Poles and accessories.

1.3 DEFINITIONS

- A. CCT: Correlated color temperature.
- B. CRI: Color Rendering Index.
- C. Fixture: See "Luminaire."
- D. IP: International Protection or Ingress Protection Rating.
- E. LED: Light-emitting diode.
- F. Lumen: Measured output of lamp and luminaire, or both.
- G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.4 SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Arrange in order of fixture designation.
 - 2. Include data on features, accessories, and finishes.
 - 3. Include physical description and dimensions of fixtures.
 - 4. Include installation and attachment details.
 - 5. Include emergency lighting units, including batteries and chargers.
 - 6. Include fixture-mounted lighting controls.
 - 7. Include life, output (lumens, CCT, and CRI), and energy-efficiency data.
 - 8. Include "Lighting Facts".

9. Photometric data and adjustment factors based on laboratory tests, complying with IES "Lighting Measurements Testing and Calculation Guides" for each fixture type. The adjustment factors shall be for lamps and accessories identical to those indicated for the fixture as applied in this Project.
 - a. Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.
10. Include the following for poles:
 - a. Materials, dimensions, and finishes.
 - b. Means of attaching fixtures to supports, and indication that attachment is suitable for components involved.
 - c. Anchor bolt templates keyed to specific poles and certified by manufacturer.
 - d. Pole and Support Component Certificates: Signed by manufacturers of poles, certifying that products are designed for indicated load requirements in AASHTO LTS-4-M and that dead load, live load, and wind load imposed by luminaire and attachments has been included in design. The certification shall be based on design calculations by a professional engineer.

B. Shop Drawings:

1. Upon request, provide point-by-point computer generated plot diagram of horizontal foot-candles at 30" above finished floor, unless noted otherwise, that shows values of illuminance projected from the arrangement of light fixtures as shown on the drawings, including mounting heights, and as described in the 'LIGHTING FIXTURE SCHEDULE'. Indicate on the computer report the locations, spacing, and heights of fixtures.

C. Samples:

1. Manufacturers shall be prepared to submit complete fixture samples for approval by Architect and Engineer. Samples shall be submitted only at the request of the Architect/Engineer. Sample fixtures shall be shipped prepaid by the Contractor and shall be furnished within two weeks of request. Fixtures shall be complete with specified lamps and mounting hardware. Samples shall be evaluated for two weeks prior to acceptance or rejection. Samples shall remain on the project site as an example of materials, workmanship, finish, color, tolerance, performance, and general quality of all other fixtures of the respective type to be installed on the project. Fixtures judged inferior to the sample shall not be accepted. The Architect/Engineer shall be the final judge of fixture acceptance.

1.5 QUALITY ASSURANCE

- A. Luminaire Photometric Data Testing Laboratory Qualifications: Fixture manufacturer's laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.
- B. Each fixture type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among fixtures.
- C. Fixtures must meet the following:
 1. LM-79: Approved Method for Electrical and Photometric Measurement of SSL Products
 2. LM-80: Approved Method for Measuring Lumen Maintenance of LED Light Sources
 3. L-70: 70% Lumen Maintenance

4. TM-21: Establishes a method for projecting lumen maintenance (and useful lifetime) of LED light sources from available LM-80 data

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver lighting fixtures and accessories in factory fabricated containers or wrappings that properly protect fixtures from debris and physical damage.
- B. Handle lighting fixtures carefully to prevent damage, breaking, and scoring. Do not install damaged fixtures or components; replace with new.
- C. Store lighting fixtures in clean dry place. Protect from weather, dirt, fumes, water, construction debris, and physical damage.
- D. Store poles on decay-resistant-treated skids at least 12 inches above grade and vegetation.
- E. Support poles to prevent distortion and arrange to provide free air circulation.
- F. Retain factory applied pole wrappings on poles until right before pole installation.

1.7 WARRANTY

- A. Manufacturer and Installer agree to repair or replace components that fail in materials or workmanship within specified warranty period. Warranty shall include repair or replacement of products that fail in materials or workmanship, that corrode, fade, stain, perforate, erode, or chalk due to effects of weather or solar radiation within specified warranty period. Manufacturer may exclude lightning damage, hail damage, vandalism, abuse, or unauthorized repairs or alterations from warranty coverage.
- B. Warranty Period: Five year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 LIGHTING FIXTURES

- A. Manufacturers
 1. Provide lighting fixtures of types described on the drawings under the 'LIGHTING FIXTURE SCHEDULE'.
 2. Provide lighting fixtures complete with, but not limited to, housings, drivers, and wiring.
 3. Manufacturer and product series are indicated in the 'LIGHTING FIXTURE SCHEDULE' and constitute the type and quality of fixture to be provided. All published specifications of the manufacturer that correspond to the indicated catalog number, shall be considered as part of this specification even though they may not be shown in complete detail.
 4. Manufacturer's product series indicate the general line of fixtures required and may not necessarily include all prefixes and suffixes for options, trim and/or configurations required.
 5. Bid prices shall be based on information in all columns of the 'LIGHTING FIXTURE SCHEDULE'.

6. Where a conflict exists between the fixture description and the manufacturer's product series, the price shall include the more expensive option. Coordinate conflicts with engineer prior to submitting bid.
7. The listing of a manufacturer does not guarantee that manufacturer will have a product that meets the requirements put forth in the fixture description. Approval of specific fixtures by an approved manufacturer will be subject to review by the Specifier.
8. No substitutions shall be accepted unless listed.
9. The Lumen Output column of the 'LIGHTING FIXTURE SCHEDULE' lists the nominal lumen output for each fixture type. Submitted fixture shall be capable of providing listed lumen output within 10% of listed lumen output.
10. Provide fixtures from a single manufacturer for each fixture type.
11. Pricing for light fixture types shall be through local lighting rep listed only.

B. General

1. Ship fixtures factory assembled, complete in every respect, including all necessary parts, shown or not shown on the drawings, required for a complete installation in accordance with the manufacturer's recommendations.
2. All low voltage lighting wiring shall be as recommended by the fixture manufacturer. Low voltage wiring shall be minimum #10 AWG Copper.

C. Listings

1. Provide fixtures for use in damp or wet locations that are UL Listed for the specific installation.

D. Fixture Construction

1. Fixtures shall be designed with metal parts grounded as common unit.
2. Fixture housing shall be formed and supported to prevent warping and sagging.
3. Metal parts shall be free of burrs, sharp corners, and edges.
4. Doors, Frames, and Other Internal Access:
 - a. Smooth operating and designed to permit access without use of tools.
 - b. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally when secured in operating position.
5. Provide metal trim rings for recessed downlights and wallwash type fixtures, unless noted otherwise.
6. Provide metal flange for recessed linear fixtures mounted in drywall construction, unless noted otherwise.
7. Finishes: Manufacturers' standard, unless otherwise indicated.
8. Exposed Hardware Material: Stainless steel.

E. Light Engines

1. Color temperature shall be 4000K, unless noted otherwise in the 'LIGHTING FIXTURE SCHEDULE'
2. Color Rendering Index: 80 CRI
3. Individual LEDs shall be connected such that a catastrophic loss or the failure of one LED will not result in the loss of the entire light engine.
4. LED light engine shall be suitable for field maintenance or service from below with plug-in connectors.
5. LED light engine shall be upgradable.
6. The thermal management (of the heat generated by the LEDs) shall be of sufficient capacity to ensure proper operation of the light engine over the expected useful life.

2.2 DRIVERS

A. Manufacturers

1. Furnished with fixture as tested and recommended by fixture manufacturer as a complete lighting system.
2. All fixtures of the same type shall be furnished with the same manufactured driver type.

B. General

1. All drivers shall be equipped with a disconnecting means internal to the fixture. The line side terminals of the disconnecting means shall be guarded. Provide Sta-Kon Series LD3 Luminaire Disconnect or equivalent.
2. LED driver shall be rated for dual 120/277 volt operation at 60 Hertz.
3. Drivers shall be electronic-type, labeled as compliant with radio frequency interference (RFI) requirements of FCC Title 47 Part 15, and comply with NEMA SSL 1 "Electronic Drivers for LED Devices, Arrays, or Systems".
4. Drivers shall have a sound rating of "A", have a minimum efficiency of 85%, and be rated for a THD of less than 20 percent at all input voltages.
5. Dimmable LED drivers shall be 0-10V type, 10% minimum, unless noted otherwise on the 'LIGHTING FIXTURE SCHEDULE'.
6. Dimmable LED drivers shall be capable of dimming without LED strobing or flicker across their full dimming range.

C. Emergency Battery Driver

1. General:
 - a. Comply with UL 924.
 - b. Self-contained, modular, battery-inverter unit factory mounted within fixture body.
 - c. Connect emergency battery driver to un-switched normal lighting circuit .
2. Battery:
 - a. Sealed, nickel cadmium with minimum 5-year nominal life.
 - b. Unit shall operate for a minimum of 90 minutes after power interruption.
 - c. Fully automatic current-limiting charger.
3. Battery Operation:
 - a. Relay automatically turns lamp(s) on when power supply circuit voltage drops to 80 percent of nominal voltage or below.
 - b. Lamp automatically disconnects from battery when voltage approaches deep-discharge level.
 - c. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
 - d. Integral time-delay relay to hold unit on for fixed interval when power is restored after an outage.
 - e. Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.
 - f. Test Switch and Light Emitting Diode Indicator Light: Visible and accessible without opening fixture or entering ceiling space.

2.3 FIXTURE SUPPORT COMPONENTS

- A. Comply with Division 26 Section 260529 "Hangers and Supports for Electrical Systems" for additional support components not specified below.
- B. Comply with luminaire manufacturers' mounting requirements.
- C. Use stainless steel fasteners and mounting bolts unless otherwise indicated.

2.4 POLES

- A. Pole Construction:
 - 1. Seamless, extruded structural tube complying with ASTM B 429/B 429M, Alloy 6063-T6.
 - 2. Handhole: Oval-shaped, with minimum clear opening of 2-1/2 by 5 inches, with cover secured by stainless steel captive screws.
 - 3. Mounting Provisions: Butt flange for bolted mounting on foundation.
 - 4. Grounding and Bonding Lugs: Welded 1/2-inch threaded lug, complying with requirements in Division 26 Section 260526 "Grounding and Bonding for Electrical Systems," listed for attaching grounding and bonding conductors of type and size listed in that Section, and accessible through handhole.
 - 5. Finishes: Manufacturers' standard, unless otherwise indicated.
 - 6. Anchor Bolts, Leveling Nuts, Bolt Caps, and Washers:
 - a. Hot-dip galvanized after fabrication unless otherwise indicated.
 - b. Corrosion-resistant items compatible with support components.
 - c. Materials shall not cause galvanic action at contact points.
 - 7. Anchor Bolt Template: Plywood or steel.
- B. Mounting Components:
 - 1. Finish: Same as pole.
 - 2. Fixture Support Brackets: Detachable, cantilever, without underbrace. Adapter fitting welded to pole and bracket, then bolted together with stainless steel bolts.
 - 3. Pole-Top Tenons: Fabricated to support fixture(s) and securely fastened to pole top.
 - 4. Mast Arms: Single-arm type, continuously welded to pole attachment plate.
 - 5. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.
 - 6. Concrete Pole Foundations: Cast in place, with anchor bolts to match pole-base flange. Concrete, reinforcement, and formwork are specified in Division 03 CONCRETE.
- C. Pole Accessories
 - 1. Base Covers: Manufacturers' standard metal units, arranged to cover pole's mounting bolts and nuts. Finish same as pole.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Inspection

1. Inspect each fixture for damage prior to installation. Replace damaged fixtures and components.
2. Examine areas, structure, and other conditions under which lighting fixtures are to be installed and supported.
3. Review architectural drawings for ceiling construction where applicable and verify details with ceiling installer. Provide hardware and additional supporting devices as necessary to install lighting fixtures in each area.
4. Where lighting fixtures are recessed into ceiling construction, obtain information from the ceiling installer as to the specific type of ceiling to be installed, and provide recommended hardware and trim.

B. General

1. Install fixtures plumb, square, and level with ceiling and walls, and secure according to manufacturer's printed instructions and approved shop drawings.
2. Install lighting fixtures at locations and heights as indicated on drawings. Where mounting heights are not indicated, coordinate with architect prior to rough-in.
3. Install lighting fixtures in strict conformance with manufacturer's recommendations and instructions.
4. Install recessed fixtures to eliminate light leakage between fixture frame and finished surface.
5. Tighten connectors and terminals, including set screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL and NEC.
6. Adjust fixtures that require field adjustment or aiming.
7. Install remote drivers in accordance with manufacturer's recommendations.

C. Supports

1. Provide fixtures and/or fixture outlet boxes with hangers to properly support fixture weight.
2. Able to maintain fixture position after cleaning or maintenance.
3. Provide support for fixture without causing deflection of ceiling or wall.
4. Fixture-mounting devices shall be capable of supporting a horizontal force of 100 percent of fixture weight and a vertical force of 400 percent of fixture weight.
5. Provide all necessary additional or auxiliary supporting steel for fixtures not mounted on building framework, and where necessary to span ceiling channels of suspended ceiling construction.
6. Support all fixtures directly from the building structure. Do not utilize any of the following items for support.
 - a. Acoustic materials.
 - b. Gypsum-base materials.
 - c. Mechanical or plumbing items or equipment.
7. Metal decking shall not be pierced for fixture support.

D. Flush Mounted Fixtures in Drywall Ceilings

1. Install a minimum of two ceiling support system wires for each fixture from structural members to fixture frame or frame kit.

2. Install drywall frames where required. Brace frames temporarily to prevent distortion during handling.
3. Install trim ring or flange flush with finished surface, where applicable.
4. Where fixtures are specified as trimless and utilizing a spackle flange, provide supporting structure along entire perimeter of fixture for support of flange.
5. Coordinate installations with ceiling installer.

E. Wall Mounted Fixtures

1. Attached to junction box or as recommended by fixture manufacturer.
2. Do not attach fixtures directly to gypsum board.

F. Surface Mounted Fixtures

1. Secured to outlet box. Outlet box to be supported directly to structure.
2. Support surface-mounted fixtures greater than 2' in length at a point in addition to the outlet box.

G. Poles

1. Inspect each pole for damage prior to installation. Replace damaged poles.
2. Examine areas and other conditions under which poles are to be installed and supported.
3. Review all design drawings, including civil, landscape, and architectural, for pole locations in relation to the following underground features and notify the engineer immediately of any potential conflicts:
 - a. Fire Hydrants and Storm Drainage Piping: minimum 5 feet.
 - b. Water, Gas, Electric, Communication, and Sewer Lines: minimum 10 feet.
 - c. Trees: minimum 15 feet from tree trunk.
 - d. Curbs: minimum 2 feet from edge of curb.
4. Align pole foundations and poles to allow for orientation of fixture(s) as shown on drawings.
5. Set anchor bolts in concrete pole foundations according to anchor-bolt templates furnished by pole manufacturer.
6. Use anchor bolts and nuts defined for the application and approved by manufacturer.
7. Raise and set pole using web fabric slings (not chain or cable). Mount pole with leveling nuts, and tighten top nuts to torque level recommended by pole manufacturer.
8. Grout void between pole base and foundation. Use non-shrink or expanding concrete grout firmly packed to fill space.
9. Install base covers unless otherwise indicated.
10. Where poles are installed in concrete-paved areas, provide concrete control joint around pole base.

3.2 COORDINATION

- A. Sequence lighting fixture installation with other work to reduce the possibility of damage to fixtures during remainder of construction period.
- B. Coordinate exact location of all light fixtures with architect, civil engineer, and site contractor prior to installation. Fixture locations shall be installed relative to other site features installed by site contractor and should not be scaled off of drawings.

DIVISION 27
Not Used

DIVISION 31

**SECTION 31 1000
SITE CLEARING**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Stripping and stockpiling topsoil.
 - 2. Temporary erosion- and sedimentation-control measures.
- B. Related Sections include the following:
 - 1. Division 31 Section "Earth Moving" for subgrade preparation, grading, and subbase course.

1.3 DEFINITIONS

- A. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.
- B. Surface Soil: Soil that is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil; but in disturbed areas such as urban environments, the surface soil can be subsoil.
- C. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil and is the zone where plant roots grow.

1.4 MATERIAL OWNERSHIP

- A. Except for stripped topsoil or other materials indicated to remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.5 SUBMITTALS

- A. Product Specification Data Sheets: For each type of manufactured material and product indicated.
- B. Existing Conditions: Documentation of existing trees and plantings, adjoining construction, and site improvements that establishes preconstruction conditions that might be misconstrued as damage caused by site clearing.

1. Use sufficiently detailed photographs or video.
- C. Record Drawings: Identifying and accurately showing locations of capped utilities and other subsurface structural, electrical, and mechanical conditions.

1.6 PROJECT CONDITIONS

- A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities. Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.
 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
- B. Salvable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises where indicated.
- C. Utility Locator Service: Notify PA One Call (1-800-242-1776) for area where Project is located before site clearing. Augment PA One Call with private utility service where necessary.
- D. Do not commence site clearing operations until temporary erosion- and sedimentation-control and temporary fencing are in place.
- E. Soil Stripping, Handling, and Stockpiling: Perform only when the topsoil is dry or slightly moist.

PART 2 - PRODUCTS

- A. Satisfactory Soil Material: Requirements for satisfactory soil material are specified in Division 31 Section Earth Moving.
- B. Erosion control materials are shown on the Erosion and Sediment Control Drawing Set and Report.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect and maintain benchmarks and survey control points from disturbance during construction.
- B. Protect existing site improvements to remain from damage during construction.
 1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.2 TEMPORARY EROSION AND SEDIMENTATION CONTROL

- A. Provide temporary erosion- and sedimentation-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways,

according to Erosion- and Sedimentation Control Drawings and requirements of authorities having jurisdiction.

B. Temporary Stabilization defined per PA Code Title 25 Chapter 102.22:

1. Upon temporary cessation of an earth disturbance activity or any stage or phase of an activity where a cessation of earth disturbance activities will exceed 4 days, the site shall be immediately seeded, mulched, or otherwise protected from accelerated erosion and sedimentation pending future earth disturbance activities.
2. For an earth disturbance activity or any stage or phase of an activity to be considered temporarily stabilized, the disturbed areas shall be covered with one of the following:
 - a. A minimum uniform coverage of mulch and seed, with a density capable of resisting accelerated erosion and sedimentation.
 - b. An acceptable BMP which temporarily minimizes accelerated erosion and sedimentation

C. Permanent Stabilization defined per PA Code Title 25 Chapter 102.22:

1. Upon final completion of an earth disturbance activity or any stage or phase of an activity, the site shall immediately have topsoil restored, replaced, or amended, seeded, mulched or otherwise permanently stabilized and protected from accelerated erosion and sedimentation.
2. E&S BMPs shall be implemented and maintained until the permanent stabilization is completed. Once permanent stabilization has been established, the temporary E&S BMPs shall be removed. Any areas disturbed in the act of removing temporary E&S BMPs shall be permanently stabilized upon completion of the temporary E&S BMP removal activity.
3. For an earth disturbance activity or any stage or phase of an activity to be considered permanently stabilized, the disturbed areas shall be covered with one of the following:
 - a. A minimum uniform 70% perennial vegetative cover, with a density capable of resisting accelerated erosion and sedimentation.
 - b. An acceptable BMP which permanently minimizes accelerated erosion and sedimentation.

D. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.

E. Inspect, maintain, and repair erosion- and sedimentation-control measures during construction until permanent vegetation has been established.

F. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.3 UTILITIES

A. Locate, identify, disconnect, and seal or cap utilities indicated to be removed or abandoned in place.

1. Arrange with utility companies to shut off indicated utilities. All utility disconnection and reconnection work shall be coordinated with respective utility company and work shall be in accordance with respective utility company's standards.
 - B. Locate, identify, and disconnect utilities indicated to be abandoned in place.
 - C. Interrupting Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
 1. Notify Owner/Owner's Representative not less than 3 days in advance of proposed utility interruptions.
 2. Do not proceed with utility interruptions without Owner/Owner's Representative written permission.
 - D. Excavate for and remove underground utilities indicated to be removed.
- 3.4 TOPSOIL STRIPPING
- A. Remove sod and grass before stripping topsoil.
 - B. Strip topsoil to depth of 6 inches in a manner to prevent intermingling with underlying subsoil or other waste materials.
 1. Remove subsoil and non-soil materials from topsoil, including clay lumps, gravel, and other objects more than 2 inches in diameter; trash, debris, weeds, roots, and other waste materials.
 - C. Stockpile topsoil away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust and erosion by water.
 1. Dispose of surplus topsoil. Surplus topsoil is that which exceeds quantity indicated to be stockpiled or reused.
- 3.5 DISPOSAL OF SURPLUS AND WASTE MATERIALS
- A. Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.

END OF SECTION 311000

SECTION 31 2200

GRADING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Cutting and grading of site.
 - 2. Topsoil placement.
- B. Related Sections:
 - 1. Division 01: Administrative, procedural, and temporary work requirements.
 - 2. Section 31 1100 - Clearing and Grubbing.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Topsoil:
 - 1. Stockpiled on-site material, specified in Section 31 1100 supplemented by off-site material, if required.
 - 2. Off-site materials: Natural friable loam of region, free of clay, toxic substances, large or matted roots, debris, excess weeds, and rocks over 1 inch in any dimension, with acidity range of 5.5 to 7.5.

PART 3 EXECUTION

3.1 CUTTING AND GRADING

- A. Excavate expansive subsoils from areas under and to a point 5 feet outside of structures to a minimum depth of 5 feet.
- B. Excavate subsoil to permit placement of structures, paving, and site improvements, and from areas to be regraded.
- C. Uniformly grade areas to smooth surface at required grades and elevations. Adjust contours to eliminate water ponding and provide positive drainage. Make grade changes gradually. Blend slopes into level areas.
- D. Leave areas to receive topsoil 4 inches below final required grade.
- E. Leave areas to receive planting beds below final required grade per landscaping drawings and specifications.
- F. Tolerances: Within plus or minus 1 inch of required subgrade elevation.

3.2 TOPSOIL PLACEMENT

- A. Place topsoil to 4 inch depth over areas modified by work of this Contract that are not covered by planting beds, structures or paving.
- B. Uniformly distribute to required grades; feather back to where grades remain unchanged.
- C. Uniformly grade areas to smooth surface at required grades and elevations. Adjust contours to eliminate water ponding and provide positive drainage. Make grade changes gradually. Blend slopes into level areas.

- D. Remove rubbish, debris, vegetation, and concentrations of rocks. Rake areas smooth; leave suitable for seeding or sodding.

3.3 CLEANING

- A. Remove surplus materials and those not suitable for reuse from site. Contractor shall bear all costs and responsibilities for disposing of material at an off-site location meeting local, state, and federal regulations.

3.4 PROTECTION

- A. Protect graded areas from traffic and erosion; keep free of trash and debris.
- B. Repair settled, eroded, or rutted areas.

END OF SECTION

SECTION 31 2300

EXCAVATION AND FILL

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Excavating for structures and site components.
 - 2. Filling.
 - 3. Trenching.
 - 4. Backfilling.
- B. Related Sections:
 - 1. Division 01: Administrative, procedural, and temporary work requirements.

1.2 REFERENCES

- A. ASTM International (ASTM):
 - 1. C136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
 - 2. D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³) (600 kN-m/m³).
 - 3. D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³) (2,700 kN-m/m³).
 - 4. D2487 - Standard Classification of Soils for Engineering Purposes.
 - 5. D2922 - Standard Test Methods for Density of Soil and Soil Aggregate in Place by Nuclear Methods (Shallow Depth).
 - 6. D4254 - Standard Test Methods for Minimum Index Density of Soils and Calculation of Relative Density.
 - 7. D4318 - Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

1.3 SYSTEM DESCRIPTION

- A. Limits of Work: Do not extend earthwork beyond areas of excavation or construction shown on Drawings or reasonably necessary for performance of Work.
- B. Contractor is responsible for design of temporary earth retention systems.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940/D2940M; with at least 90 percent passing a 1-1/2-inch (37.5-mm) sieve and not more than 12 percent passing a No. 200 (0.075-mm) sieve.
- B. Sand: ASTM C33/C33M; fine aggregate.
- C. Common Fill: Reused site or imported soils free from trash, debris, roots over 1 inch in diameter, matted roots, rocks over 3 inches in diameter, topsoil, and other deleterious matter.

2.2 SOURCE QUALITY CONTROL

- A. Testing and Inspection Services: Test Engineered Fill prior to placement:
 - 1. Liquid limit, plastic limit, and plasticity index: Test to ASTM D4318.
 - 2. Moisture/density relationship: Test to ASTM D698.

3. Provide soil description; determine compliance with gradation and quality requirements.

PART 3 EXECUTION

3.1 EXCAVATING

- A. Excavate to grades and sub-grades indicated. Make excavations large enough to permit placing and inspection of work.
- B. Stockpile excavated materials that are suitable for reuse separately from sub-grade material.
- C. Remove and dispose of excavated material that is unsuitable or not required for backfilling. Contractor shall bear all costs and responsibilities for disposing of material at an off-site location meeting local, state, and federal regulations.
- D. Remove underground obstructions.
- E. Brace sides of excavations where necessary; maintain until permanent construction is in place. Remove temporary shoring and bracing as backfill is placed.
- F. Excavation for Structures:
 1. Form bottoms of excavations reasonably level.
 2. Maintain moisture level in excavations as near their natural level as possible.
- G. Correct over-excavation under footings by use of lean concrete. Correct other over-excavation by use of Engineered Fill, compacted to density of existing sub-grade.
- H. Keep excavations free of water.

3.2 BACKFILLING

- A. Fill vegetated areas with Common Fill to achieve required grades and elevations.
 1. Place fill in maximum 8 inch deep loose, even, horizontal lifts.
 2. Compact each lift to 85% with a moisture content as specified in ASTM D698 and D1557.
- B. Fill under structures with Engineered Fill.
 1. Place fill in maximum 8 inch deep loose, even, horizontal lifts.
 2. Compact each lift to 95% with a moisture content as specified in ASTM D698 and D1557.
- C. Do not fill over porous, wet, frozen, or soft sub-grades.
- D. Bench fill into slopes.
- E. When moisture must be added to aid in compaction, uniformly apply water to surface, but do not flood. Free water shall not appear on surface during or after compaction operations.
- F. Scarify soil too wet for proper compaction and allow to dry. Replace and re-compact.
- G. Uniformly grade areas to smooth surface at required grades and elevations. Adjust contours to eliminate water ponding and provide positive drainage. Make grade changes gradually. Blend slopes into level grades.
- H. Tolerances: Within plus or minus 1 inch of required sub-grade elevation.

3.3 TRENCHING

- A. Cut trenches sufficiently wide to allow for installation of utilities and for inspection of work.
- B. Hand trim excavations; remove loose matter.

- C. Remove rocks and obstructions.
- D. Correct over-excavation by use of lean concrete or pipe bedding material.
- E. Keep trenches free of water.

3.4 FIELD QUALITY CONTROL

- A. Testing and Inspection Services: Perform field in place density tests, ASTM D2922, at following rates; minimum of three tests for each lift or area:
 - 1. Under structures: One test for each 2,000 square feet, per lift.
 - 2. Under paving: One test for each 2,000 square feet, per lift.
 - 3. Trenches: One test for each 150 linear feet, per lift.

3.5 CLEANING

- A. Remove surplus materials and those not suitable for reuse from site.

3.6 PROTECTION

- A. Protect graded areas from traffic and erosion; keep free of trash and debris.

END OF SECTION

HACP NVH Recreational Area

SECTION 31 2000 EARTH MOVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section shall include, but not be limited to, the following:
 - 1. Preparing sub-grades for infiltration area, sidewalks, parking areas, access roads, and planting areas.
 - 2. Excavating to line, grade and configuration as shown on the Drawings.
 - 3. Fill to line, grade and configuration as shown on the Drawings.
 - 4. Excavating and backfilling for utility trenches, including the storm sewer system.
 - 5. Excavation and backfilling for landscaping.
- B. This Section shall not include work within the building limits, except for bulk grading.

1.3 DEFINITIONS

- A. Backfill: Soil material, aggregate material or controlled low-strength material used to fill an excavation.
 - 1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
 - 2. Final Backfill: Backfill placed over initial backfill to fill a trench.
- B. Bedding Course: Course placed over the excavated sub-grade in a trench before laying pipe.
- C. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill meeting the requirements of the Technical Specifications.
- D. Excavation: Removal of material encountered above sub-grade and to lines and dimensions indicated.
 - 1. Authorized Additional Excavation: Excavation below sub-grade elevations or beyond indicated lines and dimensions as directed by Owner.
 - 2. Unauthorized Excavation: Excavation below sub-grade elevations or beyond indicated lines and dimensions without direction by Owner. Unauthorized excavation, as well as remedial work directed by Owner, shall be without additional compensation.
- E. Fill: Soil materials used to raise existing grades.
- F. Rock: Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material that exceed 1 cu. yd. for bulk excavation or 3/4 cu. yd. for footing, trench, and

pit excavation that cannot be removed by rock excavating equipment equivalent to the following in size and performance ratings, without systematic drilling, ram hammering, ripping, or blasting, when permitted:

1. Excavation of Footings, Trenches, and Pits: Late-model, track-mounted hydraulic excavator; equipped with a 42-inch-wide, maximum, short-tip-radius rock bucket; rated at not less than 138-hp flywheel power with bucket-curling force of not less than 28,090 lbf and stick-crowd force of not less than 18,650 lbf; measured according to SAE J-1179.
 2. Bulk Excavation: Late-model, track-mounted loader; rated at not less than 210-hp flywheel power and developing a minimum of 48,510-lbf breakout force with a general purpose bare bucket; measured according to SAE J-732.
- G. Structures: Manholes, footings, foundations, retaining walls, buildings, slabs, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.
- H. Sub-base Course: Course placed between the sub-grade and base course for hot-mix asphalt pavement, or course placed between the sub-grade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.
- I. Sub-grade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below sub-base, drainage fill, or topsoil materials.
- J. Utilities: On-site underground pipes, conduits, ducts, and cables.

1.4 SUBMITTALS

- A. Product Data: For the following:
1. Each type of plastic warning tape.
 2. Geotextile.
 3. Each type of aggregate.
- B. Material Test Reports - Soils: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated:
1. Classification according to ASTM D 2487 of each on-site and borrow soil material proposed for fill and backfill.
 2. Laboratory compaction curve according to ASTM D 698 for each on-site and borrow soil material proposed for fill and backfill.
- C. Pre-excavation Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including finish surfaces, that might be misconstrued as damage caused by earthwork operations. Submit before earthwork begins.
- D. Material Test Reports - Aggregate: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated:
1. Classification according to ASTM D 2487 of each on-site and borrow soil material proposed for fill and backfill.
 2. Material Certification for each type and source of material.

1.5 QUALITY ASSURANCE / CONTROL

- A. Geotechnical Testing Agency Qualifications: An independent testing agency qualified according to ASTM E 329 to conduct soil materials and rock-definition testing, as documented according to ASTM D 3740 and ASTM E 548. Testing requirements are discussed further in the Section.
- B. Independent Testing Laboratory selected and paid for by the Owner, shall be retained to perform construction testing on site based on the requirements of this Specification.
- C. If compaction requirements are not complied with during the construction process, remove and recompact deficient areas until proper compaction is obtained at no additional expense to the Owner.
- D. In areas to receive pavement, CBR (California Bearing Ratio) tests shall be performed by the independent testing laboratory at a frequency of 5 per type of pavement. Test reports shall be submitted a minimum of 10 days in advance of scheduled pavement installation to the Owner's Representative. If the CBR testing is completed, test results will not be used to reduce the pavement thickness. CBR testing may be deleted based on the opinion of the Geotechnical Engineer.
- E. Field density tests for in-place materials shall be performed according to one of the following standards as part of construction testing standards:
 - 1. Sand-Cone Method: ASTM D 1556
 - 2. Balloon Method: ASTM D 2167
 - 3. Nuclear Method: ASTM D 2922 (Method B-Direct Transmission)
- F. Independent Testing Laboratory shall prepare test reports that indicate test location, elevation data, and test results. The Owner and Contractor shall be provided with copies of reports within 96 hours of time test was performed. In event that any test performed fails to meet these Specifications, the Owner and Contractor shall be notified immediately by independent testing laboratory.
- G. Costs related to retesting due to failures shall be paid for by the Contractor at no additional expense to Owner. Contractor shall provide free access to site for testing activities

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

- A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations. If borrow is necessary, the Contractor shall comply with the conditions of the Erosion and Sediment Control Plan.
- B. Common Fill: ASTM D 2487 Soil Classification Groups GW, GP, GM, SW, SP, and SM or a combination of these groups; free of rock or gravel larger than 2 inches in any dimension, and free of debris, waste, frozen materials, vegetation, and other deleterious matter.
- C. Bedding Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; except with 100 percent passing a 1-inch (25-mm) sieve and not more than 8 percent passing a No. 200 (0.075-mm) sieve.

- D. Drainage Stone: Shall meet the requirements of Section 703 for AASHTO 57 of the Pennsylvania Department of Transportation Publication 408 Specifications, latest revisions. Drainage Stone shall be washed gravel. Slag is not acceptable.
- E. Trench Backfill: Shall be No. 2A Coarse Aggregate the meeting the requirements of Section 703 of the Pennsylvania Department of Transportation Publication 408 Specifications, latest revisions or AASHTO No. 57 crushed limestone. Drainage Stone is unacceptable for this use. Slag is not acceptable.

2.2 GEOTEXTILES

- A. General: Separation Geotextile: Woven geotextile fabric, manufactured for separation applications, made from polyolefins or polyesters; with elongation less than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:
 - 1. Survivability: Class 2; AASHTO M 288.

2.3 AGGREGATE SUB-BASE

- A. Aggregate Sub-base: Sub-base shall be crushed limestone in accordance with PADOT standard specifications for sub-base aggregate. Slag is not allowed.

2.4 ACCESSORIES

- A. Delete warning tapes in this Article if not required. Use may be mandatory for underground hazardous utilities.
- B. Warning Tape: Acid- and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches (150 mm) wide and 4 mils (0.1 mm) thick, continuously inscribed with a description of the utility; colored as follows:
 - 1. Red: Electric.
 - 2. Yellow: Gas, oil, steam, and dangerous materials.
 - 3. Orange: Telephone and other communications.
 - 4. Blue: Water systems.
 - 5. Green: Sewer systems.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.
- B. Preparation of subgrade for earthwork operations including removal of vegetation, topsoil, debris, obstructions, and deleterious materials from ground surface is specified in Division 31 Section Site Clearing.

- C. Protect and maintain erosion and sedimentation controls during earthwork operations.

3.2 DEWATERING

- A. General Prevent surface water and ground water from entering excavations, from ponding on prepared sub-grades, and from flooding Project site and surrounding area.
- B. Protect sub-grades from softening, undermining, washout, and damage by rain or water accumulation.
 - 1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.
 - 2. Install a dewatering system, if necessary, to keep sub-grades dry and convey ground water away from excavations. Maintain until dewatering is no longer required.

3.3 EXCAVATION, GENERAL

- A. Unclassified Excavation: Excavate to sub-grade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.
 - 1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.
 - 2. Remove rock to lines and grades indicated to permit installation of permanent construction without exceeding the following dimensions:
 - 3. Earth excavation includes excavating pavements and obstructions visible on surface; underground structures, utilities, and other items indicated to be removed; together with soil, boulders, and other materials not classified as rock or unauthorized excavation.
 - 4. Rock excavation includes removal and disposal of rock. Remove rock to lines and subgrade elevations indicated to permit installation of permanent construction without exceeding the following dimensions:

3.4 EXCAVATION FOR WALKS AND PAVEMENTS

- A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

3.5 EXCAVATION FOR UTILITY TRENCHES

- A. Excavate trenches to indicated gradients, lines, depths, and elevations.
 - 1. Excavate trenches to uniform widths to provide the clearances shown on the Drawings.
- B. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape sub-grade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench sub-grade.

3.6 SUBGRADE INSPECTION

- A. Notify Owner's Representative when excavations have reached required sub-grade.
- B. If Owner's Representative determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.
- C. Proof-roll sub-grade with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated sub-grades.
 - 1. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Owner's Representative, and replace with compacted backfill or fill as directed.
- D. Reconstruct sub-grades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Owner's Representative, without additional compensation.

3.7 UNAUTHORIZED EXCAVATION

- A. Fill unauthorized excavation with PADOT No. 2A, or AASHTO No. 57 crushed limestone as directed by Owner's Representative, or common fill if acceptable to the Owner's Representative.

3.8 STORAGE OF SOIL MATERIALS

- A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
 - 1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.9 BACKFILL

- A. Place and compact backfill in excavations promptly, but not before completing the following:
 - 1. Construction below finish grade including, where applicable, sub-drainage, damp-proofing, waterproofing, and perimeter insulation.
 - 2. Surveying locations of underground utilities for Record Documents.
 - 3. Testing and inspecting underground utilities.
 - 4. Removing concrete formwork.
 - 5. Removing trash and debris.
 - 6. Removing temporary shoring and bracing, and sheeting.
 - 7. Installing permanent or temporary horizontal bracing on horizontally supported walls.
- B. Place backfill on subgrades free of mud, frost, snow, or ice.

3.10 UTILITY TRENCH BACKFILL

- A. Place backfill on subgrades free of mud, frost, snow, or ice.

- B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.
- C. Provide 4-inch thick, concrete-base slab support for piping or conduit less than 30 inches (750 mm) below surface of roadways. After installing and testing, completely encase piping or conduit in a minimum of 4 inches of concrete before backfilling or placing roadway subbase.
- D. Place and compact final backfill of satisfactory soil to final subgrade elevation.
- E. Install warning tape directly above utilities, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.11 COMMON FILL

- A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.
- B. Place and compact fill material in layers to required elevations in accordance with the Drawings.
- C. Place soil fill on subgrades free of mud, frost, snow, or ice.

3.12 COMPACTION OF SOIL BACKFILLS AND FILLS

- A. Place backfill and fill soil materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.

3.13 GRADING

- A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
 - 1. Provide a smooth transition between adjacent existing grades and new grades.
 - 2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.
- B. Site Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within tolerances noted on the Drawings.

3.14 AGGREGATE SUB-BASE COURSE

- A. Place sub-base in accordance with PADOT Section 350.

3.15 PROTECTION

- A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

- B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.
 - 1. Scarify or remove and replace soil material to depth as directed by Owner; reshape and re-compact.
- C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.
 - 1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.16 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Disposal: Remove waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Owner's property.
- B. Excess satisfactory soil shall be stockpiled at a designated site chosen by the Owner in accordance with the erosion and sediment control plan.

END OF SECTION 312000

DIVISION 32

SECTION 32 1216

ASPHALT PAVING

GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Aggregate base course
 - 2. Asphalt pavement binder and surface courses.
- B. Related Sections:
 - 1. Division 01: Administrative, procedural, and temporary work requirements.

1.2 REFERENCES

- A. Asphalt Institute (AI):
 - 1. MS-2 - Mix Design Methods for Asphalt Concrete and Other Hot Mix Types.
 - 2. MS-3 - Asphalt Plant Manual.
 - 3. MS-8 - Asphalt Paving Manual.
 - 4. MS-19 - Basic Asphalt Emulsion Manual.
- B. ASTM International (ASTM):
 - 1. C136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregate.
 - 2. D946 - Standard Test Method for Penetration-Graded Asphalt Cement for Use in Pavement Construction.
 - 3. D1188 - Standard Test Method for Bulk Specific Gravity of Compacted Bituminous Mixtures Using Paraffin-Coated Specimens.
 - 4. D2172 - Standard Test Method for Quantitative Extraction of Bitumen from Bituminous Paving Mixtures.
 - 5. D2922 - Standard Test Methods for Determining the Density of Soil and Soil Aggregate in Place by Nuclear Methods (Shallow Depth).

1.3 SUBMITTALS

- A. Submittals for Review:
 - 1. Mix Designs: Indicate composition of each type of asphalt pavement
 - 2. Aggregate base course

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A paving-mix manufacturer registered with and approved by authorities having jurisdiction or the PENNDOT.
- B. Testing Agency Qualifications: Qualified in accordance with ASTM D3666 for testing indicated.
- C. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of City of Pittsburgh or PENNDOT for asphalt paving work.
- D. Obtain materials from same source throughout work.

1.5 PROJECT CONDITIONS

- A. Do not place asphalt when base surface temperature is less than 40 degrees F, or surface is wet or frozen.

PART 2 PRODUCTS

2.1 MATERIALS

A. AGGREGATES

1. General: Use materials and gradations that have performed satisfactorily in previous installations.
2. Coarse Aggregate: ASTM D692/D692M, sound; angular crushed stone, crushed gravel, or cured, crushed blast-furnace slag.
3. Fine Aggregate: ASTM D1073 or AASHTO M 29, sharp-edged natural sand or sand prepared from stone, gravel, cured blast-furnace slag, or combinations thereof.
 - a. For hot-mix asphalt, limit natural sand to a maximum of 20 percent by weight of the total aggregate mass.
4. Mineral Filler: ASTM D242/D242M or AASHTO M 17, rock or slag dust, hydraulic cement, or other inert material.

B. ASPHALT MATERIALS

1. Asphalt Binder: ASTM D6373 or AASHTO M 320 binder designation PG 58-28, PG 64-22, PG 70-22, PG 76-22.
2. Asphalt Cement: ASTM D3381/D3381M for viscosity-graded material ASTM D946/D946M for penetration-graded material.
3. Cutback Prime Coat: ASTM D2027/D2027M, medium-curing cutback asphalt, MC-30 or MC-70, MC-250.
4. Emulsified Asphalt Prime Coat: ASTM D977 or AASHTO M 140 emulsified asphalt, or ASTM D2397/D2397M or AASHTO M 208 cationic emulsified asphalt, slow setting, diluted in water, of suitable grade and consistency for application.
5. Tack Coat: ASTM D977 or AASHTO M 140 emulsified asphalt, or ASTM D2397/D2397M or AASHTO M 208 cationic emulsified asphalt, slow setting, diluted in water, of suitable grade and consistency for application.
6. Fog Seal: ASTM D977 or AASHTO M 140 emulsified asphalt, or ASTM D2397/D2397M or AASHTO M 208 cationic emulsified asphalt, slow setting, factory diluted in water, of suitable grade and consistency for application.
7. Water: Potable.
8. Undersealing Asphalt: ASTM D3141/D3141M; pumping consistency.

C. AUXILIARY MATERIALS

1. Recycled Materials for Hot-Mix Asphalt Mixes: Reclaimed asphalt pavement; reclaimed, unbound-aggregate base material; and recycled tires, asphalt shingles or glass from sources and gradations that have performed satisfactorily in previous installations, equal to performance of required hot-mix asphalt paving produced from all new materials.
2. Herbicide: Commercial chemical for weed control, registered by the EPA, and not classified as "restricted use" for locations and conditions of application. Provide in granular, liquid, or wettable powder form.
3. Sand: ASTM D1073 or AASHTO M 29, Grade No. 2 or No. 3.
4. Joint Sealant: ASTM D6690, Type II or III, hot-applied, single-component, polymer-modified bituminous sealant.

2.2 MIXES

- A. Asphalt material shall be manufactured from approved sources and meet the requirements of Bulletin No. 25 "Specifications for Bituminous Materials", Publication No. 37, current edition.
- B. Asphalt cement shall conform to requirements in Section 702 in the current edition of PennDOT's Pub. 408 for AASHTO MP1, PG 64-22.
- C. Tack coat shall conform to the requirements in Section 460 in the current edition of PennDOT's Pub. 408 for emulsified asphalt, Class AE-T.
- D. Superpave Wearing Surface on all roads shall be Superpave Asphalt Mixture Design, Asphalt Wearing Course, PG64-22, 0 to 0.3 Million ESAL's, 9.5mm Fine Grade complying with requirements in Section 410 in the current edition of PennDOT's Pub. 408. Superpave Scratch and Leveling on all roads shall be Superpave Asphalt Mixture Design Asphalt Wearing Course, PG64-22, 0 to 0.3 Million ESAL's, 9.5mm complying with requirements in Section 413 in the current edition of PennDOT's Pub. 408. The asphalt wearing surface and scratch and leveling course shall incorporate coarse aggregate having a Skid Resistance Level (SRL) designation of "G" or better, supplied from sources approved for this

classification as defined and listed in PennDOT's Bulletin No. 14.

- E. Superpave Binder shall be Superpave Asphalt Mixture Design, WMA Binder Course, PG64-22, 0 to 0.3 Million ESAL's, 19mm mix complying with the requirements in Section 413 in the current edition of PennDOT's Pub. 408.
- F. Superpave Base shall be Superpave Asphalt Mixture Design, HMA Base Course, PG64-22, 0 to 0.3 Million ESAL's, 25mm mix complying with the requirements in Section 413 in the current edition of PennDOT's Pub. 408.
- G. Joint Sealant shall conform to the requirements for AET; Class E-8 emulsified asphalt in Section 413 in the current edition of PennDOT's Pub. 408.

PART 3 EXECUTION

3.1 CONSTRUCTION

- A. Aggregate Base Course:
 - 1. Place to depth after compaction as shown on the drawings.
 - 2. Roller compact to minimum 95 percent. Add small quantities of fine aggregate if necessary to aid compaction.
 - 3. Uniformly grade areas to smooth surface at required grades and elevations. Make grade changes gradually. Blend slopes into level grades.
 - 4. Tolerances: Within plus or minus 1 inch of required elevation.
- B. Primer: Apply to base course and contact surfaces of curbs and abutments at minimum rate of 0.10 to 0.30 gallon per square yard per inch depth.
- C. Asphalt Pavement:
 - 1. Place within 24 hours after applying primer.
 - 2. Minimum compacted thicknesses:
 - a. Binder course: As indicated on drawings
 - b. Surface course: As indicated on drawings
 - 3. Apply tack coat to binder course at minimum rate of 0.05 to 0.15 gallon per square yard.
 - 4. Compact with pneumatic roller, then with steel roller. Do not displace or extrude asphaltic concrete from position. Hand compact in areas inaccessible to rolling equipment.
 - 5. Roll with consecutive passes to achieve uniform, smooth surface, free from roller marks.
 - 6. Construction joints:
 - a. Place mixture as continuous as possible. Roll unprotected edge of freshly laid mixture only when laying is discontinued for such length of time as will allow cooling of mixture.
 - b. When resuming work, cut back previously laid material to produce slightly beveled edge for full depth of course; place fresh mixture against fresh cut.
 - c. Hot smoothing irons may be used for sealing joints; use care to avoid burning surface.
 - d. Construct joints either parallel to or at right angles to longitudinal axis of work.
- D. Installation Tolerances:
 - 1. Maximum surface deviation: Plus or minus 1/4 inch in 10 feet, measured parallel to line of drainage.
 - 2. Maximum deviation from specified thickness: Plus or minus 1/4 inch.

3.2 FIELD QUALITY CONTROL

- A. Testing and Inspection Services:
 - 1. Aggregate base course: Perform field in place density tests, ASTM D1557 or D2922, one test for each 1,000 square yards.
 - 2. Asphaltic concrete:
 - a. Perform one laboratory density and stability test for each day's operation.
 - b. Perform one field in place density test, ASTM D1188, on each type of asphaltic concrete for each day's operation.
 - c. Perform one extraction and gradation test, ASTM D2172, on each type of asphaltic concrete for each day's operation.

- d. Examine pavement to determine whether specified total thickness of asphaltic concrete has been placed, minimum of one core test for each 1,000 square yards of paving.

END OF SECTION 32 1216

**SECTION 32 1313
CONCRETE PAVING**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes exterior cement concrete pavement for the following:
 - 1. Walkways.
 - 2. Curbs.
- B. Related Sections include the following:
 - 1. Division 31 Section "Earthwork" for sub-grade preparation, grading, and sub-base course.
 - 2. Division 32 Section "Pavement Joint Sealants" for joint sealants of joints in concrete pavement and at isolation joints of concrete pavement with adjacent construction.
 - 3. Division 3 Section "Cast-in-Place Concrete" for general building applications of concrete.

1.3 DEFINITIONS

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

1.4 SUBMITTALS

- A. Product Data: For each type of manufactured material and product indicated.
- B. Design Mixtures: For each concrete pavement mixture. Include alternate mixture designs when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
- C. Qualification Data: For testing agency.
- D. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated, based on comprehensive testing of current materials:
 - 1. Aggregates: Include service record data indicating absence of deleterious expansion of concrete due to alkali-aggregate reactivity.
- E. Material Certificates: Signed by manufacturers certifying that each of the following materials complies with requirements:

1. Cementitious materials.
2. Steel reinforcement and reinforcement accessories.
3. Fiber reinforcement.
4. Admixtures.
5. Curing compounds.
6. Applied finish materials.
7. Bonding agent or epoxy adhesive.
8. Joint fillers.
9. Field quality-control test reports.
10. Minutes of pre-installation conference.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Manufacturer of ready-mixed concrete products who complies with ASTM C 94/C 94M requirements for production facilities and equipment.
 1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- B. Testing Agency Qualifications: An independent agency qualified according to ASTM C 1077 and ASTM E 329 for testing indicated, as documented according to ASTM E 548.
 1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-01 or an equivalent certification program.
- C. ACI Publications: Comply with ACI 301, "Specification for Structural Concrete," unless modified by requirements in the Contract Documents.
- D. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.
- E. Mockups: Cast mockups of full-size sections of concrete pavement to demonstrate typical joints, surface finish, texture, color, and standard of workmanship.
 1. Build mockups in the location and of the size indicated or, if not indicated, as directed by Landscape Architect.
 2. Notify Landscape Architect seven days in advance of dates and times when mockups will be constructed.
 3. Obtain Landscape Architect's approval of mockups before starting construction.
 4. Maintain approved mockups during construction in an undisturbed condition as a standard for judging the completed pavement.
 5. Demolish and remove approved mockups from the site when directed by Landscape Architect.
 6. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- F. Pre-installation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."
 1. Before submitting design mixtures, review concrete pavement mixture design and examine procedures for ensuring quality of concrete materials and concrete pavement construction practices. Require representatives, including the following, of each entity directly concerned with concrete pavement, to attend conference:

- a. Contractor's superintendent.
- b. Independent testing agency responsible for concrete design mixtures.
- c. Ready-mix concrete producer.
- d. Concrete pavement contractor.

1.6 PROJECT CONDITIONS

- A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

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 Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.
 - 2. Products: Subject to compliance with requirements, provide one of the products specified.
 - 3. 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.
 - 4. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 FORMS

- A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, smooth exposed surfaces.
 - 1. Use flexible or curved forms for curves with a radius 100 feet or less.
- B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

2.3 STEEL REINFORCEMENT

- A. Plain-Steel Welded Wire Reinforcement: ASTM A 185, fabricated from as-drawn steel wire into flat sheets.
- B. Deformed-Steel Welded Wire Reinforcement: ASTM A 497, flat sheet.
- C. Epoxy-Coated Welded Wire Fabric: ASTM A 884/A 884M, Class A, plain steel.
- D. Reinforcing Bars: ASTM A 615/A 615M, Grade 60; deformed.

- E. Plain Steel Wire: ASTM A 82, as drawn.
- F. Deformed-Steel Wire: ASTM A 496.
- G. Epoxy-Coated-Steel Wire: ASTM A 884/A 884M, Class A coated, plain.
- H. Joint Dowel Bars: Plain steel bars, ASTM A 615/A 615M, Grade 60. Cut bars true to length with ends square and free of burrs.
- I. Epoxy-Coated Joint Dowel Bars: ASTM A 775/A 775M; with ASTM A 615/A 615M, Grade 60, plain steel bars.
- J. Tie Bars: ASTM A 615/A 615M, Grade 60, deformed.
- K. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded wire reinforcement, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete of greater compressive strength than concrete, and as follows:
 - 1. Equip wire bar supports with sand plates or horizontal runners where base material will not support chair legs.
 - 2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.
- L. Epoxy Repair Coating: Liquid two-part epoxy repair coating, compatible with epoxy coating on reinforcement.
- M. Zinc Repair Material: ASTM A 780.

2.4 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source throughout the Project:
 - 1. Portland Cement: ASTM C 150, Type I, white
 - a. Fly Ash: ASTM C 618, Class C.
 - b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.
- B. Normal-Weight Aggregates: ASTM C 33, coarse aggregate, uniformly graded. Provide aggregates from a single source.
 - 1. Maximum Coarse-Aggregate Size: 1 inch nominal.
 - 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- C. Water: ASTM C 94/C 94M.
- D. Air-Entraining Admixture: ASTM C 260.
- E. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material.

1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
2. Retarding Admixture: ASTM C 494/C 494M, Type B.
3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

2.5 CURING MATERIALS

- A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. dry.
- B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- C. Water: Potable.
- D. Evaporation Retarder: Waterborne, monomolecular film forming; manufactured for application to fresh concrete.
- E. Clear Waterborne Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B.

2.6 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber or ASTM D 1752, cork or self-expanding cork.
- B. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

2.7 CONCRETE MIXTURES

- A. Prepare design mixtures, proportioned according to ACI 301, for each type and strength of normal-weight concrete determined by either laboratory trial mixes or field experience.
 1. Use a qualified independent testing agency for preparing and reporting proposed concrete mixture designs for the trial batch method.
- B. Proportion mixtures to provide normal-weight concrete with the following properties:
 1. Compressive Strength (28 Days): 4000 psi.
 2. Maximum Water-Cementitious Materials Ratio at Point of Placement: 0.45.
 3. Slump Limit: 5 inches, plus or minus 1 inch.
- C. Add air-entraining admixture at manufacturer's prescribed rate to result in normal-weight concrete at point of placement having an air content as follows:
 1. Air Content: 4-1/2 percent plus or minus 1.5 percent for 1-inch nominal maximum aggregate size.
- D. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.

- E. Chemical Admixtures: Use admixtures according to manufacturer's written instructions.
- F. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement according to ACI 301 requirements for concrete exposed to deicing chemicals.

2.8 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Furnish batch certificates for each batch discharged and used in the Work.
 - 1. When air temperature is between 85 deg F and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.
- B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Mix concrete materials in appropriate drum-type batch machine mixer.
 - 1. For concrete mixes of 1 cu. yd. or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
 - 2. For concrete mixes larger than 1 cu. yd., increase mixing time by 15 seconds for each additional 1 cu. yd..
 - 3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixing time, quantity, and amount of water added.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.
- B. Proof-roll prepared subbase surface below concrete pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding.
 - 1. Completely proof-roll subbase in one direction and repeat in perpendicular direction. Limit vehicle speed to 3 mph.
 - 2. Proof-roll with a loaded 10-wheel tandem-axle dump truck weighing not less than 15 tons.
 - 3. Subbase with soft spots and areas of pumping or rutting exceeding depth of 1/2 inch require correction according to requirements in Division 2 Section "Earthwork".
- C. Proceed with concrete pavement operations only after nonconforming conditions have been corrected and subgrade is ready to receive pavement.

3.2 PREPARATION

- A. Remove loose material from compacted subbase surface immediately before placing concrete.

3.3 EDGE FORMS AND SCREED CONSTRUCTION

- A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides for pavement to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.
- B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

3.4 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.
- C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.
- D. Install welded wire reinforcement in lengths as long as practicable. Lap adjoining pieces at least one full mesh, and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.
- E. Zinc-Coated Reinforcement: Use galvanized steel wire ties to fasten zinc-coated reinforcement. Repair cut and damaged zinc coatings with zinc repair material.
- F. Epoxy-Coated Reinforcement: Use epoxy-coated steel wire ties to fasten epoxy-coated reinforcement. Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D 3963/D 3963M.
- G. Install fabricated bar mats in lengths as long as practicable. Handle units to keep them flat and free of distortions. Straighten bends, kinks, and other irregularities, or replace units as required before placement. Set mats for a minimum 2-inch overlap of adjacent mats.

3.5 JOINTS

- A. General: Form construction, isolation, and contraction joints and tool edgings true to line with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline, unless otherwise indicated.
 - 1. When joining existing pavement, place transverse joints to align with previously placed joints, unless otherwise indicated.
- B. Construction Joints: Set construction joints at side and end terminations of pavement and at locations where pavement operations are stopped for more than one-half hour unless pavement terminates at isolation joints.
 - 1. Continue steel reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of pavement strips, unless otherwise indicated.
 - 2. Provide tie bars at sides of pavement strips where indicated.
 - 3. Butt Joints: Use bonding agent at joint locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

4. Keyed Joints: Provide preformed keyway-section forms or bulkhead forms with keys, unless otherwise indicated. Embed keys at least 1-1/2 inches into concrete.
 5. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt-coat one-half of dowel length to prevent concrete bonding to one side of joint.
- C. Expansion Joints: Form expansion joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, walks, other fixed objects, and where indicated.
1. Locate expansion joints at intervals of 20 feet, unless otherwise indicated.
 2. Extend joint fillers full width and depth of joint.
 3. Terminate joint filler not less than 1/2 inch or more than 1 inch below finished surface if joint sealant is indicated.
 4. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.
 5. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
 6. Protect top edge of joint filler during concrete placement with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.
- D. Control Joints: Form weakened-plane control joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness, as follows to match jointing of existing adjacent concrete pavement:
1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with grooving tool to a 1/4-inch radius. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover marks on concrete surfaces.
 2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before developing random contraction cracks.
- E. Edging: Tool edges of pavement, gutters, curbs, and joints in concrete after initial floating with an edging tool to a 1/4-inch radius. Repeat tooling of edges after applying surface finishes. Eliminate tool marks on concrete surfaces.

3.6 CONCRETE PLACEMENT

- A. Inspection: Before placing concrete, inspect and complete formwork installation, steel reinforcement, and items to be embedded or cast in. Notify other trades to permit installation of their work.
- B. Remove snow, ice, or frost from subbase surface and reinforcement before placing concrete. Do not place concrete on frozen surfaces.
- C. Moisten subbase to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.
- D. Comply with ACI 301 requirements for measuring, mixing, transporting, and placing concrete.
- E. Do not add water to concrete during delivery or at Project site.

- F. Do not add water to fresh concrete after testing.
- G. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.
- H. Consolidate concrete according to ACI 301 by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.
 - 1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand spreading and consolidation. Consolidate with care to prevent dislocating reinforcement, dowels, and joint devices.
- I. Place concrete in two operations; strike off initial pour for entire width of placement and to the required depth below finish surface. Lay welded wire fabric or fabricated bar mats immediately in final position. Place top layer of concrete, strike off, and screed.
 - 1. Remove and replace concrete that has been placed for more than 15 minutes without being covered by top layer, or use bonding agent if approved by Landscape Architect.
- J. Screed pavement surfaces with a straightedge and strike off.
- K. Commence initial floating using bull floats or darbies to impart an open textured and uniform surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.
- L. Curbs and Gutters: When automatic machine placement is used for curb and gutter placement, submit revised mix design and laboratory test results that meet or exceed requirements. Produce curbs and gutters to required cross section, lines, grades, finish, and jointing as specified for formed concrete. If results are not approved, remove and replace with formed concrete.
- M. Slip-Form Pavers: When automatic machine placement is used for pavement, submit revised mix design and laboratory test results that meet or exceed requirements. Produce pavement to required thickness, lines, grades, finish, and jointing as required for formed pavement.
 - 1. Compact subbase and prepare subgrade of sufficient width to prevent displacement of paver machine during operations.
- N. When adjoining pavement lanes are placed in separate pours, do not operate equipment on concrete until pavement has attained 85 percent of its 28-day compressive strength.
- O. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
 - 1. When air temperature has fallen to or is expected to fall below 40 deg F, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F and not more than 80 deg F at point of placement.
 - 2. Do not use frozen materials or materials containing ice or snow.
 - 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mix designs.

- P. Hot-Weather Placement: Comply with ACI 301 and as follows when hot-weather conditions exist:
1. Cool ingredients before mixing to maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
 2. Cover steel reinforcement with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
 3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

3.7 FLOAT FINISHING

- A. General: Do not add water to concrete surfaces during finishing operations.
- B. Float Finish: Begin the second floating operation when bleed-water sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats, or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.
1. Medium-to-Fine-Textured Broom Finish: Draw a soft bristle broom across float-finished concrete surface perpendicular to line of traffic to provide a uniform, fine-line texture.

3.8 CONCRETE PROTECTION AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
- B. Comply with ACI 306.1 for cold-weather protection.
- C. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.
- E. Curing Methods: Cure concrete by moisture curing, moisture-retaining-cover curing, curing compound, or a combination of these as follows:
1. Moist Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
 - a. Water.
 - b. Continuous water-fog spray.
 - c. Absorptive cover, water saturated and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

3.9 PAVEMENT TOLERANCES

A. Comply with tolerances of ACI 117 and as follows:

1. Elevation: 1/4 inch.
2. Thickness: Plus 3/8 inch, minus 1/4 inch.
3. Surface: Gap below 10-foot-long, unlevelled straightedge not to exceed 1/4 inch.
4. Lateral Alignment and Spacing of Tie Bars and Dowels: 1 inch.
5. Vertical Alignment of Tie Bars and Dowels: 1/4 inch.
6. Alignment of Tie-Bar End Relative to Line Perpendicular to Pavement Edge: 1/2 inch.
7. Alignment of Dowel-Bar End Relative to Line Perpendicular to Pavement Edge: Length of dowel 1/4 inch per 12 inches.
8. Joint Spacing: 3 inches.
9. Contraction Joint Depth: Plus 1/4 inch, no minus.
10. Joint Width: Plus 1/8 inch, no minus.

3.10 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Testing Services: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:

1. Testing Frequency: Obtain at least 1 composite sample for each 5000 sq. ft. or fraction thereof of each concrete mix placed each day.
 - a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mix. Perform additional tests when concrete consistency appears to change.
3. Air Content: ASTM C 231, pressure method; one test for each composite sample, but not less than one test for each day's pour of each concrete mix.
4. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.
5. Compression Test Specimens: ASTM C 31/C 31M; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.
6. Compressive-Strength Tests: ASTM C 39/C 39M; test 1 specimen at 7 days and 2 specimens at 28 days.

- a. A compressive-strength test shall be the average compressive strength from 2 specimens obtained from same composite sample and tested at 28 days.
- C. Strength of each concrete mix will be satisfactory if average of any 3 consecutive compressive - strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
- D. Test results shall be reported in writing to the Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
- E. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Landscape Architect but will not be used as sole basis for approval or rejection of concrete.
- F. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Landscape Architect.
- G. Remove and replace concrete pavement where test results indicate that it does not comply with specified requirements.
- H. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.11 REPAIRS AND PROTECTION

- A. Remove and replace concrete pavement that is broken, damaged, or defective or that does not comply with requirements in this Section.
- B. Protect concrete from damage. Exclude traffic from pavement for at least 14 days after placement. When construction traffic is permitted, maintain pavement as clean as possible by removing surface stains and spillage of materials as they occur.
- C. Maintain concrete pavement free of stains, discoloration, dirt, and other foreign material. Sweep concrete pavement not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION 32 1313

SECTION 32 1313.1

CONCRETE PAVING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Concrete curbs, sidewalk, and paving.
- B. Related Sections:
 - 1. Division 01: Administrative, procedural, and temporary work requirements.
 - 2. Section 03 1000 - Concrete Forms and Accessories.
 - 3. Section 03 2000 - Concrete Reinforcement.
 - 4. Section 03 3000 - Cast-In-Place Concrete.
 - 5. Section 03 3500 - Concrete Finishing.
 - 6. Section 07 9200 - Joint Sealers.

1.2 REFERENCES

- A. ASTM International (ASTM) D1752 - Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.

1.3 SUBMITTALS

- A. Product Data: For each type of product.
- B. Sustainable Design Submittals:
 - Samples for Initial Selection: For each type of product, ingredient, or admixture requiring color selection.
- C. Samples for Verification: For each type of product or exposed finish, prepared as Samples of size indicated below:
 - 1. Exposed Aggregate: 10-lb (4.5-kg) Sample of each mix.
- D. Design Mixtures: For each concrete paving mixture. Include alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Formwork:
 - 1. Specified in Section 03 1000.
 - 2. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, and smooth exposed surfaces.
 - a. Use flexible or uniformly curved forms for curves with a radius of 100 feet (30.5 m) or less.
 - 3. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and that will not impair subsequent treatments of concrete surfaces.
- B. Reinforcement:
 - 1. Specified in Section 03 2000.
 - 2. Plain-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, fabricated from steel wire into flat sheets.
 - 3. Deformed-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, flat sheet.
 - 4. Epoxy-Coated Welded-Wire Reinforcement: ASTM A884/A884M, Class A, plain steel.
 - 5. Reinforcing Bars: ASTM A615/A615M, Grade 60 (Grade 420); deformed.
 - 6. Epoxy-Coated Reinforcing Bars: ASTM A775/A775M or ASTM A934/A934M; with ASTM A615/A615M, Grade 60 (Grade 420) deformed bars.

7. Steel Bar Mats: ASTM A184/A184M; with ASTM A615/A615M, Grade 60 (Grade 420) deformed bars; assembled with clips.
8. Plain-Steel Wire: ASTM A1064/A1064M.
9. Deformed-Steel Wire: ASTM A1064/A1064M.
10. Epoxy-Coated-Steel Wire: ASTM A884/A884M, Class A; coated.
11. Epoxy-Coated, Joint Dowel Bars: ASTM A775/A775M; with ASTM A615/A615M, Grade 60 (Grade 420) plain-steel bars.
12. Tie Bars: ASTM A615/A615M, Grade 60 (Grade 420); deformed.
13. Hook Bolts: ASTM A307, Grade A (ASTM F568M, Property Class 4.6), internally and externally threaded. Design hook-bolt joint assembly to hold coupling against paving form and in position during concreting operations, and to permit removal without damage to concrete or hook bolt.
14. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded-wire reinforcement, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete of greater compressive strength than concrete specified, and as follows:
15. Equip wire bar supports with sand plates or horizontal runners where base material will not support chair legs.
16. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.
17. Epoxy Repair Coating: Liquid, two-part, epoxy repair coating, compatible with epoxy coating on reinforcement.

C. Concrete Materials:

1. Specified in Section 03 3000.
2. Cementitious Materials: Use the following cementitious materials, of same type, brand, and source throughout Project:
 - a. Portland Cement: ASTM C150/C150M, Portland cement Type I/Type II
 - b. Fly Ash: ASTM C618, Class C or Class F.
 - c. Slag Cement: ASTM C989/C989M, Grade 100 or 120.
 - d. Blended Hydraulic Cement: ASTM C595/C595M, Type IS, Portland blast-furnace slag, Type IP, Portland-pozzolan or Type IL, Portland-limestone, Type IT, ternary blended cement.
3. Normal-Weight Aggregates: ASTM C33/C33M, Class 4S, Class 4M, Class 1N, uniformly graded. Provide aggregates from a single source with documented service-record data of at least 10 years' satisfactory service in similar paving applications and service conditions using similar aggregates and cementitious materials.
4. Maximum Coarse-Aggregate Size: 1-1/2 inches (38 mm) nominal.
5. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
6. Exposed Aggregate: Selected, hard, and durable; washed; free of materials with deleterious reactivity to cement or that cause staining; from a single source, with gap-graded coarse aggregate as follows:
 - a. Aggregate Sizes: 3/4 to 1 inch (19 to 25 mm) nominal.
7. Air-Entraining Admixture: ASTM C260/C260M.
8. Chemical Admixtures: Admixtures certified by manufacturer to be compatible with other admixtures and to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material.
9. Water-Reducing Admixture: ASTM C494/C494M, Type A.
10. Retarding Admixture: ASTM C494/C494M, Type B.
11. Water-Reducing and Retarding Admixture: ASTM C494/C494M, Type D.
12. High-Range, Water-Reducing Admixture: ASTM C494/C494M, Type F.
13. High-Range, Water-Reducing and Retarding Admixture: ASTM C494/C494M, Type G.
14. Plasticizing and Retarding Admixture: ASTM C1017/C1017M, Type II.
15. Color Pigment: ASTM C979/C979M, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, free of carbon black, nonfading, and resistant to lime and other alkali s.
16. Water: Potable and complying with ASTM C94/C94M.

2.2 ACCESSORIES

- A. Joint Filler: ASTM D1751, asphalt-saturated Cellulosic fiber ASTM D1752, cork or self-expanding cork or ASTM D8139, semi-rigid, closed-cell polypropylene foam in preformed strips.
- B. Joint Sealers: Specified in Section 07 9200.

PART 3 EXECUTION

3.1 CONSTRUCTION OF FORMS

- A. Construct formwork in accordance with Section 03 1000.
- B. Set forms accurately to required grades and alignment.
- C. Brace forms to withstand loads applied during concrete placement.
- D. Install flexible or curved forms of wood or metal for curves with radius of 300 feet or less.
- E. Leave forms in place for minimum 12 hours after completion of finishing operation.
- F. Provide expansion joints where paving abuts other construction, and at spacings as indicated on Drawings.
 - 1. Shape joint filler to concrete cross section and fasten in place.
 - 2. Provide holes for dowel bars maximum 1/8 inch larger than bar diameter.
 - 3. Use removable strips to provide recess for sealant.

3.2 PLACING REINFORCING

- A. Install reinforcement in accordance with Section 03 2000.
- B. Place reinforcing in middle third of flatwork.
- C. Stop alternate bars of reinforcing steel at control joints.
- D. Provide dowels at maximum 12 inches on center at expansion joints. Wrap one end of dowel in building paper or felt. Stop reinforcement on both sides of joint.

3.3 PLACING CONCRETE

- A. Place concrete in accordance with Section 03 3000.
- B. Place concrete continuously between predetermined expansion and control joints. Do not interrupt successive placement such that cold joints occur.
- C. Shape curbs and gutters to cross section indicated on Drawings.
- D. Strike off flatwork with screed, then float to uniform surface.
- E. Provide broom finish in accordance with Section 03 3500.
- F. Tool expansion joint edges and other exposed edges to smooth, dense surface with 1/8 inch radius.
- G. Provide control joints at spacings as indicated on Drawings.
- H. Installation Tolerances: Surfaces true to plane, in longitudinal direction to required grade, within plus or minus 1/4 inch in 10 feet, noncumulative.
- I. Seal joints as specified in Section 07 9200.

END OF SECTION 32 1313.1

SECTION 32 1373
CONCRETE PAVING JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Expansion and control joints.
 - 2. Joints between concrete and other construction.
- B. Related Sections include the following:
 - 1. Division 32 Section "Concrete Paving" for constructing joints in concrete pavement.

1.3 SUBMITTALS

- A. Product Data: For each joint-sealant product indicated.
- B. Samples for Verification: For each type and color of joint sealant required. Install joint-sealant samples in 1/2-inch- wide joints formed between two 6-inch- long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.
- C. Product Certificates: For each type of joint sealant and accessory, signed by product manufacturer.
- D. Qualification Data: For Installer.
- E. Compatibility and Adhesion Test Reports: From sealant manufacturer, indicating the following:
 - 1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
 - 2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.
- F. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for sealants.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers trained and approved by manufacturer.

- B. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.
- C. Preconstruction Compatibility and Adhesion Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.
 - 1. Use manufacturer's standard test methods to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
 - 2. Submit not fewer than eight pieces of each type of material, including joint substrates, shims, joint-sealant backings, secondary seals, and miscellaneous materials.
 - 3. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
 - 4. For materials failing tests, obtain joint-sealant manufacturer's written instructions for corrective measures including use of specially formulated primers.
 - 5. Testing will not be required if joint-sealant manufacturers submit joint preparation data that are based on previous testing of current sealant products for adhesion to, and compatibility with, joint substrates and other materials matching those submitted.
- D. Product Testing: Obtain test results for "Product Test Reports" Paragraph in "Submittals" Article from a qualified testing agency based on testing of current sealant products within a 36-month period preceding the commencement of the Work.
 - 1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 for testing indicated, as documented according to ASTM E 548.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Project site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration date, pot life, curing time, and mixing instructions for multicomponent materials.
- B. Store and handle materials to comply with manufacturer's written instructions to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: 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.
 - 2. When ambient and substrate temperature conditions are outside limits permitted by joint sealant manufacturer or are below 40 deg F.
 - 3. When joint substrates are wet.
- B. Joint-Width Conditions: Do not proceed with installation of joint sealants where joint widths are less than that allowed by joint sealant manufacturer for application indicated.
- C. Joint-Substrate Conditions: Do not proceed with installation of joint sealants until contaminants capable of interfering with their adhesion are removed from joint substrates.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products listed in other Part 2 articles.
- B. Products: Subject to compliance with requirements, provide one of the products listed in other Part 2 articles.

2.2 MATERIALS, GENERAL

- A. Compatibility: Provide joint sealants, backing materials, 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 Landscape Architect from manufacturer's list of available colors.

2.3 COLD-APPLIED JOINT SEALANTS

- A. Multicomponent Jet-Fuel-Resistant Sealant for Concrete: Pourable, chemically curing elastomeric formulation complying with the following requirements for formulation and with ASTM C 920 for type, grade, class, and uses indicated:
 - 1. Urethane Formulation: Type M; Grade P; Class 12-1/2; Uses T, M, and, as applicable to joint substrates indicated, O.
 - a. Available Products:
 - 1) Pecora Corporation; Urexpam NR-300.
 - 2) Approved equal.
 - 2. Coal-Tar-Modified Polymer Formulation: Type M; Grade P; Class 25; Uses T and, as applicable to joint substrates indicated, O.
 - a. Available Products:
 - 1) Meadows, W. R., Inc.; Sealtight Gardox.
 - 2) Approved equal.
 - 3. Bitumen-Modified Urethane Formulation: Type M; Grade P; Class 25; Uses T, M, and, as applicable to joint substrates indicated, O.
 - a. Available Products:
 - 1) Tremco Sealant/Waterproofing Division; Vulkem 202.
 - 2) Approved equal.

- B. Single-Component Jet-Fuel-Resistant Urethane Sealant for Concrete: Single-component, pourable, coal-tar-modified, urethane formulation complying with ASTM C 920 for Type S; Grade P; Class 25; Uses T, M, and, as applicable to joint substrates indicated, O.
 - 1. Available Products:
 - a. Sonneborn, Div. of ChemRex, Inc.; Sonomeric 1.
 - b. Approved equal.
- C. Type NS Silicone Sealant for Concrete: Single-component, low-modulus, neutral-curing, nonsag silicone sealant complying with ASTM D 5893 for Type NS.
 - 1. Available Products:
 - a. Crafcro Inc.; RoadSaver Silicone.
 - b. Approved equal.
- D. Type SL Silicone Sealant for Concrete and Asphalt: Single-component, low-modulus, neutral-curing, self-leveling silicone sealant complying with ASTM D 5893 for Type SL.
 - 1. Available Products:
 - a. Crafcro Inc.; RoadSaver Silicone SL.
 - b. Approved equal.
- E. Multicomponent Low-Modulus Sealant for Concrete and Asphalt: Proprietary formulation consisting of reactive petropolymer and activator components producing a pourable, self-leveling sealant.
 - 1. Available Products:
 - a. Meadows, W. R., Inc.; Sof-Seal.
 - b. Approved equal.

2.4 HOT-APPLIED JOINT SEALANTS

- A. Jet-Fuel-Resistant Elastomeric Sealant for Concrete: Single-component formulation complying with ASTM D 3569.
 - 1. Available Products:
 - a. Crafcro Inc.; Superseal 444/777.
 - b. Meadows, W. R., Inc.; Poly-Jet 3569.
 - c. Approved equal.
- B. Jet-Fuel-Resistant Sealant for Concrete and Tar Concrete: Single-component formulation complying with ASTM D 3581.
 - 1. Available Products:
 - a. Crafcro Inc.; Superseal 1614A.
 - b. Meadows, W. R., Inc.; Poly-Jet 1614.
 - c. Meadows, W. R., Inc.; Poly-Jet 3406.

- d. Meadows, W. R., Inc.; Poly-Jet 3569.
 - e. Approved equal.
- C. Elastomeric Sealant for Concrete: Single-component formulation complying with ASTM D 3406.
 - 1. Available Products:
 - a. Crafco Inc.; Superseal 444/777.
 - b. Meadows, W. R., Inc.; Poly-Jet 3406.
 - c. Approved equal.
- D. Sealant for Concrete and Asphalt: Single-component formulation complying with ASTM D 3405.
 - 1. Available Products:
 - a. Koch Materials Company; Product No. 9005.
 - b. Koch Materials Company; Product No. 9030.
 - c. Meadows, W. R., Inc.; Sealtight Hi-Spec.
 - d. Approved equal.

2.5 JOINT-SEALANT BACKER MATERIALS

- A. General: Provide joint-sealant backer materials that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by joint-sealant manufacturer based on field experience and laboratory testing.
- B. Round Backer Rods for Cold- and Hot-Applied Sealants: ASTM D 5249, Type 1, of diameter and density required to control sealant depth and prevent bottom-side adhesion of sealant.
- C. Backer Strips for Cold- and Hot-Applied Sealants: ASTM D 5249; Type 2; of thickness and width required to control sealant depth, prevent bottom-side adhesion of sealant, and fill remainder of joint opening under sealant.
- D. Round Backer Rods for Cold-Applied Sealants: ASTM D 5249, Type 3, of diameter and density required to control sealant depth and prevent bottom-side adhesion of sealant.

2.6 PRIMERS

- A. Primers: Product 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.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.

1. 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.
- B. Joint Priming: Prime joint substrates where indicated or where recommended in writing by joint-sealant manufacturer, based on 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.

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 backer materials of type 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 backer materials.
 2. Do not stretch, twist, puncture, or tear backer materials.
 3. Remove absorbent backer materials that have become wet before sealant application and replace them with dry materials.
- D. 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 provided for each joint configuration.
 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- E. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified 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 sealants from surfaces adjacent to joint.
 2. Use tooling agents that are approved in writing by joint-sealant manufacturer and that do not discolor sealants or adjacent surfaces.
- F. Provide joint configuration to comply with joint-sealant manufacturer's written instructions, unless otherwise indicated.
- G. Provide recessed joint configuration for silicone sealants of recess depth and at locations indicated.

3.4 CLEANING

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

3.5 PROTECTION

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

END OF SECTION 32 1373

SECTION 32 1713
PARKING BUMPERS

GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Precast concrete parking bumpers.
- B. Related Sections:
 - 1. Division 01: Administrative, procedural, and temporary work requirements.

1.2 SUBMITTALS

- A. Submittals for Review:
 - 1. Product Data: Provide unit configuration and dimensions.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Concrete Mix:
 - 1. Minimum 3500 PSI, 28 day strength, air entrained to 5 to 7 percent.

2.2 ACCESSORIES

- A. Reinforcing Bars: No. 3 deformed steel.
- B. Dowels: Steel, 1/2 inch diameter x 24 inches long, pointed tip.

2.3 FABRICATION

- A. Use rigid molds, constructed to maintain precast units uniform in shape, size and finish. Maintain consistent quality during manufacture.
- B. Embed two longitudinal reinforcing bars.
- C. Cure units to develop concrete quality, and to minimize appearance blemishes including non uniformity, staining, and surface cracking.
- D. Minor patching in plant is acceptable, providing appearance of units is not impaired.
- E. Nominal Size: 6 inches high x 6 inches deep x 6 feet long.
- F. Provide two vertical fastening holes per unit.
- G. Profile: Rectangular cross section with rounded or canted top, square ends.
- H. Finish: Manufacturer's standard.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Set units in place without damage to shape or finish.
- B. Align adjacent units.
- C. Secure to paving with two dowels per unit.

END OF SECTION 32 1713

SECTION 32 1723

PAVEMENT MARKINGS

GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Painted striping, directional arrows, and letters applied to [asphaltic] [and] [concrete] paving.
- B. Related Sections:
 - 1. Division 01: Administrative, procedural, and temporary work requirements.

1.2 SUBMITTALS

- A. Submittals for Review:
 - 1. Product Data: Include product attributes, performance characteristics, and application instructions.

1.3 PROJECT CONDITIONS

- A. Environmental Requirements: Do not apply paint during rain or at ambient temperatures below 40 degrees F, nor when such conditions are anticipated within 8 hours after application.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers:
 - 1. Benjamin Moore and Co. (www.benjaminmoore.com)
 - 2. PPG Architectural Finishes, Inc. (www.pittsburghpaints.com)
 - 3. Sherwin Williams. (www.sherwin-williams.com)
- B. Substitutions: Under provisions of Division 01.

2.2 MATERIALS

- A. Striping Paint:
 - 1. Type: Chlorinated rubber, Alkyd, Vinyl-latex emulsion, or approved equal, non-bleeding, formulated specifically for painting in vehicular traffic areas.
 - 2. Colors:
 - a. Parking stall striping, directional markings, and restricted parking zone markings: White.
 - b. Accessible parking emblems and paths: In accordance with applicable accessibility code.

2.3 EQUIPMENT

- A. Application Equipment: Pressurized, self contained, capable of applying straight line from 2 to 6 inches wide with consistent coverage.

2.4 MIXES

- A. Mix materials in accordance with manufacturer's instructions.

ART 3 EXECUTION

3.1 PREPARATION

- A. Allow paving to cure minimum time recommended by paint manufacturer prior to applying paint.
- B. Clean paving of grease, oil, and loose and foreign matter that could impair adhesion.
- C. Remove curing compound from new concrete by lightly sandblasting. Minimize sandblasting of surfaces not receiving paint.
- D. Locate markings according to drawings, using guide lines and templates.

3.2 APPLICATION

- A. Apply paint by machine at rates recommended by manufacturer.
- B. Apply paint in [one coat.] [two coats.]
- C. Provide 4 inch wide parking stall stripes.

3.3 PROTECTION

- A. Close areas to traffic until paint is cured.

END OF SECTION 32 1723

SECTION 32 1726

TACTILE WARNING SURFACING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Tactile warning pavers on mortar.
- B. Related Sections:
 - 1. Division 01: Administrative, procedural, and temporary work requirements.
 - 2. Section 04 0513 - Masonry Mortar and Grout.

1.2 REFERENCES

- A. ASTM International (ASTM):
 - 1. C136 - Standard Test Method for Sieve Analysis for Fine and Coarse Aggregate.
 - 2. C140 - Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units.
 - 3. C144 - Standard Specification for Aggregate for Masonry Mortar.
 - 4. C293 - Standard Test Method for Flexural Strength of Concrete (Using Simple Beam With Center-Point Loading).
 - 5. C1028 - Standard Test Method for Determining the Static Coefficient of Friction of Ceramic Tile and Other Like Surfaces by the Horizontal Dynamometer Pull-Meter Method.

1.3 SUBMITTALS

- A. Submittals for Review:
 - 1. Samples: 3 x 3 inch paver samples showing available colors.

1.4 QUALITY ASSURANCE

- A. Products and Installation: Conform to applicable accessibility code.
- B. Installer Qualifications: Minimum 2 years documented experience in work of this Section.
- C. Mockup:
 - 1. Size: Minimum 4 x 4 feet.
 - 2. Show: Paver size, color and surface texture, maximum color range, and joint profile.
 - 3. Locate where directed.
 - 4. Approved mockup may [not] remain as part of the Work.

1.5 PROJECT CONDITIONS

- A. Environmental Requirements:
 - 1. Do not install pavers when surrounding air or substrate surface temperature is below 40 degrees F or above 90 degrees F during or 48 hours after completion of the work.
 - 2. Do not install pavers when wind velocity exceeds 15 MPH or relative humidity exceeds 70 percent.

1.6 WARRANTIES

- A. Furnish manufacturer's warranty providing coverage against cracking, spalling, and fading of pavers.

1.7 MAINTENANCE

- A. Extra Materials: 2 percent extra pavers.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers: Certified ADA compliant manufacturer.
- B. Substitutions: Not permitted.

2.2 MATERIALS

- A. Tactile Warning Pavers:
 - 1. Source: As indicated on the Drawings
 - 2. Description: Polymer composite, ultraviolet stabilized, non-slip, truncated dome pattern.
 - 3. Slip resistance: Combined wet/dry coefficient of friction not less than 0.90, tiles, tested to ASTM C1028.
 - 4. Size: As indicated on the Drawings
 - 5. Color: To be selected from manufacturer's full color range.

2.3 ACCESSORIES

- A. Mortar: Specified in Section 04 0513.

2.4 ACCESSORIES

- A. Cleaner: Type recommended by paver manufacturer.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Set pavers in full mortar bed minimum 3/4 inch thick.
- B. Support pavers over full bearing surface.
- C. Place pavers in block or running bond pattern from straight reference line.
- D. Maintain 3/8 inch joints between pavers and at adjacent construction.
- E. Machine cut units at perimeter and around obstructions. Minimize units less than one-half normal size.
- F. Discard cracked, broken, chipped, stained, and otherwise damaged pavers.
- G. Rake out joints to full depth.
- H. Fill joints with mortar; tool to flush profile.
- I. Allowable Tolerances:
 - 1. Maximum change in plane between adjacent pavers and between pavers and adjacent surfaces: 1/8 inch.
 - 2. Maximum variation from level or indicated slopes: Plus or minus 1/4 inch in 10 feet.

3.2 CLEANING

- A. Protect adjacent surfaces.
- B. Apply cleaner in accordance with manufacturer's instructions.
- C. Thoroughly rinse surfaces with clean water after completion of cleaning; remove all traces of cleaning solution.

END OF SECTION 32 1726

**SECTION 32 1816.13
PLAYGROUND SURFACE SYSTEMS**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Contract 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. Unitary synthetic poured dual density rubber seamless surface
- B. Related Sections:
 - 1. Division 11 Section "Playground Equipment and Structures" for play structures installed only over protective use zones, at appropriate fall heights.
 - 2. Division 31 Section "Site Clearing" for stripping, grubbing, removing topsoil, and protecting trees to remain.
 - 3. Division 31 Section "Earthwork" for excavation, filling, and grading work, including compacted subgrades and subbase courses, and dewatering.

1.3 DEFINITIONS

- A. CPSC: U.S. Consumer Products Safety Commission
- B. Critical Height: Standard measure of shock attenuation. According to Consumer Products Safety Commission (CPSC) No. 325, this means "the fall height below which a life-threatening head injury would not be expected to occur."
- C. SBR: Styrene-butadiene rubber.
- D. EPDM: Ethylene propylene diene terpolymer rubber.
- E. EWF: Engineered Wood Fiber; natural processed wood product manufactured expressly for use as a playground surface.
- F. IPEMA: International Play Equipment Manufacturer's Association.
- G. Use Zone: According to ASTM F 1487, this means "the area beneath and immediately adjacent to a play structure that is designated for unrestricted circulation around the equipment and on whose surface it is predicted that a user would land when falling from or exiting the equipment."

1.4 REFERENCES

- A. ASTM F 1292-13 or latest version Specification for Impact Attenuation of Surfacing Materials within the Uses Zone of Playground Equipment.

- B. Accessibility of Surface Systems: According to ASTM F 1951-13 or latest version..
- C. Minimum Characteristics for EWF Surfaces: According to ASTM F 2075, ASTM 2223, ASTM F 2479, ASTM F 1292, and ASTM F 1951.
- D. United States Department of Justice – Americans with Disabilities Act (ADA) Standards for Accessible Design, latest edition.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Manufacturer's written instructions for recommended maintenance practices.
- C. Shop Drawings: For each playground surface system, include materials, plans, cross sections, drainage, installation, and edge termination. Include patterns made by varying colors of surfacing. Include details of graphics.
- D. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:
 - 1. Extent of surface systems and use zones for equipment.
 - 2. Critical heights for playground surfaces and fall heights for equipment.
- E. Samples for Initial Selection:
 - 1. Include similar samples of playground surface system and accessories involving color selection.
- F. Samples for Verification: For each type of playground surface system indicated.
 - 1. Minimum 4 inch disc Sample of synthetic rubber seamless surface.
- G. Product Schedule: For playground surface systems. Use same designations indicated on Drawings.
- H. Qualification Data: For qualified Installer and testing agency.
- I. Material Certificates: For each type of playground surface system, from the manufacturer.
- J. MSDS and Product data sheets for items in Part-2 Products.
- K. Material Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each playground surface system.
- L. Product Certificates: For each type of playground surface system, from the manufacturer, including IPEMA.
- M. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each playground surface system. Specific Testing to include:
 - 1. ASTM 1028 Skid Resistance Test
 - 2. Test results from a Zenon Arc Weatherometer exposure test from a third party shall be submitted by the installer prior to the installation of the surface. The surfacing system

(pebbles and binder) shall be tested for a minimum of 10,000 hours and show no less than a 15% tensile strength (PSI) degradation.

3. ASTM 1292 – If critical fall height is required, impact attenuation test results shall be submitted to the requiring agency prior to installation of the surface. The results shall be submitted on the letterhead of the independent testing lab. Impact attenuation results must comply with ASTM 1292 Standard Specification for Impact Attenuation of Surface Systems Under and Around Playground Equipment for the critical fall height of equipment.

- N. Compliance audit report verifying the playground surface systems meet playground safety standards and accessibility.
- O. Warranty: Sample of special warranty.
- P. Operation and Maintenance Manual: See Division 01 Section "Operation and Maintenance Data" for manual requirements.
- Q. The Installer shall submit a minimum of three (3) similar projects of scope, scale, and material.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers trained and approved by manufacturer. Installer's Site Superintendent is to have a minimum of five (5) years of experience installing similar materials on similarly scaled projects.
- B. Source Limitations: Obtain playground surface system materials, including primers and binders, from single source from single manufacturer.
 - 1. Provide secondary materials including adhesives, primers, and geotextiles, and repair materials of type and from source recommended by manufacturer of playground surface system materials.
- C. Standards and Guidelines: Comply with CPSC No. 325, "Handbook for Public Playground Safety"; IPEMA-certified product, ASTM F 1292; and ASTM F 1487.
- D. Color: All colors of surfacing shall be as specified in the Contract Documents. Colors shall be uniform in appearance. In the case of color percentages of material, the mixtures of color shall be uniform and consistent.
- E. Compliance Audit: The Contractor shall have third-party testing to verify compliance on all playground surface systems installed within the playground. Audit and testing shall verify:
 - 1. Impact attenuating surface complies with ASTM F 1292.
 - 2. Distances, spacing, and transitions comply with playground safety standards, ASTM F 1951, and ADA.
- F. Standards and Guidelines: Comply with CPSC No. 325, "Handbook for Public Playground Safety"; ASTM F 1292; and ASTM F 1487.

1.7 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit playground surface system installation to be performed according to

manufacturers' written instructions and warranty requirements. Temperature should be 40 degrees and rising during the installation period. The installer shall have sole discretion based off of their judgment to proceed or to halt the installation based on their judgment.

1.8 WARRANTY

- A. Playground Protective Surfacing shall be warranted for a period of one (1) year after date of Substantial Completion. Warranty shall not cover defects resulting from lack of adequate maintenance, neglect, or abuse by City staff, hail, or incidents that are beyond the Contractor's control.
- B. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of playground surface system that fail in materials or workmanship within the specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Reduction in impact attenuation.
 - b. Deterioration of surface and other materials beyond normal weathering.

PART 2 - PRODUCTS

2.1 UNITARY SYNTHETIC DUAL-DENSITY SEAMLESS SURFACE

- A. Surface System: Poured-in-place, two (2) layer system with wearing course over cushion course. Provide manufacturer's standard thickness for each layer as required for overall thickness indicated, IPEMA- certified product or tested for impact attenuation according to ASTM F 1292 and for accessibility according to ASTM F 1951.
 - 1. Products: Subject to compliance with requirements. Provide the following product or approved equal.
 - a. PebbleFlex 2.0 surfacing system by Landscape Structures; 601 7th Street South Delano, MN 55238 p. 888-438-6574 f. 763-972-3185 <https://www.playlsi.com/>
 - 2. Top Layer: PebbleFlex 2.0 aliphatic thermoplastic polyurethane Pebbles. Black material, if included must be an aliphatic thermoplastic polyurethane pebble and not a rubber such as EPDM or TPV.
 - 3. Impact Layer: The impact layer is to be made of rubber. The rubber is to be select SBR rubber strands of not more than 1" in length.
 - 4. Equal Materials: The PebbleFlex 2.0 pebbles are an aliphatic thermoplastic polyethylene pebble. The system is 100% color throughout. The PebbleFlex 2.0 binder is 100% solids aliphatic. Any equal product must be urethane based, not rubber based such as EPDM or TPV, must include an aliphatic polyurethane binder and must be 100% color throughout. Any black rubber based material is not considered equal.
 - 5. Finish Texture: Pebble grain.
 - 6. Critical Height: As indicated on the Contract Drawings.
 - 7. Overall Thickness: Not less than as indicated on the Contract Drawings.
 - 8. Primer/Adhesive: Manufacturer's standard primer and weather-resistant, moisture-cured polyurethane adhesive suitable for unit, substrate, and location indicated.
 - 9. Color(s): Brown

- B. Leveling and Patching Material for Use on Concrete Substrate Below Synthetic Play Surface: Portland cement-based grout or epoxy- or polyurethane-based formulation suitable for exterior use and approved by playground surface system manufacturer.

2.2 DRAINAGE

- A. See Division 33 Section "Sub-drainage Systems".

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for maximum moisture content, sub-grade and substrate conditions, drainage, and other conditions affecting performance of the Work.
- B. Surface Substrates: Verify that substrates are satisfactory for unitary playground surface system installation and that substrate surfaces are dry, cured, and uniformly level or sloped to drain within recommended tolerances according to playground surface system manufacturer's written requirements for cross-section profile.
 - 1. Concrete Substrates: Verify that substrates are dry, free from surface defects, and free of laitance, glaze, efflorescence, curing compounds, form-release agents, hardeners, dust, dirt, loose particles, grease, oil, and other contaminants incompatible with playground surface system or that may interfere with adhesive bond. Determine adhesion, dryness, and acidity characteristics by performing procedures recommended in writing by playground surface system manufacturer.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. General: Prepare substrates to receive surfacing products according to playground surface system manufacturer's written instructions. Verify that substrates are sound and without high spots, ridges, holes, and depressions.
- B. Concrete Substrates: Provide sound supportive surface for playground surface system.
 - 1. Repair unsatisfactory surfaces and fill holes and depressions.
 - 2. New or existing concrete
 - a. If applying directly to concrete, concrete must be cured for at least 28 days.
 - b. If an SBR layer is used between the concrete and safety surface, then the concrete must be cured for at least 14 days.
 - c. New concrete must be light broom finish and can be prepared simply by acid etching.
 - 3. Saw cut concrete for terminal edges of playground surface systems as indicated.
 - 4. Treat control joints and other non-moving substrate cracks to prevent telegraphing through playground surface system.

- C. Surface Preparation: Concrete must have adequate drains to prevent water from backing up into the surface.

3.3 GENERAL INSTALLATION

- A. General: Comply with playground surface system manufacturer's written installation instructions. Install playground surface system over area and in thickness indicated.

3.4 DRAINAGE SYSTEMS

- A. Install drainage systems as indicated on Contract Drawings, Details, and per Division 33 Section "Sub-drainage Systems".

3.5 INSTALLATION

- A. Thickness: The total depth of the surface shall be installed in strict accordance and conformity to the Manufacturer's drawings and these specification requirements. Surface thickness will vary in the impact layer. Thickness of the impact layer will be installed according to the fall height(s) of the play equipment. These requirements must be verified in the field prior to starting the installation of the impact layer.
- B. Impact Cushion Layer: The impact layer is to be made of rubber. The SBR rubber is to be a strand of not more than 1 inch in length. The manufacturer's minimum depth of greater shall be installed as required by the fall height(s) required by the playground equipment that exists or is to be installed and to meet the test results of the finished surface as expressly required within this specification.

For surrounding curbing, prime the vertical surface of the curbing using the SBR binder. Mix one fifty-pound bag of SBR buffing with 8.14 pounds of aromatic polyurethane binder so that the buffing are covered evenly. Spread the mix and trowel to the appropriate depth. Let cure.

- C. Top Layer: The overall thickness shall be no less than 3/8" and be composed of PebbleFlex 2.0 material with an aliphatic polyurethane binder supplied by the manufacturer.
 - 1. Mixing and Finishing: Dry mix 100 pounds of PebbleFlex 2.0 Pebbles (50 large/50 small) in a mortar mixer. After thorough mixing, add 15 pounds of binder to the dry pebbles in the mortar mixer. Mix thoroughly so that each pebble is covered evenly. Dump the mix onto the surface and spread it at a minimum thickness of 3/8", keeping the surface as level as possible. Hand or power trowel using a solution of soapy water to spray the surface of the trowel. This will allow easier manipulation of the trowel. Let the surface set for 72 hours.
 - 2. High Wear Areas: Under all high wear areas, such as under slides and swings increase the PebbleFlex 2.0 layer to 1/2".
- D. Large Areas: All areas in excess of 1,800 square feet, or areas that require adjacent color pours due to designs, shall have this work done in strict accordance with the manufacturer's installation requirements with adjacent poured layer surfaces being flush throughout.

3.6 CLEANING

- A. The contractor shall clean the job site and remove any excess materials.

- B. The contractor shall instruct the Owner's personnel on proper maintenance and repair of PebbleFlex 2.0 surface.

END OF SECTION 32 1816

SECTION 32 3113

CHAIN LINK FENCES AND GATES

GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Fence framework, fabric, and accessories.
 - 2. Excavation for posts.
 - 3. Concrete post foundations.
 - 4. Gates and hardware.
- B. Related Sections:
 - 1. Division 01: Administrative, procedural, and temporary work requirements.
 - 2. Section 03 3000 - Cast-In-Place Concrete.

1.2 REFERENCES

- A. ASTM International (ASTM) C94 - Standard Specification for Ready-Mixed Concrete.
- B. Chain Link Fence Manufacturers Institute (CLFMI) - Product Manual.

1.3 SYSTEM DESCRIPTION

- A. Fence Height: As indicated on Drawings

1.4 SUBMITTALS

- A. Submittals for Review:
 - 1. Shop Drawings: Include layout, spacing of components, post foundation dimensions, hardware, and schedule of components.
 - 2. Samples: 6 x 6 inch fabric samples illustrating construction and finish.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers:
 - 1. Ameristar. (www.ameristarfencing.com)
 - 2. Master-Halco, Inc. (www.fenceonline.com)
 - 3. Merchants Metals. (www.merchantsmetals.com)
 - 4. Perfection Fence Corp. (www.perfectionfence.com)
 - 5. Southwestern Wire, Inc. (www.southwesternwire.com)
- B. Substitutions: Under provisions of Division 01.

2.2 MATERIALS

- A. Materials and Components: Conform to CLFMI Product Manual.
- B. Framing:
 - 1. Intermediate posts: Type I - round.
 - 2. Terminal, corner, rail, brace, and gate posts: Type I - round.
 - 3. Framing sizes: Per CLFMI Product Manual.
 - 4. Finish: PVC coating over metallic coating, to CLFMI Product Manual.
- C. Fabric:
 - 1. Classification: CLFMI Standard Residential service.
 - 2. Finish: PVC coating over metallic coating, to CLFMI Product Manual.

2.3 ACCESSORIES

- A. Post Caps:[Cast steel or malleable iron, galvanized, sized to post diameter.
- B. Concrete: Specified in Section 03 3000.
- C. Hinged Gate Hardware:
 - 1. Two hinges per gate leaf, sized to gate weight and conditions.
 - 2. Fork latch with gravity drop [and padlock provisions].
 - 3. Center gate stop and drop rod for double gates.
- D. Sliding Gate Hardware: Cantilevered type.

2.4 FABRICATION OF GATES

- A. Fabricate to CLFMI Product Manual.
- B. Welded or Fitting and truss rod frame construction.

2.5 FINISHES

- A. Framing: Owner to select color.
- B. Fabric: Owner to select color.
- C. Hardware and Fittings: Color to match framing.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install fencing in accordance with CLFMI Product Manual.
- B. Space posts maximum 8 feet on center.
- C. Drill post holes into undisturbed or compacted soil, with diameter equal to 3 times post diameter.
- D. Set posts minimum 36 inches below grade, with bottom of hole 3 inches below bottom of post. Excavate deeper in soft or loose soils and for posts with heavy lateral loads.
- E. Place concrete around posts in continuous pour, tamp and dome top away from post. Check for vertical and top alignment; brace posts until concrete has set.
- F. Pour top of footings 2 inches below finished grade.
- G. Stretch panels taut and secure to posts with wire post brackets.
- H. Install gates plumb and level. Adjust for smooth operation.

3.2 INSTALLATION TOLERANCES

- A. Maximum Variation from Plumb: 1/4 inch in 10 feet.
- B. Maximum Offset from True Position: 1 inch.

END OF SECTION

SECTION 32 3119
DECORATIVE METAL FENCES AND GATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes exterior cement concrete pavement for the following:
1. Fences
 2. Gates
- B. Related Sections include the following:
1. Division 31 Section "Earthwork" for subgrade preparation, grading, and subbase course.
 2. Division 32 Section "Pavement Joint Sealants" for joint sealants of joints in concrete pavement and at isolation joints of concrete pavement with adjacent construction.
 3. Division 3 Section "Cast-in-Place Concrete" for general building applications of concrete.

1.3 REFERENCES

- A. **ASTM STANDARDS:** American Society for Testing and Materials
1. A121 - 19 Standard Specification for Metallic-Coated Carbon Steel Barbed Wire
 2. A123 / A123M - 17 Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products A153 / A153M - 16a Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
 3. A500 / A500M - 18 Standard Specification for Cold Formed Welded and Seamless Carbon Steel Structural Tubing in Round
 4. Shapes.
 5. A505 - 16 Standard Specification for Steel, Sheet and Strip, Alloy, Hot-Rolled and Cold-rolled , General Requirements A513/A513M - 19 Standard Specification for Electric-Resistance - Welded Carbon and Alloy Steel Mechanical Tubing A641/A641M - 09a (2014) Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire.
 6. A653/A653M - 19 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
 7. A659/A659M - 18 Standard Specification for Commercial Steel (CS), Sheet and Strip, Carbon (0.16 Maximum to 0.25 Maximum Percent), Hot-Rolled
 8. A787/A787M - 15a Standard Specification for Electric-Resistance-Welded Metallic-coated Carbon Steel Mechanical Tubing A853 - 24 (2017) Standard Specification for Steel Wire, Carbon, for General Use
 9. A1008 / A1008M - 18 Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Harden-able
 10. A1064 / A1064M - 18a Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
 11. B6 - 18 Standard Specification for Zinc

12. B22 - 14 Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes and Tubes. D2247 - 15 Standard Practice for Testing Water Resistance of Coatings in 100% Relative Humidity.
13. D2794 - 93 (2014) Standard Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact). D3359 - 17 Standard Test Methods for Measuring Adhesion by Tape.
14. F626 - 14 (2019) Standard Specification for Fence Fittings
15. F900 - 11 (2017) Standard Specification for industrial and commercial swing gates.
16. F934 - 96 (2017) Standard Specification for Standard Colors for Polymer-Coated Chain Link Fence Materials. F1043 - 18 Standard Specification for Strength and Protective Coatings on Steel Industrial Chain Link Fence
17. Framework.
18. F1184 - 16 Standard Specification for industrial and commercial horizontal slide gates.
19. F2919 / F2919M - 12 (2018) Standard Specification for Welded Wire Mesh Fence Fabric (Metallic-Coated or Polymer Coated) with Variable Mesh Patterns or Meshes Greater than 6 in² [3871 mm²] in Panels
20. F2957 - 13(2019)e1 Standard Specification for Ornamental Aluminum Fence Systems

1.4 SUBMITTALS

- A. Product Data: Material descriptions, dimension of individual components and profiles, and finishes for the following:
 1. Fence, gate posts, brackets, rails and fittings.
 2. Gates and hardware.
- B. Shop Drawings: In accordance to Section 01 33 00:
 1. Show locations of fence, each gate, posts, rails, and details of gate swing direction, or other operation, hardware, and accessories.
 2. Indicate materials, dimensions, sizes, weights, and finishes of components.
 3. Include plans, elevations, sections, gate swing direction and other required installation and operational clearances, and details of post anchorage, attachment and bracing.
 4. Installation recommendations and instructions by manufacturer describing all details for a typical fence and gates.
- C. Verification Samples: For each finish product specified, two (2) samples, minimum size 6 in long, representing actual standard/optional color or color chips for custom color.
- D. 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 Landscape Architects and owners, and other information specified.
- E. Maintenance Data: Material Safety Data Sheet available upon request.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has completed installations of fences and gates similar in material, design, and extent to those indicated for this project and whose work has resulted in construction with a record of successful in-service performance.

- B. Source Limitations for Fences and Gates: Obtain each color, grade, finish, type, and variety of components for fences and gates from one source with resources to provide fences and gates of consistent quality in appearance and physical properties.

1.6 PROJECT CONDITIONS

- A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
 - 1. Notify local utility making services before beginning work.
 - 2. Unless otherwise indicated in the general provisions of the contract, notify the Landscape Architect no less than two (2) days in advance of proposed utility interruptions.
 - 3. Do not proceed with utility interruptions without Landscape Architect's written permission.
- B. Field Measurements: Verify layout information for fences and gates shown on drawings in relation to property survey and existing structures. Verify dimensions by field measurements.

PART 2 - PRODUCTS

2.1 MANUFACTURER

- A. Omega II Fence Systems 1735 St-Elzéar west, Laval (Quebec), Canada H7L 3N6
p. 800-836-6342 f. 450-681 customerservice@omegatwo.com www.omegatwo.com or approved equal.
 - 1. Requests for substitutions will be considered in accordance with provisions of Section 01 60 00 - Product Requirement:
 - a. All substitution approval requests shall be accompanied by manufacturing drawings and specifications, and they shall meet all specifications for design, size, gauge of metal parts, and fabrication.

2.2 COATINGS

- A. Zinc coating:
 - 1. Wire meshes are coated with 0.5 oz/ft² zinc in conformity with ASTM A641 Class 1.
 - 2. Square fence posts, swing gate frame and posts:
 - a. Thickness of 11GA or less: Zinc coated (pre-galvanized process) with a minimum of 0.9 oz/ft² as per ASTM A653 Grade 90.
 - b. Thickness over 1/8 in: Coated with a minimum of 2.3 oz/ft² zinc (hot-dip galvanizing) in conformity with ASTM A123 Grade 100.

- B. Zinc coating:

1. Wire meshes are coated with 0.5 oz/ft² zinc in conformity with ASTM A641 Class 1.
 2. Square fence posts, swing gate frame and posts:
 - a. Thickness of 11GA or less: Zinc coated (pre-galvanized process) with a minimum of 0.9 oz/ft² as per ASTM A653 Grade 90.
 - b. Thickness over 1/8 in: Coated with a minimum of 2.3 oz/ft² zinc (hot-dip galvanizing) in conformity with ASTM A123 Grade 100.
- C. Polyester Coating: Polyester coating to be minimum 4 mils applied by an electrostatic process. Coating shall cover all surfaces of the wire and post sections. Coating shall be capable of withstanding the following tests:
1. Mechanical adhesion test as per ASTM D3359 - Method B.
 2. Shock resistance tests as per ASTM D2794.
 3. Salt spray testing with a minimum of 1 000 hours without red rust appearance, as per ASTM B117.
 4. Humidity resistance in a weather meter chamber as per ASTM D2247.
 5. Exposure to ultraviolet light with exposure of 1 000 hours using apparatus Type E and 63°C as per ASTM D1499.
- D. Polyester Surface Coating Colors:
1. Standard Coating: Black, RAL 9004 (30% Gloss).

2.3 MATERIALS

- A. Panel Height:
1. 5-foot-high nominal panels: 61-1/8 in.
- B. Model "OMEGA LANDSCAPE ARCHITECTURAL" – Steel Mesh Fence Panels:
1. 92-11/16 in wide, welded by resistance using 6 gauge (0.192 in) pre-galvanized steel wire, welded at each crossing to form rectangles 1-15/16 in x 6 in.
 2. Cold rolled annealed wire made of AISI Grade 1018 steel with tensile strength of at least 75 000 psi in accordance with ASTM A853.
 3. One end of the vertical wires of the panel shall extend 1 in from the last or the first horizontal wire to create a spiked top or bottom depending on installed position. The other end is cut flush.
 4. Panels shall have the following number of folds based on the panel height:
 - a. 5-foot-high nominal panels: 2 folds.
 5. Panel camber may not exceed 0.094 in.
- C. Square Posts: Cold rolled 1008 grade steel to meet ASTM A500 and ASTM A787 and the following maximum horizontal loads, length as required for installation type:
1. The length of the posts is minimum 36 in more than the actual height of the fence for installation in the ground depending on local land code requirements (frost line).
 2. Installation

- a. In ground, post length as required for local frost line requirements
3. Post Size
 - a. For 5-foot-high nominal panels

Post Size	Gauge	Maximum horizontal load
2 in x 2 in	16	263 pounds
	11	463 pounds
3 in x 3 in	11	1,106 pounds

D. Post Brackets

1. Universal Collar Bracket Kit: Universal bracket for standard use on line or end posts 2 in or 3 in. Includes the following: 14 gauge steel collar and wire retaining plate 1/4 in x 1 in, nut, washer and carriage bolt 5/16 in x 1-1/2 in, all galvanized steel.
 - a. For 90° turn, use the same bracket
 - b. For different angles, used the “Universal collar angle brackets”.
 - c. For 5-foot-high nominal panels: Provide 6 brackets per panel.

E. Post caps:

1. Aluminum alloy: For dimension posts 2 in x 2 in, 3 in x 3 in and 4 in x 4 in.
2. Galvanized steel: For larger dimensions.

2.4 SINGLE/DOUBLE GATES

A. Configuration:

1. Single Swing.

B. Gate Frames:

1. Two (2) 1-1/2 in x 1-1/2 in horizontal tubes and two (2) 2 in x 2 in vertical tubes, all 16 gauge tubes, welded at intersections to create a rigid frame, in accordance with ASTM F900.

C. Gate Posts: Cold rolled from 1008 grade steel to meet ASTM A500 and ASTM A787. Posts are to include cap and SPF-W Kit for adjacent panel mounting. Length as required for installation

type:

1. Installation
 - a. In ground, post length as required for local frost line requirements
2. Post Size
 - a. For 5-foot-high nominal panels

Opening Dimension	Post Size
3 ft to 9 ft	3 in x 3 in, 11 gauge
> 9 ft to 13 ft	4 in x 4 in, 11 gauge
> 13 ft to 19 ft	6 in x 6 in, 11 gauge

D. Gate Hardware:

1. Standard Hardware: Hot-dip galvanized steel in conformity with ASTM F900, sized to assure proper gate operation. Non-moving parts shall be powder coated.
 - a. Hinge: Structurally designed to support all gates without deformation during opening and closing.
 - b. Latch: Clamp-on gravity system that is self latching. Includes the following:
 - 1) Self-locking Device: With padlock eyes as an integral part of latch.

E. Additional Hardware

1. Drop bar: Secure gate in open position, with stop pipe to engage the center drop rod.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for a verified survey of property lines and legal boundaries, site clearing, earthwork, pavement work, and other conditions affecting performance.
- B. Do not begin installation before final grading is completed, unless otherwise permitted by Landscape Architect.

- C. 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 ft or line of sight between stakes. Indicate locations of utilities, lawn sprinkler system, underground structures, benchmarks, and property monuments.

3.3 IN-GROUND CONCRETE INSTALLATION

- A. Install fencing on established boundary lines inside property line
- B. Post Excavation: Drill or hand-excavate holes for posts to diameters and spacing indicated, in firm, undisturbed or compacted soil.
- C. Post Setting: Set posts in concrete footing. Protect portion of posts above ground from concrete splatter. Place concrete around posts and consolidation. Using mechanical devices to set posts is not permitted. Verify that posts are set plumb, aligned, and at correct height and spacing, and hold in position during placement and finishing operations until concrete is sufficiently cured. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.
 - 1. Dimensions and Profile: As indicated on Drawings.
 - 2. Space line posts uniformly at center to center.
 - 3. Exposed Concrete Footings: Extend concrete 2 in above grade. Smooth and shape to shed water.
 - 4. Posts Set into Concrete in Sleeves: Use steel pipe sleeves pre-set and anchored into concrete for installing posts. After posts have been inserted into sleeves, fill annular space between post and sleeve with non shrink, non-metallic 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 in deep and 3/4 in larger than OD of post. Clean holes of loose material, insert posts, and fill granular space between post and concrete with non- shrink, non-metallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions, and finished sloped to drain water away from post.
 - 6. Flange Post Installation: Bolt mounting plates attached to each post to slab or structure as indicated, using expansion bolts.

3.4 FENCE INSTALLATION

- A. Model "OMEGA LANDSCAPE ARCHITECTURAL"
- B. Install the fence along the specified layout according to the drawings. The fence panel shall be installed to maintain a clear minimum distance of 1-1/4 in and a maximum distance of 2 in from the ground surface. Holes for posts shall be at least 8 in diameter and at least 42 in deep.

- C. Posts shall be adequately supported within the concrete forms to maintain the required positioning and prescribed level until concrete has set. All necessary anchors and posts shall be at a minimum depth of 36 in into the ground.
- D. Square Post Installation: Once the concrete is set, the fence sections are fastened to the posts with the desired bracket type.
 - 1. Universal Collar Bracket Kit: Brackets slot allows for adjustments of $\pm 1\text{-}1/2$ in on each side. Always install the brackets flush with horizontal wire of the panel (no gap).

Post Size	Post Spacing C/C
2 in x 2 in	97-11/16 in
3 in x 3 in	98-11/16 in

- E. For the fence to follow slopes, it is required to step the fence sections. The Universal bracket on square posts can be slid along the post at the desired height and should always be install flush with horizontal wire (no gap). When faced with a steep slope, it will be necessary to order longer posts and panels cut in half as to keep the gap under the panel to a minimum.
- F. Upon cutting or trimming a post or a wire mesh section, apply a zinc rich primer to the exposed ends and finish with the matching touch-up paint supplied by the manufacturer.
- G. Panels must be installed as instructed by client:
 - 1. Spikes pointing up or down for safety
 - 2. Bents facing inwards or outwards the field

3.5 GROUTING AND ANCHORING CEMENT

- A. Non-shrink, Non-metallic Grout: Premixed, factory-packaged, non-staining, noncorrosive, non-gaseous grout complying with ASTM C1107. Provide grout, recommended in writing by manufacturer, for exterior applications.
- B. Erosion-Resistant Anchoring Cement: Factory-packaged, non-shrink, non-staining, 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.

3.6 GATE INSTALLATION AND ADJUSTMENT

- A. Install gate posts in accordance with manufacturer's instructions.
- B. Concrete Set Gate Posts: Drill holes in firm, undisturbed or compacted soil. Holes shall have a diameter 4 times greater than outside dimension of post, and depths approximately 6 in deeper than frost level. Excavate deeper as required for adequate support in soft and loose soils, and for posts with heavy lateral loads. Set post bottom 36 in below surface when in firm, undisturbed

soil. Place concrete around posts in a continuous pour, tamp for consolidation. Trowel finish around post and slope to direct water away from posts. Check each post for vertical and top alignment and maintain in position during placement and finishing operations.

- C. Install gates perfectly horizontal and leveled (at junction), plumb, and secure for full opening without interference.
- D. Attach hardware so to have the nuts inside the property thus making the assembly tamper-proof which will prevent unauthorized removal. Install ground-set items in concrete for anchorage.
- E. Adjust hardware for smooth operation and lubricate where necessary 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.

3.7 GROUNDING AND BONDING

- A. Fence Grounding: Install at maximum intervals of 1,500 ft except as follows:
 - 1. Fences within 100 ft of Buildings, Structures, Walkways, and Roadways: Ground at maximum intervals of 750 ft.
 - 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 in below finished grade.
 - 3. Conductors: Bare, solid wire for No. 6 AWG and smaller; stranded wire for No. 4 AWG and larger.
 - a. Material Above Finished Grade: Copper.
 - b. Material on or below Finished Grade: Copper.
 - c. Bonding Jumpers: Braided copper tape, 1 in wide, woven of No. 30 AWG bare copper wire, terminated with copper ferrules.
 - 4. Connectors and Ground Rods: Listed in UL 467.
 - a. Connectors for Below-Grade Use: Exothermic welded type.
 - b. Ground Rods: Copper-clad steel. Size: 5/8 in by 96 in.
- B. Protection at Crossings of Overhead Electrical Power Lines: Ground fence at location of crossing and at a maximum distance of 150 ft 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 in below finished grade. Connect rod to fence with No. 6 AWG conductor. Connect conductor to each fence component at the grounding location.
- 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 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.

3.8 FIELD QUALITY CONTROL - GROUNDING

- 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 (2) 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. Desired Maximum Grounding Resistance Value: 25 ohms. Excessive Ground Resistance: If resistance to ground exceeds desired value, notify Landscape Architect promptly. Include recommendations to reduce ground resistance and proposal to accomplish recommended work.
- C. 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.

3.9 SITE CLEANING

- A. Clean and adjust soil disturbed during work. Get of all surplus and waste materials and replace damaged turf in accordance with directives of Engineer and Consultant.

3.10 MAINTENANCE

- A. Inspection
 - 1. A thorough visual inspection shall be done annually.
 - 2. This inspection must include overall verification of physical condition.
- B. Moveable parts shall be adjusted, if needed, every five (5) years, unless project requires additional inspections.

- C. In areas of extreme winter conditions, entire installation must be free of excessive ice and snow accumulation.

END OF SECTION 32 3119

**SECTION 32 8400
PLANTING IRRIGATION**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Work in this section includes the installation of the irrigation system from the point of connection, immediately downstream of the cistern and pump. For specific cistern and pump information, refer to Cistern Drawings.
- B. Section Includes:
 - 1. Piping
 - 2. Sleeves for piping
 - 3. Manual valves
 - 4. Automatic control valves
 - 5. Miscellaneous piping specialties
 - 6. Sprinklers
 - 7. Quick couplers
 - 8. Dripline system
 - 9. Controllers
 - 10. Boxes for automatic control valves

1.3 DEFINITIONS

- A. Circuit Piping: Downstream from control valves to sprinklers, specialties, and drain valves. Piping is under pressure during flow.
- B. Main Piping: Downstream from point of connection to water distribution piping to, and including, control valves. Piping is under water-distribution-system pressure.
- C. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.
- D. Layout design:
 - 1. Full and complete coverage is a requirement. Contractor shall, at no additional costs to the Owner, modify layout, make necessary adjustments, as needed to obtain a full coverage areas without overthrow on roadways, pavements, structures, furniture, fountains or buildings and to protect trees and shrubs from close high spray velocity.
 - 2. Provide flow velocities that do not exceed 5.0 ft. per second.
 - 3. Provide independent irrigation of individual bed zones or planters.
- E. Only similar types of heads with matched precipitation rates may run on same zone.

- F. Piping Design: Do not mix different heads for each line. Provide main size as needed for proper flow, but not less than specified on plan.
- G. Provide electric solenoid controlled underground irrigation system manufactured especially for control of automatic circuit valves of underground irrigation system. Provide unit of capacity to suit number of circuits indicated.
 - 1. Source Power: 120 volts AC.
 - 2. Low Voltage Controls: 24 volts AC.
- H. Provide controller to control all zones.
- I. The extent of the irrigation system is shown on the Drawings.

1.4 PERFORMANCE REQUIREMENTS

- A. Irrigation zone control shall be automatic operation with controller and automatic control valves.
- B. Location of Sprinklers and Specialties: Design location is approximate. Make minor adjustments as necessary to avoid plantings and obstructions such as signs and light standards. Maintain 100 percent irrigation coverage of areas indicated.
- C. Delegated Design: Design 100 percent coverage irrigation system, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- D. Minimum Working Pressures: The following are minimum pressure requirements for piping, valves, and specialties unless otherwise indicated:
 - 1. Irrigation Main Piping: 65 psi.
 - 2. Circuit Piping: 65 psi.

1.5 SUBMITTALS - REVIEW

- A. Product Data: Submit manufacturer's technical data and installation instructions for all components and equipment used.
- B. Shop Drawings:
 - 1. Indicate piping layout to water source.
 - 2. Include piping layout and details illustrating location and types of sprinkler heads, valves, control system and wiring diagram showing routes, wire sizes, wiring details and source of current and connections, and schedule of fittings.
 - 3. Indicate location of sleeves under pavements and conflicts with existing utilities.
- C. Samples
 - 1. Submit the following material samples:
 - a. Piping and fittings.
 - b. Wire connectors and sealer.
 - c. Control wire.

2. Materials List: Include dripline and low-volume irrigation components, control zone components, shop drawings and other components shown on drawings and installation details or described herein. Quantities of materials need not be included.
3. Manufacturers' Data: Submit manufacturers' catalog cuts, specifications, and operating instructions for equipment shown on materials list.

1.6 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Manufacturer's data sheets should include rated capacities, operating characteristics, and furnished specialties and accessories.
- B. Wiring Diagrams: For power, signal, and control wiring.
- C. Delegated-Design Submittal: For irrigation 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.

1.7 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Irrigation systems, drawn to scale, on which components are shown and coordinated with each other, using input from Installers of the items involved. Also include adjustments necessary to avoid plantings and obstructions such as signs and light standards.
- B. Qualification Data: For qualified Installer.
- C. Zoning Chart: Show each irrigation zone and its control valve.
- D. Controller Timing Schedule: Indicate timing settings for each automatic controller zone.
- E. Field quality-control reports.
- F. Materials List: Include discipline and low-volume irrigation components, control zone components, shop drawings and other components shown on drawings and installation details or described herein. Quantities of materials need not be included.
- G. Manufacturers' Data: Submit manufacturers' catalog cuts, specifications, and operating instructions for equipment shown on materials list.

1.8 CLOSEOUT SUBMITTALS

- A. Comply with the requirements of the General Conditions.
- B. Record Drawings:
 1. Prepare a map diagram showing location of all valves, lateral lines, and route of the control wires. Identify all valves as to size, station, number and type of irrigation. "As-built" drawings must be approved before charts are prepared.
 2. Provide one chart per controller showing the area covered by each satellite controller. The chart shall be a reduced drawing of the actual "as-built" system. If controller

sequence is not legible when the drawing is reduced to door size, the drawing shall be enlarged to a size that is readable and placed folded, in a sealed plastic container, inside the controller door. A second full-sized copy of each chart is to be given to the Landscape Architect.

3. The chart shall be a photographically reproduced print with a different color used to show coverage for each station. When completed and approved, the chart shall be hermetically sealed between two pieces of clear plastic. Charts must be completed and approved prior to final inspection of the irrigation system.
4. At the time of the irrigation mainline test, provide a preliminary set of "Record" drawings to the Owner.

C. Operation and Maintenance Data:

1. Provide schedule indicating length of time each valve is required to be run to provide a determined amount of water.
2. Include complete parts list with manufacturer's designations for each component.
3. The Installer shall conduct a training/demonstration session with the Owner or Owner's operations personnel. The training must include any required winterization procedures. The Contractor shall document the training session with appropriate minutes and sign-in sheet.

D. Loose Equipment to Furnish: Loose irrigation equipment, operating keys and spare parts will be furnished by the Irrigation Contractor in quantities below:

1. Two (2) quick coupler keys and matching swivel hose ells for $\frac{3}{4}$ " garden hose.
2. Two (2) valve keys for gate valves.
3. Two (2) keys for each controller.

1.9 MAINTENANCE MATERIAL SUBMITTALS

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

1. Sprinklers: Equal to 5 percent of amount installed for each type and size indicated, but no fewer than 5 units.

1.10 QUALITY ASSURANCE

A. Installer's qualifications: single firm specializing in irrigation work with a minimum of five (5) years experience properly installing irrigation systems of comparable size. Crew leader is to hold a certification of competence in irrigation design or installation.

1. Provide references of your last five (5) consecutive systems, and five systems of comparable size with bid proposal.

B. Multiple units: when two or more units of the same type or class of materials or equipment are required, these units are products of one manufacturer.

C. Materials, equipment, and methods of installation shall comply with the following codes and standards:

1. State of Pennsylvania and City of Pittsburgh Building Codes.

2. American Society for Testing and Materials (ASTM).
 3. National Sanitation Foundation (NSF).
- D. Nameplates: Nameplate bearing manufacturer's name or identification trademark securely affixed in a conspicuous place on equipment, or name or trademark cast integrally with equipment, stamped, or otherwise permanently marked on each item of equipment.
- E. Requirements of Regulatory Agencies:
1. All work and materials shall be in full accordance with the latest rules and regulations of safety orders of Division of Industrial Safety; the Uniform Building Code and other applicable laws or regulations, including any local Plumbing Codes.
 2. Should the Contract documents be at variance with the aforementioned rules and regulations, notify the Owner for instructions before proceeding with work affected.
- F. Flushing and Testing:
1. Schedule testing with Owner's Representative a minimum of three (3) days in advance of testing.
 2. Provide clean, clear water, pumps, labor, fittings, and equipment necessary to conduct line flushing and testing procedures.
 3. Required Dripline and Emitter Lateral Flushing Procedures.
 - a. Flush the system every two weeks for the first six (6) weeks and check the water that is flushed out for cleanliness. Establish a regular system flushing schedule for the future based on results from the initial six-week flushing schedule.
 - b. Flush the system completely after any repairs are made and monitor system operation closely under regular system flushing schedule.
 - c. Check the pressure at the supply and flush headers on a regular basis and compare with the pressure readings taken after installation.
 4. Required Dripline and Emitter Lateral Leakage Testing Procedures.
 - a. Subject installed dripline tubing and emitter lateral piping to water pressure equal to specified operating pressure for ten (10) minutes. Test with control zone components and dripline flush valve components installed.
 - b. Partially backfill buried pipe and tubing to prevent movement under pressure. Expose couplings, fittings, and valve components.
 - c. Visually inspect valve assemblies and fittings for leakage and replace defective pipe, fitting, joint, valve, or appurtenance. Repeat test until test segment is free from leaks. Cement or caulking to seal leaks is prohibited.
 5. Required Dripline and Emitter Lateral Operational Testing Procedures.
 - a. Activate each dripline and emitter lateral control zone valve in sequence from controller. Provide either one additional person with radio or use handheld remote to activate remote control valves from controller. Manually activating remote control valve using manual bleed mechanism at remote control valve is not an acceptable method of activation. Owner's Representative will visually observe operation, water application patterns, and leakage.
 - b. Replace or adjust defective valve, fitting, dripline segment, emitter lateral segment, or appurtenance to correct operational and coverage uniformity deficiencies.

- c. Repeat test(s) until each dripline or emitter lateral test segment passes testing procedures. Repeat tests, replace components, and correct deficiencies at no additional cost to Owner and/or Owner's Representative.

G. Permits and Inspections:

1. Any permits for the installation or construction of any work included under this contract, which are required by any of the legally constituted authorities having jurisdiction, shall be obtained and paid for by the contractor, each at the proper time.
2. The Contractor shall also arrange for and pay all costs in connection with any inspection and examination required by these authorities.

1.11 DELIVERY, STORAGE, AND HANDLING

- A. Deliver irrigation system components in manufacturer's original, undamaged and unopened containers, with labels intact and legible.
- B. Deliver plastic pipe in bundles, packaged to provide adequate protection of pipe ends.
- C. Store and handle materials to prevent damage and deterioration.
- D. Provide secure, locked storage for valves, sprinkler heads and similar components that cannot be immediately replaced to prevent installation delays.
- E. Contractor is responsible for materials through final acceptance

1.12 PROJECT CONDITIONS

- A. Protect existing trees, plants, and lawns and other features designated to remain as part of the final landscape.
- B. The Contractor shall carefully coordinate with the landscape work and other site developments, including all new and existing utilities.
- C. The Contractor shall verify the correctness of all finish grades within the work area to ensure the proper soil coverage of the irrigation pipes.
- D. Irrigation system layout is diagrammatic. Exact location of piping, sprinkler heads, valves, and other components shall be established by Contractor in the field at time of installation.
- E. Where possible sprinkler head layout should match drawings as closely as possible; field stake line and head locations for coordination with landscape contractor and approval by Landscape Architect prior to installation. Drawings are diagrammatic to the extent that swing joints, offsets and all fittings are not shown. Lines are to be common trenched wherever possible.
- F. Space sprinkler components as indicated. Do not exceed sprinkler spacing shown on Drawings.
- G. Locate existing utilities in areas of work. If utilities are to remain, provide adequate means of protection during the system installation. Repair utilities damaged during the work to the

satisfaction of the Utility Owner and at the Contractor's expense. Notify local Utilities Protection Service 48 hours before start of construction.

- H. Should uncharted or incorrectly charted piping or other utilities be encountered during excavation, notify the Owner immediately for direction as to procedure. Cooperate with the Owner and Utility companies in keeping active services and facilities in operation.
- I. Minor adjustments in system layout will be permitted to clear existing field obstruction. Final system layout shall be acceptable to the Landscape Architect.
- J. Confirm valve box layout with Landscape Architect prior to installation. All valve boxes to be ganged where possible and not visible.

1.13 WARRANTY

- A. Warranties are subject to the General Conditions and Supplementary Agreements.
- B. Irrigation Contractor is responsible to insure complete coverage as specified herein of the areas to be irrigated. During the warranty period the Irrigation Contractor shall make any adjustments as necessary to maintain proper coverage.
- C. The Contractor shall guarantee all parts and labor for a period of one year from the date of final inspection. If within that period settlement occurs, and adjustments in pipes, valves and sprinkler heads, lawn areas or paving are necessary to bring the system, grade or paving to the proper level of the permanent grades, the Contractor, as part of the work under his Contract, shall make all adjustments without extra cost to the Owner, including the restoration of all damaged planting, paving or other improvements of any kind.

1.14 OPERATION AND MAINTENANCE

- A. It is the Landscape Contractor's responsibility to determine water application rates and controller cycling. The Irrigation Contractor will coordinate system installation with planting soil placement and planting activities. The Irrigation Contractor will also instruct the Landscape Contractor on the operation and programming of the controller and will assist the Landscape Contractor as necessary in such operations throughout the one-year maintenance period. Any adjustments, repairs, etc., other than programming, are the total responsibility of the Irrigation Contractor.
- B. As part of this contract, the Irrigation Contractor shall winterize the system the first year, and provide written instructions to the Owner for future service and maintenance. The Irrigation Contractor shall return to the site during the subsequent spring season and demonstrate to the Owner the proper procedures for the system start-up, operation and maintenance.

PART 2 - PRODUCTS

2.1 UNAUTHORIZED MATERIALS

- A. Materials and products required for work of this section shall not contain asbestos, polychlorinated biphenyl (PCB) or other hazardous materials identified by the Owner.

2.2 IRRIGATION SYSTEM MANUFACTURERS

- A. All irrigation system components shall be supplied by regionally authorized distributors to provide single source responsibility for warranty service and operations to conform to specifications in all aspects.

2.3 PIPES, TUBES, AND FITTINGS

- A. Comply with requirements in the piping schedule for applications of pipe, tube, and fitting materials, and for joining methods for specific services, service locations, and pipe sizes.
- B. Soft Copper Tube: ASTM B 88, Type L water tube, annealed temper.
 - 1. Cast-copper-alloy fittings in first subparagraph below are available in NPS 1/4 to NPS 12 (DN 8 to DN 300); wrought-copper fittings are available in NPS 1/4 to NPS 8 (DN 8 to DN 200).
 - 2. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper solder-joint fittings. Furnish wrought-copper fittings if indicated.
 - 3. Bronze Flanges: ASME B16.24, Class 150, with solder-joint end.
 - 4. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces and solder-joint or threaded ends.
- C. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.
 - 1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper solder-joint fittings. Furnish wrought-copper fittings if indicated.
 - 2. Bronze Flanges: ASME B16.24, Class 150, with solder-joint end.
 - 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.
- D. PVC Pipe: ASTM D 1785, PVC 1120 compound, Schedule 40.
 - 1. PVC Socket Fittings: ASTM D 2466, Schedule 40.
 - 2. PVC Threaded Fittings: ASTM D 2464, Schedule 80.
 - 3. PVC Socket Unions: Construction similar to MSS SP-107, except both headpiece and tailpiece shall be PVC with socket ends.
- E. PVC Pipe, Pressure Rated: ASTM D 2241, PVC 1120 compound, SDR 21.
 - 1. PVC Socket Fittings: ASTM D 2467, Schedule 40.
 - 2. PVC Socket Unions: Construction similar to MSS SP-107, except both headpiece and tailpiece shall be PVC with socket or threaded ends.

2.4 PIPING JOINING MATERIALS

- A. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.
- B. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

- C. Solvent Cements for Joining PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
- D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

2.5 MANUAL VALVES

A. Bronze Ball Valves:

- 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. Hammond Valve.
 - b. NIBCO Inc.
 - c. Watts Regulator.
- 2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psi.
 - c. CWP Rating: 600 psi.
 - d. Body Design: Two piece.
 - e. Body Material: Bronze.
 - f. Ends: Threaded or solder joint if indicated.
 - g. Seats: PTFE or TFE.
 - h. Stem: Bronze.
 - i. Ball: Chrome-plated brass.
 - j. Port: Full.

B. Bronze Gate Valves:

- 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. Hammond Valve.
 - b. NIBCO Inc.
 - c. Watts Regulator.
- 2. Description:
 - a. Standard: MSS SP-80, Type 2.
 - b. Class: 125.
 - c. CWP Rating: 200 psi.
 - d. Body Material: ASTM B 62 bronze with integral seat and screw-in bonnet.
 - e. Ends: Threaded or solder joint.
 - f. Stem: Bronze, nonrising.
 - g. Disc: Solid wedge; bronze.
 - h. Packing: Asbestos free.
 - i. Handwheel: Malleable iron, bronze, or aluminum.

2.6 AUTOMATIC CONTROL VALVE

A. Plastic, Automatic Control Valves:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Rain Bird PGA-NP-HAN series automatic control valves with purple flow control handle or comparable.
 - a. Description: Molded-plastic body, 150 psi rated, normally closed, diaphragm type with manual-flow adjustment, and operated by 24-VAC solenoid.

2.7 DRIP CONTROL ZONE KITS

A. General Information

1. Provide control zone kits manufactured by Rain Bird as indicated on construction drawings.
2. Control zone kit assemblies for dripline irrigation zones must include control valve, filtration, and pressure regulation components sized to meet the hydraulic demands and flow requirements of the zones that they service.

B. Basis-of-Design Product: Subject to compliance with requirements, provide Rain Bird Low Flow Control Zone Kit for dripline zones with flows from 0.2 to 5.0 GPM (0.8 to 18.9 lpm), including low flow valve (LFV) and pressure regulating filter (PRF) or comparable.

1. Available model numbers:
 - a. XCZ-LF-100 1" Low Flow valve 1" with and 3/4" PR filter or approved equal.
2. Low Flow Valve (LFV) component specifications include:
 - a. Valve body and bonnet constructed of high impact, weather-resistant plastic, stainless steel and other chemical/UV resistant materials
 - b. Diaphragm with a double-knife seal, constructed of durable Buna-N rubber with a clog-resistant metering orifice
 - c. Energy-efficient, low-power encapsulated solenoid with captured plunger and 90 mesh (200 micron) solenoid filter
 - d. External bleed for manual system flushing during start-up, internal bleed for manual zone activation during maintenance operations
 - e. Inlet pressure rating: 20 to 120 PSI (1,4 to 8,3 bar)
 - f. Female threaded inlet and outlet connections
 - g. Anti-siphon valve configuration (AXCZ-075-PRF) includes listed features and incorporates atmospheric vacuum breaker with I.A.P.M.O and A.S.S.E. listing approval
3. Pressure Regulating Filter (PRF) combines filtration and pressure regulation in one integrated unit for protection of downstream components of drip irrigation system. PRF component specifications include:
 - a. Compact "Y" filter body and cap configuration constructed of glass-filled, UV-resistant polypropylene, with 120 PSI (8,3 bar) operating pressure rating. Maximum dimensions of filter body; Height: 4 1/2" (11,4 cm), Length: 5 1/2" (14 cm), Width: 2" (5,1 cm)

- b. Standard 200 mesh (75 micron) filter screen constructed of durable stainless steel attached to a polypropylene frame. Screen is serviceable for cleaning purposes by unscrewing cap from filter body and removing filter element.
- c. Normally-open pressure regulating device with preset outlet pressure of approximately 30 PSI (2,1 bar). Pressure regulating device allows full flow with minimal pressure loss unless inlet pressure is greater than preset level. As inlet pressure increases above preset level, internal spring compresses to reduce downstream pressure.
- d. Male threaded 3/4" (19 mm) inlet and outlet connections.

2.8 DRIPLINE

A. Basis-of-Design Product: Subject to compliance with requirements, provide Netafim Techline CV dripline or comparable.

1. Techline CV is a continuous self-cleaning, recycled content, pressure compensating dripline with built-in check valve. This low volume dripline has integral and evenly spaced pressure compensating check valve emitters welded to the inside of the tubing that contains recycled content. Techline CV is available with emitters in four discharge rates (0.26, 0.4, 0.6, and 0.9 gallons per hour [GPH]) evenly spaced at 12", 18", or 24" centers. Techline CV is available in 100', 250', 500', and 1,000' coils. Techline CV Blank Tubing is available in 100', 250', 500' and 1,000' coils.
2. Techline CV shall be nominally sized to 17mm (1/2") low-density linear polyethylene tubing with recycled content qualifying for maximum LEED credits. Techline CV shall be constructed with pressure compensation, continuously self-cleaning, integral emitters with an internal check valve at these spacings (12", 18", or 24" centers). Techline CV may also be manufactured without emitters installed. The exterior of the tubing shall be brown in color and conform to an outside diameter (O.D.) of 0.66 inches and an inside diameter (I.D.) of 0.56 inches. Individual pressure compensating emitters shall be welded to the inside wall of the tubing as an integral part of the manufacturing process. These emitters shall be constructed of a two (2) piece plastic emitter housing containing a continuously self-flushing molded silicone diaphragm. The emitter shall have a built-in check valve that will hold back a 4.6' column of water. The emitter shall be installed into the tubing so that the inlet to the emitter is toward the center of the tubing cross section. The emitter shall also have a built-in physical root barrier whereby the water shall exit the emitter from one location and shall exit the tubing from a second location. This physical barrier shall create an air gap inside the exit bath of the emitter.
3. Each emitter shall have the ability to independently regulate discharge rates, with an inlet pressure range of 14.5 - 58 pounds per square inch (psi), at a constant flow and with a manufacturer's coefficient of variability (Cv) of 0.03 or less. Recommended operating pressure shall be between 14.5 - 58 psi. The emitter discharge rate shall be 0.26, 0.4, 0.6, or 0.9 gallons per hour (GPH) utilizing a combination of turbulent flow and reduced pressure compensation by molded silicone diaphragm. The emitters shall be capable of continuously cleaning themselves while in operation. The dripline shall be available with 12", 18", and 24" spacing between emitters unless otherwise specified. For subsurface installation, Techline CV pipe depth shall be 4" to 6". Maximum system pressure shall be 58 psi for maximum fitting integrity. Filtration shall be 120 mesh or finer. Bending radius shall not be smaller than 7" or tubing kinking may result.
4. For on-surface or under mulch installations, 6" metal wire staples (TLS6) shall be installed 3' - 5' on center, (depending on soil type) and two staples shall be installed over every change-of-direction fitting.

2.9 DRIP TUBE INSERT FITTINGS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Rain Bird Dripline Tube fittings listed below or comparable.

1. Available model numbers, designed for compatibility with Rain Bird XF Series Dripline Tubing:
 - a. Tee: XFF-TEE insert tee (17 x 17 x 17 mm)
 - b. Coupling: XFF-COUP insert coupling (17 x 17 mm)
 - c. Elbow: XFF-ELBOW insert elbow (17 x 17 mm)
 - d. Cross: XFD-CROSS insert cross (17 x 17 x 17 x 17 mm)
 - e. Insert Adapters:
 - 1) 1/2" (13 mm) Male pipe thread adapter: XFF-MA-050 [17 mm x 1/2" (13 mm) MPT]
 - 2) 3/4" (19 mm) Male pipe thread adapter: XFF-MA-075 [17 mm x 3/4" (19 mm) MPT]
 - 3) 3/4" (19 mm) Female pipe thread adapter: XFD-FA-075 [17 mm x 3/4" (19 mm) FPT]
 - 4) 1/2" (13 mm) Tee male pipe thread adapter: XFF-TMA-050 [17 mm x 1/2" (13 mm) MPT x 17 mm]
 - 5) 3/4" (19 mm) Tee female pipe thread adapter: XFD-TFA-075 [17 mm x 3/4" (19 mm) FPT x 17 mm]
2. XF Series insert fitting specifications and features include:
 - a. Constructed from black and/or brown acetyl plastic for long-term, leak free connections
 - b. Intended for use with polyethylene tubing with ID of 0.536" (13,6 mm), including Rain Bird XF Dripline and XF Series Blank Tubing
 - c. Operating pressure range is 0 to 50 PSI (0 to 3,5 bar)

2.10 IRRIGATION ACCESSORIES

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Rain Bird accessories listed below or comparable.

1. 1/4" (6,4 mm) Barb Transfer Fittings
 - a. Available model numbers:
 - 1) XBF1CONN: 1/4" (6,4 mm) Barb Connector
 - 2) XBF2EL: 1/4" (6,4 mm) Barb x Barb Elbow
 - 3) XBFTEE: 1/4" (6,4 mm) Barb x Barb Tee
 - b. 1/4" (6,4 mm) Barb Transfer Fittings specifications and features include:
 - 1) Three fitting configurations:
 - a) Connector
 - b) Elbow
 - c) Tee

- 2) Designed for connections of Rain Bird XQ 1/4" (6,4 mm) distribution tubing with an ID of 0.17" (4,3 mm)
- 3) Barbed on one end to permit easy insertion into any 1/2" (13 mm) or 3/4" (19 mm) polyethylene tubing using a Rain Bird Xeriman® tool (XM-TOOL)
- 4) Constructed from UV resistant acetyl.
- 5) Operating pressure range between 0 to 50 PSI (0 to 3.5 bar)

2.11 SPRINKLERS

- A. General Requirements: Designed for uniform coverage over entire spray area indicated at available water pressure.
- B. Plastic, Pop-up Spray Sprinklers:
 1. Basis-of-Design Product: Subject to compliance with requirements, provide Rain Bird 1800SAM series pop-up fixed-spray sprinklers or comparable.
 2. Description:
 - a. Body Material and Flange: ABS.
 - b. Pattern: Fixed, with flow adjustment.
 - c. Integral check valve capable of holding back up to 14' of head.
 3. Capacities and Characteristics:
 - a. Pop-up Height: 4" or 12" as indicated on Drawings.
 - b. Nozzle: ABS.
 - c. Flow: 0.29 to 3.7 gpm.
 - d. Arc: full, half, or part circle.
 - e. Radius: 5' to 15'.
 - f. Inlet: NPS 1/2".

2.12 QUICK COUPLERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Rain Bird 5NP or comparable.
- B. Description: Factory-fabricated, bronze or brass, one-piece assembly with 1" FPT inlet. Include coupler water-seal valve; removable upper body with spring-loaded or weighted, rubber-covered purple (non potable) cap; hose swivel with ASME B1.20.7, 3/4-11.5NH threads for garden hose on outlet; and operating key for both valve (#55-K) and cap (#2049).

2.13 CONTROLLERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Rainbird ESP-LXD two-wire controller with metal cabinet and metal pedestal or comparable.
- B. Description:
 1. Two-wire controller utilizing field decoders to operate up to 100 automatic control valves on a single wire path. Controller is to be remotely accessible via cell communication if desired by the Owner.

2. Control Transformer: 24-VAC secondary, with primary fuse.
3. Timing Device: Adjustable, 24-hour, 14-day clock, with automatic operations to skip operation any day in timer period, to operate every other day, or to operate two or more times daily.
 - a. Manual or Semiautomatic Operation: Allows this mode without disturbing preset automatic operation.
 - b. Nickel-Cadmium Battery and Trickle Charger: Automatically powers timing device during power outages.
 - c. Surge Protection: Metal-oxide-varistor type on each station and primary power.
4. Rain Sensor: Rainbird WR2 wireless or comparable.
 - a. Wiring:
 - 1) Controller Interface Wire: 30" length of #22 gauge UV resistant extension wire.

2.14 BOXES FOR AUTOMATIC CONTROL VALVES

- A. Plastic Boxes:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armor Access.
 - b. Carson Industries LLC.
 - c. Rain Bird.
 - d. NDS.
- B. Description: Box and cover, with open bottom and openings for piping; designed for installing flush with grade.
 1. Size: As required for valves and service, 10" round minimum.
 2. Shape: Round (gate valves and quick couplers); Rectangular (control valves).
 3. Sidewall Material: PE, ABS, or FRP.
 4. Cover Material: PE, ABS, or FRP.
 5. Lettering: "VALVE BOX".
 6. Color: Non-Potable Purple Lid
- C. Drainage Backfill: Cleaned gravel or crushed stone, graded from ¾" minimum to 2" maximum.

PART 3 - EXECUTION

3.1 GENERAL

- A. Dripline Layout of Work
 1. Stake out Dripline irrigation system. Items staked include manifold/header pipe and tubing, sleeves, control zone assemblies, flush valves, air relief valves, and check valves.

2. Dripline Irrigation System Layout Review: Dripline irrigation system layout review will occur after staking has been completed. Notify Owner's Representative one week in advance of review. Modifications will be identified by Owner's Representative at this review.
- B. The Irrigation Contractor shall carefully schedule his work with the Landscape Contractor and all other site developments.
- C. Sleeves are required wherever piping or electrical wires are placed under paved surfaces. (Installed as part of other sections and Contract). Irrigation Contractor is responsible for coordination of all sleeves.
- D. Full and completed coverage is required. Contractor shall make any necessary minor adjustments to layout as required to achieve full coverage of irrigated areas at no additional cost to the Owner.
- E. Where piping is shown on drawings to be under paved areas but running parallel and adjacent to planted areas, the intent is to install piping in planted areas. Do not install directly over another line in the same trench.
- F. It shall be the Contractor's responsibility to establish the location of all sprinkler heads in order to assure proper coverage of all areas. In no case shall spacing of sprinkler heads exceed distances shown on the drawings and/or those specified. Pipe sizes shall conform to those shown on drawings. No substitution of smaller pipe sizes will be permitted, but substitutions of larger sizes may be approved. All pipe damaged or rejected because of defects shall be removed from the site at the time of said rejection.
- G. Install irrigation system after completion of site grading, the irrigation system shall be installed and completely operational three days prior to the installation of any planting operations.

3.2 POINT OF CONNECTION

- A. The water source for this irrigation system is an proposed 3/4" meter. Point of connection is on the upstream side of the meter. See Irrigation Drawings for Point of Connection (POC) schematic diagram.

3.3 EXCAVATING

- A. All piping is to be trenched other than 1", which may be pulled.
- B. Excavate to depths required to provide 6" of Granular Fill bedding material under paved surfaces.
- C. Should utilities not shown on the plans be found during excavations, the Contractor shall promptly notify the Owner for instructions as to further actions required. Failure to do so will make Contractor liable for any and all damage thereto arising from his operations subsequent to discovery of such utilities. Indicate such utility crossings on the record drawings promptly.
- D. Install main line irrigation lines with a minimum cover of ten inches (10") and a maximum cover of twelve inches (12") based on finished grades.

- E. Install lateral irrigation lines with a minimum cover of ten inches (10") and a maximum cover of twelve inches (12") based on finished grades.
- F. Perform all excavations as required for installation of work included under this Section, including shoring of earth banks, if necessary. Restore all surfaces, existing underground installations, etc., damaged or cut as a result of the excavations, to their original condition.
- G. Trenches shall be open, vertical sided construction wide enough to provide free working space around work installed and to provide adequate space for backfilling and compacting.
- H. When two (2) pipes are to be placed in the same trench, a six-inch (6") space is to be maintained between the pipes. The Contractor shall not install two pipes with one directly above the other.
- I. The Contractor shall cut trenches for pipe to required grade lines and compact trench bottom to provide accurate grade and uniform bearing for the full length of the line.
- J. The Contractor shall be held responsible for damages caused by these operations and shall immediately repair or replace damaged parts.

3.4 DRIPLINE EXCAVATION, TRENCHING, AND BACKFILL

- A. Excavate and install pipes at minimum cover indicated in drawings or specifications. Excavate trenches at appropriate width for connections and fittings.
- B. Minimum cover for dripline components (distance from top of pipe to finish grade):
 - 1. Buried PVC manifold and supply header pipe to dripline grid layouts: 12" (30,5 cm) to top of pipe.
 - 2. Buried dripline lateral pipe downstream PVC manifold and supply header pipe: 4" (10 cm) to top of pipe
 - 3. On-grade dripline lateral pipe downstream PVC manifold and supply header pipe: Secure to finish grade with approved tubing stakes. Install and test prior to installation of landscape and mulch.
- C. Backfill only after buried lines have been reviewed, tested, and approved.
- D. Excavated material is generally satisfactory for backfill. Use backfill free from rubbish, vegetable matter, frozen materials, and stones larger than 2" (50 mm) in maximum diameter. Remove material not suitable for backfill. Use backfill free of sharp objects next to pipe.
- E. Dress backfilled areas to original grade. Incorporate excess backfill into existing site grades. Dispose of excess backfill off site.
- F. Contact Owner's Representative for trench depth adjustments where utilities conflict with irrigation trenching and pipe work.

3.5 PIPE LINE ASSEMBLY

- A. General
 - 1. Install pipes and fittings in accordance with manufacturer's latest printed instructions.

2. Clean all pipes and fittings of dirt, scales and moistures before assembly.
3. All pipe, fittings and valves, etc., shall be carefully placed in the trenches. Interior of pipes shall be kept free from dirt and debris and when laying is not in progress, open ends of pipe shall be closed by approved means.
4. All lateral connections to the main line as well as all other connections shall be made to the side of the main line pipe. No connections to the top of the line shall be allowed.

B. Solvent-Welded Joints for PVC Pipe

1. Use solvents and methods approved by solvent and pipe manufacturers.
2. Cure joint a minimum of one hour before applying any external stress on the piping and at least twenty four (24) hours before placing the joint under water pressure, unless otherwise specified by the manufacturer. Cut all pipe with square ends and remove burrs, ridges and dirt. Check dry fit pipe and fitting. Clean pipe and fitting with purple primer and apply thin coat of cement to fitting with a liberal coat to pipe. Quickly push pipe fully into fitting using a ¼ turning motion. Hold pipe and fitting together a minimum of 30 seconds, wipe off excess with cloth.

C. Threaded Joints for PVC Pipe

1. Use Teflon tape on all threaded PVC fittings.
2. Use strap-style friction wrench only. Do not use metal-jawed wrench.

D. Laying of Pipe

1. Pipes shall be bedded in at least in at least two inches (2") of finely divided material with no rocks or clods over one inch (1") diameter to provide a uniform bearing.
2. Pipe shall be snaked from side to side of trench bottom to allow for expansion and contraction. One additional foot per 100 feet of pipe is the minimum allowance for snaking.
3. Do not lay PVC pipe when there is water in the trench.
4. Plastic pipe shall be cut with PVC pipe cutters or hacksaw, or in a manner so as to ensure that a square cut. Burrs at end cuts shall be removed prior to installation so that a smooth unobstructed flow will be obtained.
5. All plastic-to-plastic joints will be solvent-weld joints or slip seal joints. All plastic pipe and fittings shall be installed as outlined and instructed by the pipe manufacturer and it shall be the Contractor's responsibility to make arrangements with the pipe manufacturer for any field assistance that may be necessary. The Contractor shall assume full responsibility for the correct installation.

E. Dripline Tubing and Fittings:

1. Use only Rain Bird XF-Series Insert Fittings or Rain Bird Easy Fit Compression Fittings for Netafim Techline CV dripline tubing connections or transitions as recommended by the Manufacturer's representative for the specific site and system conditions.
2. Dripline Insert Fittings:
 - a. Install dripline tubing and fittings in manner recommended by manufacturer and in accordance with accepted industry practices.
3. Dripline Compression Fittings:

- a. Install dripline tubing and fittings in manner recommended by manufacturer and in accordance with accepted industry practices.

3.6 PVC SLEEVES AND ELECTRICAL CONDUIT

- A. Provide all sleeves indicated and as otherwise required for the successful completion of the irrigation system. Coordinate sleeving efforts with General Contractor and the Owner.
- B. All PVC sleeves shall be a minimum of twice (2x) the diameter of pipe to be sleeved.
- C. All PVC control wire conduit shall be of sufficient size to hold the required quantity of control and common wires. Electrical wires are not to be placed in the same trench with water pipes.

3.7 ISOLATION VALVES

- A. Shall be located in the following locations:
 - 1. After backflow preventer and prior to main supply loop.
 - 2. Between main line and each quick coupler valve.
- B. Install each isolation valve in an individual valve box with a six-inch (6") (deep) layer of washed gravel below the bottom of the valve.
 - 1. Seal threaded connections with Teflon tape.

3.8 IRRIGATION CONTROL VALVES

- A. Coordinate irrigation piping installations and specialty arrangements with schematics on Drawings and with requirements specified. If Drawings are explicit enough, these requirements may be reduced or omitted.
- B. Coordinate location of all valve boxes with Landscape Architect. Do not proceed until schematic layout has been approved by Landscape Architect.
- C. All irrigation control valves shall be installed with ductile iron service tees.
- D. Install line size bronze gate valve on pressure side of each control valve. Locate in valve box with control valve.
- E. Install each electric control valve in an individual valve box with a six-inch (6") (deep) layer of washed gravel below the bottom of the valve.
- F. Seal threaded connections with Teflon tape.
- G. Valves shall be installed as shown in details and in accordance with manufacturer's instructions and specifications.

3.9 QUICK COUPLING VALVES

- A. Shall be set a minimum of twelve inches (12") from walks, curbs, or paved areas where applicable or as otherwise noted. Quick coupling valves shall be housed in standard size valve boxes.
- B. All quick coupler valves shall be installed on to ductile iron service tee.
- C. Install one inch (1") bronze gate valve on pressure side of each quick coupler valve. Locate in valve box with quick coupler valve.
- D. Valves shall be installed on a three- (3) elbow PVC Schedule 80 swing joint assembly.
- E. Provide six-inch (6") (deep) layer of washed gravel below the bottom of the valve. Top of quick coupler valves shall be as close to the top of the valve box as possible. Top of gravel layer shall be three inches (3") below the top of the valve.
- F. Quick coupling valves shall be set perpendicular to finished grade unless otherwise designated on the plans.
- G. Quick coupler locations are to be staked in the field by installer for approval by Landscape Architect prior to installation.

3.10 VALVE BOXES

- A. Valve boxes shall be set flush with grade in lawn areas and one half inch (1/2") above finish grade in ground cover and shrub bed areas.
- B. Install valve access boxes on a suitable base of gravel to provide a level foundation at proper grade and to provide drainage of the valve box.
- C. Valve boxes to be schematically laid out and approved by Landscape Architect prior to installation.

3.11 SPRINKLER INSTALLATION

- A. Install sprinklers after hydrostatic test is completed.
- B. Install sprinklers at manufacturer's recommended heights.
- C. Locate part-circle sprinklers to maintain a minimum distance of 2" from walls and other boundaries unless otherwise indicated.

3.12 INSTALLATION OF DRIPLINE IRRIGATION COMPONENTS

- A. Control Zone Kit Assembly:
 - 1. Flush mainline pipe before installing Control Zone Kit assembly.
 - 2. Locate where shown on drawings. Connect control wires to remote control valve wires using specified wire connectors and waterproof sealant. Provide connectors and sealant per manufacturer's recommendations.

3. Install a maximum of four (4) Low Flow or Medium Flow Control Zone Kits per standard rectangular valve box. Install a maximum of one (1) Medium Flow Commercial Control Zone Kits per standard rectangular valve box. Install a maximum of one High Flow Commercial Control Zone Kits per jumbo rectangular valve box.
 - a. Locate valve boxes at least 12" (30,5 cm) from, and align with, nearby walls or edges of paved areas.
 - b. Group Control Zone Kit assemblies together where practical. Align grouped valve boxes in uniform patterns. Allow at least 12" (30,5 cm) between valve boxes.
 - c. Brand controller letter and station numbers on valve box lid in 2" (50 mm) high letters.

B. Lateral Piping and Dripline Tubing:

1. Install lateral piping and dripline tubing at locations and in grid patterns as indicated on drawings and installation details, and in strict accordance with manufacturer recommendations.
2. Thoroughly flush PVC lateral piping, supply headers, and dripline tubing immediately upon installation.

C. Air Relief Valve Kit Assembly: Install at all high points in dripline tubing grid as shown and directed on drawings and installation details.

D. Flush Point Assembly: Install in flush header or at ends of each dripline zone segment as shown and directed on drawings and installation details. Install at least 12-inches from and align with adjacent walls or edges of paved areas.

3.13 CONTROLLER

- A. Mount the controller to pedestal as per manufacturer's written instructions.
- B. The automatic controller shall be installed at the approximate location shown on the Drawings. (Suitable power supply will be supplied as part of other sections and Contract).
- C. All local and other applicable codes shall take precedence in connecting the 110-volt electrical service to the controller.
- D. Install per local code, manufacturer's latest printed instructions, and as detailed.
- E. Valve control wires shall be numbered at the terminal strip.

3.14 CONTROLLER POWER SUPPLY

- A. Power to the controller(s) shall be supplied from a dedicated circuit. (Installed as part of work of other sections and Contract).
- B. The Irrigation Contractor shall be responsible for all wiring and associated equipment to connect power supply to the controller.
- C. All wiring is to be in accordance with local codes.

3.15 CONTROL WIRING

- A. All electrical equipment and wiring shall comply with local and state codes and be installed by those skilled and licensed in the trade.
- B. Wiring shall occupy the same trench and shall be installed along the same route as pressure supply or lateral lines whenever possible, and shall have a minimum of twelve inches (12") cover.
- C. Control wires shall be installed to the side of the main line whenever possible. Placement over pipes is not permitted.
- D. Where more than one (1) wire is placed in a trench, the wiring shall be taped together at intervals of twenty feet (20').
- E. An expansion curl shall be provided within three feet (3') of each wire connection and at least every one hundred feet (100') of wire length on runs of more than one hundred feet (100') in length. Expansion curls shall be formed by wrapping at least five (5) turns of wire around a one-inch (1") diameter pipe, then withdrawing pipe.
- F. Control wire splices at remote control valves to be crimped and sealed with specified splicing materials. Line splices will be allowed only on runs of more than five hundred (500') and they must be located in ten inch (10") round splice boxes that are green in color. The connector shall be 3M DBY splice kit by 3M Corporation, or accepted Substitute. Use one splice per connector sealing pack.

3.16 CLOSING OF PIPE AND FLUSHING OF LINES

- A. All testing shall be done under the supervision of the Landscape Architect and Owner. Submit written requests for inspections to the Owner at least three days prior to the anticipated inspection date.
 - 1. Thoroughly flush out all water lines under a full head of water before installing heads, valves, quick coupler assemblies, etc. Maintain flushing for a minimum of three minutes at the valve located furthest from water supply.
 - 2. After flushing, cap or plug all openings to prevent entrance of materials that would obstruct the pipe or clog heads. Leave in place until removal is necessary for completion of installation.
 - 3. Test as specified below.
 - 4. Upon completion of testing complete assembly and adjust sprinklers for proper distribution.

3.17 TESTING

- A. Make hydrostatic when welded PVC joints have cured as per manufacturer's instructions.
 - 1. Pressurized mainlines:
 - a. Completely install water meter, mains, isolation valves and control valves. Do not open laterals.
 - b. Open all isolation valves.
 - c. Fill all lines with water and shut off at meter.

- d. Test piping at hydraulic pressure of 90 PSIG for one-half (1/2) hour. Maximum loss shall be five (0) PSI. Locate pump at low point in line and apply pressure gradually.
 - e. Install pressure gauge shut-off valve and safety blow-off valve between pressure source and piping. Inspect each joint and repair leaks.
 - f. Leaks resulting from tests shall be repaired and tests repeated until the system passes.
2. Non-pressurized laterals:
- a. Test piping after laterals and swing joints are installed but before heads are installed.
 - b. Open all isolation valves.
 - c. Fill all lines with water and shut off at meter.
 - d. Test piping at hydraulic pressure of 90 PSIG for one-half (1/2) hour. Maximum loss shall be five (0) PSI. Locate pump at low point in line and apply pressure gradually.
 - e. Install pressure gauge shut-off valve and safety blow-off valve between pressure source and piping. Inspect each joint and repair leaks.
 - f. Leaks resulting from tests shall be repaired and tests repeated until the system passes.

3.18 INSPECTIONS

- A. The contractor shall maintain proper facilities and provide safe access for inspection to all parts of the work.
- B. Irrigation inspection shall consist of a minimum of:
 - 1. Mainline pressure test.
 - 2. Coverage test.
 - 3. Final irrigation inspection.
- C. The contractor shall give the Owner three days notice of its readiness for inspection.
- D. The contractor shall be solely responsible for notifying the Owner and Landscape Architect where and when such work is in readiness or testing.
- E. If any work should be covered up without the approval of the Owner and Landscape Architect it must be uncovered, if required, for examination at the contractor's expense.
- F. No inspection will commence without "Record" drawings and without completing previously corrections, or without preparing the system for inspection.

3.19 BACKFILLING AND COMPACTING

- A. After system is operating and required tests and inspections have been made, backfill excavations and trenches.
 - 1. Restore all surfaces to match adjacent surfaces. Meet grades flush. Create smooth blends and transitions.

- B. Granular fill corresponding with Section Earthwork shall be placed initially on all lines with a minimum of 3" cover. No foreign matter larger than 1/2" in size shall be permitted in the initial backfill.
 - 1. Trenches located under paving shall be backfilled with Granular Fill corresponding with the requirements of Section Planting Soil System (3" above the pipe) compacted in layers.
 - 2. Backfill in lawns and planting beds shall be planting soils corresponding with the requirements of Section Planting Soil System. Coordinate backfilling of planting soils with the Landscape Contractor. Care should be taken to restore the planting soil profile in accordance with the Contract Documents. Planting soils damaged during trenching shall be discarded. The Landscape Architect shall be the sole judge as to the suitability of the planting soils for reuse.

3.20 WINTERIZATION AND SPRING STARTUP

- A. Winterize irrigation system in fall following completion, or partial completion, of irrigation system construction. Start-up irrigation system in spring following completion, or partial completion, of irrigation system construction. Repair any damage caused in improper winterization at no additional cost to Owner. Coordinate winterization and start-up with landscape maintenance personnel.

3.21 CLEANING AND DISPOSAL OF WASTE MATERIAL

- A. Perform clean up during installation of the work and upon completion of the work. Remove from site all excess materials, soil, debris, and equipment as fast as it accumulates.
- B. Stockpile, haul from site, and legally dispose of waste materials, including unsuitable excavated materials, rock, trash, and debris.

END OF SECTION 32 8400

SECTION 32 9300 PLANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Trees
 - 2. Shrubs
- B. Related Sections include the following:
 - 1. Division 31 Section "Site Clearing" for protection of existing trees and planting, topsoil stripping and stockpiling, and site clearing.

1.3 DEFINITIONS

- A. Balled and Burlapped Stock: Exterior plants dug with firm, natural balls of earth in which they are grown, with ball size not less than sizes indicated; wrapped, tied, rigidly supported, and drum-laced as recommended by ANSI Z60.1.
- B. Container-Grown Stock: Healthy, vigorous, well-rooted exterior plants grown in a container with well-established root system reaching sides of container and maintaining a firm ball when removed from container. Container shall be rigid enough to hold ball shape and protect root mass during shipping and be sized according to ANSI Z60.1 for kind, type, and size of exterior plant required.
- C. Finish Grade: Elevation of finished surface of planting soil.
- D. Manufactured Topsoil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.
- E. Planting Soil: Native or imported topsoil, manufactured topsoil, or surface soil modified to become topsoil; mixed with soil amendments.
- F. Subgrade: Surface or elevation of subsoil remaining after completing excavation, or top surface of a fill or backfill, before placing planting soil.

1.4 SUBMITTALS

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

- B. Samples for Verification: For each of the following:
 - 1. 3 lb of mulch for each color and texture required, in labeled plastic bags.
- C. Product Certificates: For each type of manufactured product, signed by product manufacturer, and complying with the following:
 - 1. Manufacturer's certified analysis for standard products.
 - 2. Analysis of other materials by a recognized laboratory made according to methods established by the Association of Official Analytical Chemists, where applicable.
- D. Qualification Data: For Landscape Installer.
- E. Material Test Reports: For existing surface soil and imported topsoil.
- F. Planting Schedule: Indicating anticipated planting dates for exterior plants.
- G. Maintenance Instructions: Recommended procedures to be established by Owner for maintenance of exterior plants during a calendar year. Submit before expiration of required maintenance periods.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful establishment of exterior plants.
 - 1. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when exterior planting is in progress.
- B. Soil-Testing Laboratory Qualifications: An independent laboratory, recognized by the State Department of Agriculture, with the experience and capability to conduct the testing indicated and that specializes in types of tests to be performed.
- C. Planting Soil Analysis: Planting Soil Analysis: Furnish soil particle analysis by a qualified soil-testing laboratory using ASTM F1632 Method "B" stating percentages of organic matter; gradation of sand, silt, and clay content; and soil texture. Provide the following soil chemistry data: cation exchange capacity; soluble salts; extractable phosphorous; exchangeable potassium; deleterious material; pH; and mineral and plant-nutrient content of planting soil.
 - 1. Report suitability of topsoil for plant growth. State recommended quantities of nitrogen, phosphorus, and potash nutrients and soil amendments to be added to produce a satisfactory topsoil.
 - 2. All test data for the blended planting soil that will be delivered to the site must be tested within six (6) months of the installation date.
 - 3. Testing to be done on each component of planting soil prior to blending.
 - 4. The topsoil blend that is accepted will act as the standard for all future soil deliveries.
- D. Provide quality, size, genus, species, and variety of exterior plants indicated, complying with applicable requirements in ANSI Z60.1, "American Standard for Nursery Stock."
- E. Tree and Shrub Measurements: Measure according to ANSI Z60.1 with branches and trunks or canes in their normal position. Do not prune to obtain required sizes. Take caliper measurements 6 inches above ground for trees up to 4-inch caliper size, and 12 inches above

ground for larger sizes. Measure main body of tree or shrub for height and spread; do not measure branches or roots tip-to-tip.

- F. Observation: Landscape Architect may observe trees and shrubs either at place of growth or at site before planting for compliance with requirements for genus, species, variety, size, and quality. Landscape Architect retains right to observe trees and shrubs further for size and condition of balls and root systems, insects, injuries, and latent defects and to reject unsatisfactory or defective material at any time during progress of work. Remove rejected trees or shrubs immediately from Project site.

- 1. Notify Landscape Architect of sources of planting materials 7 days in advance of delivery to site.

- G. Measurements: Measure according to ANSI Z60.1. Do not prune to obtain required sizes.

- 1. Trees and Shrubs: Measure with branches and trunks or canes in their normal position. Take height measurements from or near the top of the root flare for field-grown stock and container grown stock. Measure main body of tree or shrub for height and spread; do not measure branches or roots tip to tip. Take caliper measurements 6 inches above the root flare for trees up to 4-inch caliper size, and 12 inches above the root flare for larger sizes.
 - 2. Other Plants: Measure with stems, petioles, and foliage in their normal position.

1.6 PLANT MATERIAL QUANTITIES

- A. In the event of a discrepancy in plant material quantities between the Drawing Plan and the Drawing Plant Schedule, the Drawing Plan Quantity shall be required.

1.7 SUBSTITUTIONS

- A. If specified plant material or products are not obtainable from (5) five nurseries or supply companies, submit proof of non-availability together with a proposal including a minimum of (3) three options of equivalent materials at least (90) ninety days prior to starting work.
 - 1. Submit all proposed changes in writing to Landscape Architect at least one month prior to start of planting operations.
 - 2. These provisions shall not relieve Contractor of the responsibility of obtaining specified materials in advance if special growing conditions or other arrangements must be made in order to supply specified materials.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of conformance with state and federal laws if applicable.
- B. Bulk Materials:
 - 1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.

2. Provide erosion-control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
 3. Accompany each delivery of bulk fertilizers and soil amendments with appropriate certificates.
- C. Deliver exterior plants freshly dug.
- D. Do not prune trees and shrubs before delivery, except as approved by Landscape Architect. Protect bark, branches, and root systems from sun scald, drying, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy their natural shape. Provide protective covering of exterior plants during delivery. Do not drop exterior plants during delivery.
- E. Handle planting stock by root ball.
- F. Deliver exterior plants after preparations for planting have been completed and install immediately. If planting is delayed more than six hours after delivery, set exterior plants trees in shade, protect from weather and mechanical damage, and keep roots moist.
1. Set balled stock on ground and cover ball with soil, peat moss, sawdust, or other acceptable material.
 2. Do not remove container-grown stock from containers before time of planting.
 3. Water root systems of exterior plants stored on-site with a fine-mist spray. Water as often as necessary to maintain root systems in a moist condition.
- G. Transportation of Plant Material: Plants transported to the project in open vehicles shall be covered with tarpaulins or other suitable covers securely fastened to the body of the vehicle to prevent injury to the plants. Closed vehicles shall be adequately ventilated to prevent overheating of the plants. Plants shall not remain in darkened enclosed trailer for more than 48 hours cumulative.
1. Plants shall be kept moist, fresh, and protected at all times. Such protection shall encompass the entire period during which the plants are in transit, being handled, or are in temporary storage.
 2. Unless otherwise authorized by the Landscape Architect, notify the Landscape Architect at least three working days in advance of the anticipated delivery date of any plant material. A legible copy of the bill of lading, showing the quantities, kinds, and sizes of materials included for each shipment shall be furnished to the Landscape Architect.
- H. Planting Soil and Organic Amendment: The Contractor is responsible for coordinating blending, shipping, delivery, and installation of soils so that the following conditions are met:
1. Components of stockpiled mixes do not segregate or become contaminated.
 2. Placement and compaction of the soils shall be coordinated to avoid damage to other installed work, subdrainage, or irrigation systems.
 3. Deliver to site and place directly in beds or stockpile. Do not place, move, work, or traffic over topsoil and compost when the moisture content is greater than 10- 15% volumetric moisture.
 4. Cover and protect all planting soil and organic amendment with landscape fabric or plastic if it will be left unplanted for more than 24 hours. The stock piles should not be left uncovered over weekends. Soil stock should be stored in lifts not taller than 48". Secure landscape fabric or plastic with sandbags or other weights so the cover does not blow away.

5. The Contractor shall not allow any weeds to establish within topsoil and organic amendment while stockpiled or after placement.
 6. The Contractor shall be responsible for removing all weeds that occur within the warranty period within the project limits.
- I. Storage: Unless specific authorization is obtained from the Architect, plants shall not remain on the work site longer than three days prior to being planted
1. Plants that are not planted immediately shall be protected as follows:
 - a. Earth balls shall be kept appropriately moist and their solidity carefully preserved.
 - b. Plants shall not be allowed to dry out or freeze.
 2. Both the duration and method of storage of plant materials shall be subject to the approval of the Architect
- J. Handling of Plant Materials: Exercise care in handling plant materials to avoid damage or stress.
- K. Tree Guying and Landscape Fabric: Store to prevent tears, punctures, and damage. Provide material in original, unopened containers with manufacturer's labels intact and legible. Store materials in dry area in manufacturer's protective packaging, in original containers with labels and instructions intact.

1.9 COORDINATION

- A. Planting Restrictions: Plant during one of the following periods. Coordinate planting periods with maintenance periods to provide required maintenance from date of Substantial Completion.
1. Spring Planting: April 1 to May 30
 2. Fall Planting: October 1 to Nov 30
- B. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions and warranty requirements. Under no circumstances is planting to be permitted during freezing weather, in frozen ground, excessive moisture, drought or other unsatisfactory conditions. Excessive moisture includes any soil moisture level that will adversely affect soil porosity and infiltration rates by increasing compaction.
- C. Coordination with Turf Areas (Lawns): Plant trees, shrubs, and other plants after finish grades are established and before planting turf areas unless otherwise indicated.

1.10 REJECTION OF MATERIALS

- A. Evidence of inadequate protection following digging, carelessness while in transit, or improper handling or storage, shall be cause for rejection. Evidence may include, but not be limited to, broken leaders, bark tears, broken limbs, or weak root balls.
- B. Upon arrival at the temporary storage location or the site of the work, plants shall be inspected for proper shipping procedures. Should the roots be dried out, large branches be broken, balls of earth broken or loosened, or areas of bark be torn, the Architect will reject the injured plant.

- C. When a plant has been rejected, remove it from the area of the work within 3 days and replace it with one of the required size and quality at no change in Contract Amount.

1.11 WARRANTY

- A. Special Warranty: Warrant the following exterior plants, for the warranty period indicated, against defects including death and unsatisfactory growth, except for defects resulting from lack of adequate maintenance, neglect, or abuse by Owner, or incidents that are beyond Contractor's control.
 - 1. Warranty periods below are examples only for some categories of exterior plants; revise to suit Project.
 - 2. Warranty Period for Trees and Shrubs: One year from date of Final Completion.
 - 3. Remove dead exterior plants immediately. Replace immediately unless required to plant in the succeeding planting season.
 - 4. Replace exterior plants that are more than 25 percent dead or in an unhealthy condition at end of warranty period.
 - 5. A limit of one replacement of each exterior plant will be required, except for losses or replacements due to failure to comply with requirements.

1.12 MAINTENANCE

- A. Trees and Shrubs: Maintain for the following maintenance period by pruning, cultivating, watering, weeding, fertilizing, restoring planting saucers, tightening and repairing stakes and guy supports, and resetting to proper grades or vertical position, as required to establish healthy, viable plantings. Spray as required to keep trees and shrubs free of insects and disease. Restore or replace damaged tree wrappings.
 - 1. Maintenance Period: until Final Completion.

PART 2 - PRODUCTS

2.1 TREE AND SHRUB MATERIAL

- A. General: Furnish nursery-grown trees and shrubs complying with ANSI Z60.1, with healthy root systems developed by transplanting or root pruning. Provide well-shaped, fully branched, healthy, vigorous stock free of disease, insects, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.
 - 1. Trees with damaged, crooked, or multiple leaders; tight vertical branches where bark is squeezed between two branches or between branch and trunk (including bark); crossing trunks; cut-off limbs more than 3/4 inch in diameter; or stem girdling roots will be rejected.
 - 2. Collected Stock: Do not use plants harvested from the wild, from native stands, from established landscape planting, or not grown in a nursery unless otherwise indicated.
 - 3. Trunk: the trunk of each tree shall be a single trunk (except for multi-stem trees) growing from a single un-mutilated crown of roots. No part of the trunk shall be conspicuously crooked as compared with normal trees of the same variety. The trunk shall be free from sunscald, frost cracks, or wounds resulting from abrasions, fire or other causes. No pruning wounds shall be present having a diameter exceeding one inch and such wounds must show vigorous bark on all edges. Plants shall not be pruned prior to delivery. No

trees with double-leaders or twin-heads shall be acceptable. The Contractor shall reject such plants at time of delivery by the nursery/supplier unless such plants were selected by the Architect as indicated by tags and seals.

- B. Grade: Provide trees and shrubs of sizes and grades complying with ANSI Z60.1 for type of trees and shrubs required. Trees and shrubs of a larger size may be used if acceptable to Landscape Architect, with a proportionate increase in size of roots or balls.
 - 1. Label each tree and shrub of each variety and caliper with a securely attached, waterproof tag bearing legible designation of botanical and common name.
 - 2. If formal arrangements, groupings, or consecutive order of trees or shrubs is shown, select stock for uniform height and spread, and number label to assure symmetry and consistency in planting.
- C. Name: True to botanical name, common name and hybrid, variety, or cultivar as adopted by the American Joint committee on Horticultural Nomenclature, Standardized Plant Names, latest edition, which are true to type and species.
- D. Health: Comply with local, state, and federal laws pertaining to the inspection for diseases and insect infestation, scale and shipment of plant materials. Plants shall be healthy and vigorous, free of disease, insect pests and their eggs, and larvae.

2.2 SHADE AND FLOWERING TREES

- A. Shade Trees: Single-stem trees with straight trunk, well-balanced crown, and intact leader, of height and caliper indicated, complying with ANSI Z60.1 for type of trees required.
 - 1. Provide balled and burlapped trees.
 - 2. Branching Height: One-third to one-half of tree height.
- B. Small Flowering Trees: Branched or pruned naturally according to species and type, with relationship of caliper, height, and branching according to ANSI Z60.1; stem form as follows:
 - 1. Form: Single stem or Multistem, clump, with two or more main stems as indicated on the Drawings.
 - 2. Provide balled and burlapped trees.

2.3 DECIDUOUS SHRUBS

- A. Form and Size: Deciduous shrubs with not less than the minimum number of canes required by and measured according to ANSI Z60.1 for type, shape, and height of shrub.
 - 1. Provide container-grown shrubs.

2.4 TOPSOIL

- A. Topsoil: ASTM D 5268, pH range of 5.5 to 7, a minimum of 4 and maximum of 6 percent organic material content; free of stones 1 inch or larger in any dimension and other extraneous materials harmful to plant growth.

1. Topsoil Source: Import topsoil or manufactured topsoil from off-site sources. Obtain topsoil displaced from naturally well-drained construction or mining sites where topsoil occurs at least 4 inches deep; do not obtain from bogs or marshes.
2. Topsoil Source: Amend existing in-place surface soil to produce topsoil. Verify suitability of surface soil to produce topsoil. Clean surface soil of roots, plants, sod, stones, clay lumps, and other extraneous materials harmful to plant growth.
 - a. Surface soil may be supplemented with imported or manufactured topsoil from off site sources. Obtain topsoil displaced from naturally well-drained construction or mining sites where topsoil occurs at least 4 inches deep; do not obtain from agricultural land, bogs or marshes.

2.5 INORGANIC SOIL AMENDMENTS

- A. Lime: ASTM C 602, agricultural limestone containing a minimum 80 percent calcium carbonate equivalent and as follows:
 1. Class: Class T, with a minimum 99 percent passing through No. 8 sieve and a minimum 75 percent passing through No. 60 sieve.
 2. Provide lime in form of dolomitic limestone.
- B. Select appropriate sulfate compounds from first three paragraphs below. Sulfur is used to lower pH and neutralize alkaline soils. Revise descriptions and add proprietary products if required.
- C. Sulfur: Granular, biodegradable, containing a minimum of 90 percent sulfur, with a minimum 99 percent passing through No. 6 sieve and a maximum 10 percent passing through No. 40 sieve.
- D. Iron Sulfate: Granulated ferrous sulfate containing a minimum of 20 percent iron and 10 percent sulfur.
- E. Aluminum Sulfate: Commercial grade, unadulterated.
- F. Perlite: Horticultural perlite, soil amendment grade.
- G. Gypsum is used to supply calcium-deficient soils, improve soil structure, and unlock or make available other nutrients to plant roots. Gypsum is also used to reclaim highly alkaline sodic soils by replacing sodium with calcium. Sodium is washed away by leaching the planting soil.
- H. Agricultural Gypsum: Finely ground, containing a minimum of 90 percent calcium sulfate.
- I. Sand: Clean, washed, natural or manufactured, free of toxic materials.
- J. Diatomaceous Earth: Calcined, diatomaceous earth, 90 percent silica, with approximately 140 percent water absorption capacity by weight.
- K. Zeolites: Mineral clinoptilolite with at least 60 percent water absorption by weight.

2.6 ORGANIC SOIL AMENDMENTS

- A. Compost: Well-composted, stable, and weed-free organic matter, pH range of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through 1/2-inch sieve;

soluble salt content of less than 10 decisiemens /m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and as follows:

1. Organic Matter Content: 50 to 60 percent of dry weight.
 2. Feedstock: Agricultural, food, or industrial residuals; biosolids; yard trimmings; or source-separated or compostable mixed solid waste.
- B. Peat: Finely divided or granular texture, with a pH range of 6 to 7.5, containing partially decomposed moss peat, native peat, or reed-sedge peat and having a water-absorbing capacity of 1100 to 2000 percent.
- C. Wood Derivatives: Decomposed, nitrogen-treated sawdust, ground bark, or wood waste; of uniform texture, free of chips, stones, sticks, soil, or toxic materials.
- D. Manure: Well-rotted, unleached, stable or cattle manure containing not more than 25 percent by volume of straw, sawdust, or other bedding materials; free of toxic substances, stones, sticks, soil, weed seed, and material harmful to plant growth.

2.7 FERTILIZER

- A. Bonemeal: Commercial, raw or steamed, finely ground; a minimum of 1 percent nitrogen and 10 percent phosphoric acid.
- B. Superphosphate: Commercial, phosphate mixture, soluble; a minimum of 20 percent available phosphoric acid.
- C. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:
1. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing agency.
- D. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:
1. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing agency.

2.8 MULCHES

- A. Organic Mulch: Free from deleterious materials and suitable as a top dressing of trees and shrubs, consisting of one of the following:
1. Type for trees, shrubs, grasses: Double shredded hardwood.

2.9 STAKES AND GUYS

- A. Upright and Guy Stakes: Steel "Tee" posts or approved equal, 8 feet in length.
- B. Guy: ArborTie or approved equal.

2.10 MISCELLANEOUS PRODUCTS

- A. Antidesiccant: Water-insoluble emulsion, permeable moisture retarder, film forming, for trees and shrubs. Deliver in original, sealed, and fully labeled containers and mix according to manufacturer's written instructions.
- B. Trunk-Wrap Tape: Two layers of crinkled paper cemented together with bituminous material, 4-inch- wide minimum, with stretch factor of 33 percent.

2.11 PLANTING SOIL MIX

- A. Planting Soil Mix: Mix topsoil with the following soil amendments and fertilizers in the following quantities:
 - 1. Topsoil blended with amendments and fertilizer in different portions as recommended by a qualified testing agency to produce satisfactory planting soil for bioretention plantings as indicated on the Drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive lawns and grass for compliance with requirements and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the work indicates acceptance. Any rework to correct deficient conditions will be done at the contractor's expense.
 - 1. Verify that final grades have been established, and that foreseeable plant growth will not interfere with previously completed work, especially underground utilities.
 - 2. Verify plant material is free of injury and insect infestation.
 - 3. Verify that the soils and subsoils in the areas where plant materials are to be installed have satisfactory drainage.
 - 4. Verify that the soils and subsoils in the areas where plant materials are to be installed contain no toxic materials or construction waste, trash, debris and stones larger than 1" in diameter or length, and free of all roots, brush, weeds, grass, wire, grade stakes, and other objects that would interfere with soil preparation.
 - 5. Do not mix or place soils and soil amendments in frozen, wet, or muddy conditions.
 - 6. Suspend soil spreading, grading, and tilling operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
 - 7. Verify that the surface moisture content is suitable for soil placement operations. Do not place any soil mix during precipitation events, or when the subgrade is in a frozen condition.
 - 8. Uniformly moisten excessively dry soil that is not workable and which is too dusty.

3.2 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities, and lawns and existing exterior plants from damage caused by planting operations.

- B. Provide erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.
- C. Lay out individual tree and shrub locations and areas for multiple exterior plantings. Stake locations, outline areas, adjust locations when requested, and obtain Landscape Architect's acceptance of layout before planting. Make minor adjustments as required.
- D. Apply antidesiccant to trees and shrubs using power spray to provide an adequate film over trunks, branches, stems, twigs, and foliage to protect during digging, handling, and transportation.
 - 1. If deciduous trees or shrubs are moved in full leaf, spray with antidesiccant at nursery before moving and again two weeks after planting.

3.3 PLANTING BED ESTABLISHMENT

- A. Loosen subgrade of planting beds to a minimum depth of 8 inches. Remove stones larger than 1 inch in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.
 - 1. Spread topsoil, apply soil amendments and fertilizer on surface, and thoroughly blend planting soil mix.
 - a. Delay mixing fertilizer with planting soil if planting will not proceed within a few days.
 - b. Mix lime with dry soil before mixing fertilizer.
 - 2. Spread planting soil mix to a depth of 6 inches but not less than required to meet finish grades after natural settlement. Do not spread if planting soil or subgrade is frozen, muddy, or excessively wet.
- B. Finish Grading: Grade planting beds to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.
- C. Restore planting beds if eroded or otherwise disturbed after finish grading and before planting.

3.4 TREE AND SHRUB EXCAVATION

- A. Pits and Trenches: Excavate circular pits with sides sloped inward. Trim base leaving center area raised slightly to support root ball and assist in drainage. Do not further disturb base. Scarify sides of plant pit smeared or smoothed during excavation.
 - 1. Excavate approximately three times as wide as ball diameter for balled and burlapped and container-grown stock.
- B. Subsoil removed from excavations may be used as backfill.
- C. Obstructions: Notify Landscape Architect if unexpected rock or obstructions detrimental to trees or shrubs are encountered in excavations.
 - 1. Hardpan Layer: Drill 6-inch-diameter holes into free-draining strata or to a depth of 10 feet, whichever is less, and backfill with free-draining material.

- D. Drainage: Notify Landscape Architect if subsoil conditions evidence unexpected water seepage or retention in tree or shrub pits.
- E. Fill excavations with water and allow to percolate away before positioning trees and shrubs.

3.5 TREE AND SHRUB PLANTING

- A. Set balled and burlapped stock plumb and in center of pit or trench with top of root ball 1 to 2 inches above adjacent finish grades.
 - 1. Remove burlap and wire baskets from tops of root balls and partially from sides, but do not remove from under root balls. Remove pallets, if any, before setting. Do not use planting stock if root ball is cracked or broken before or during planting operation.
 - 2. Place planting soil mix around root ball in layers, tamping to settle mix and eliminate voids and air pockets. When pit is approximately one-half backfilled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed. Water again after placing and tamping final layer of planting soil mix.
- B. Set container-grown stock plumb and in center of pit or trench with top of root ball 1 to 2 inches above adjacent finish grades.
 - 1. Carefully remove root ball from container without damaging root ball or plant.
 - 2. Place planting soil mix around root ball in layers, tamping to settle mix and eliminate voids and air pockets. When pit is approximately one-half backfilled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed. Water again after placing and tamping final layer of planting soil mix.
- C. Organic Mulching: Apply 3-inch average thickness of organic mulch extending 12 inches beyond edge of planting pit or trench. Do not place mulch within 3 inches of trunks or stems.
- D. Wrap trees of 2-inch caliper and larger with trunk-wrap tape. Start at base of trunk and spiral cover trunk to height of first branches. Overlap wrap, exposing half the width, and securely attach without causing girdling. Inspect tree trunks for injury, improper pruning, and insect infestation; take corrective measures required before wrapping.

3.6 TREE AND SHRUB PRUNING

- A. Prune, thin, and shape trees and shrubs according to standard horticultural practice. Prune trees to retain required height and spread. Unless otherwise indicated by Landscape Architect, do not cut tree leaders; remove only injured or dead branches from trees and any branches in the way of pedestrians on trees planted along sidewalks. Prune off all suckers. Prune shrubs to retain natural character. Shrub sizes indicated are sizes after pruning.

3.7 GUYING AND STAKING

- A. Upright Staking and Tying: Stake trees of 2- through 5-inch caliper. Stake trees of less than 2-inch caliper only as required to prevent wind tip-out. Use 2 steel "Tee" posts of 8 foot length or approved equal driven 6 inches to 8 inches outside of rootball. Loosely stake tree trunk to allow for trunk flexing. Stake trees just below first branch with 1 inch to 3 inch wide polypropylene straps (2 per tree on opposite sides of tree, connect from tree to stake horizontally).

1. Do not use rope or wire through a hose. Arbor Tie is an acceptable product.
- B. Remove all staking materials after one year, or as otherwise directed by the Landscape Architect.

3.8 PLANT BED MULCHING

- A. Mulch backfilled surfaces of planting beds and other areas indicated. Do NOT use weed-barriers in planting beds. Weed-barrier is to be used under gravel beds only.
 1. Double Shredded Hardwood Mulch: Apply 3-inch average thickness of organic mulch, and finish level with adjacent finish grades. Do not place mulch against plant stems.

3.9 PLANT MAINTENANCE

- A. Maintain plantings by pruning, cultivating, watering, weeding, fertilizing, mulching, restoring planting saucers, adjusting and repairing tree-stabilization devices, resetting to proper grades or vertical position, and performing other operations as required to establish healthy, viable plantings. Spray or treat as required to keep trees and shrubs free of insects and disease.
- B. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace mulch materials damaged or lost in areas of subsidence.
- C. Apply treatments as required to keep plant materials, planted areas, and soils free of pests and pathogens or disease. Use integrated pest management practices whenever possible to minimize the use of pesticides and reduce hazards. Treatments include physical controls such as hosing off foliage, mechanical controls such as traps, and biological control agents.

3.10 CLEANUP AND PROTECTION

- A. During exterior planting, keep adjacent paving and construction clean and work area in an orderly condition. Promptly remove soil and debris created by exterior planting work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.
- B. Protection of Drainage System: Protect existing drainage protection system at all drain inlets to prevent silt, materials or debris caused by planting operations from entering the drainage system.
- C. Protect exterior plants and soil from damage due to landscape operations, operations by other contractors and trades, and others. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged exterior planting.
- D. Tags: Remove all identification labels, seals and tags at final acceptance of the project.
- E. Store excess soils and mulches in stockpiles protected from erosion and contamination by other contractors and materials with tarps.

END OF SECTION 32 9300

DIVISION 33

SECTION 33 1000 WATER UTILITIES

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 and fire-service mains.
- 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. PE: Polyethylene plastic.
- D. PP: Polypropylene plastic.
- E. PVC: Polyvinyl chloride plastic.
- F. RTRF: Reinforced thermosetting resin (fiberglass) fittings.
- G. RTRP: Reinforced thermosetting resin (fiberglass) pipe.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Detail precast concrete vault assemblies and indicate dimensions, method of field assembly, and components.

1.5 INFORMATIONAL SUBMITTALS

- A. Field quality-control test reports.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For water valves and specialties to include in emergency, operation, and maintenance manuals.

1.7 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 NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. Comply with ASTM F645 for selection, design, and installation of thermoplastic water piping.
- E. Comply with FMG's "Approval Guide" or UL's "Fire Protection Equipment Directory" for fire-service-main products.
- F. NFPA Compliance: Comply with NFPA 24 for materials, installations, tests, flushing, and valve and hydrant supervision for fire-service-main piping for fire suppression.
 - 1. Potable-water piping and components shall comply with NSF 14, NSF 61, and NSF 372.

1.8 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, including fire hydrants, 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.

1.9 PROJECT CONDITIONS

- A. Interruption of Existing Water-Distribution Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water-distribution service according to requirements indicated:
 - 1. Notify Owner no fewer than two days in advance of proposed interruption of service.
 - 2. Do not proceed with interruption of water-distribution service without Construction Manager's and Owner's written permission.

1.10 COORDINATION

- A. Coordinate connection to water main with utility company.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Comply with requirements in "Piping Application" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.
- B. Potable-water piping and components shall comply with NSF 14, NSF 61, and NSF 372.

2.2 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.

2.3 SPECIAL PIPE FITTINGS

- A. Ductile-Iron Rigid Expansion Joints:
 - 1. 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. 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 (1725 kPa) minimum.

C. Ductile-Iron Deflection Fittings:

1. 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 (1725 kPa) minimum.

2.4 JOINING MATERIALS

- A. Brazing Filler Metals: AWS A5.8, BCuP Series.
- B. Bonding Adhesive for Fiberglass Piping: As recommended by fiberglass piping manufacturer.
- C. Plastic Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

2.5 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. 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: Ductile iron.
- c. Gasket Material: Natural or synthetic rubber.
- d. Pressure Rating: 150 psig (1035 kPa) minimum.
- e. Metal Component Finish: Corrosion-resistant coating or material.

C. Split-Sleeve Pipe Couplings:

1. 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: 150 psig (1035 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:
1. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
 2. Dielectric Flanges:
 - a. Description:
 - 1) Standard: ASSE 1079.
 - 2) Factory-fabricated, bolted, companion-flange assembly.
 - 3) Pressure Rating: 150 psig (1035 kPa).
 - 4) End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
 3. Dielectric-Flange Insulating Kits:
 - a. Description:
 - 1) Nonconducting materials for field assembly of companion flanges.
 - 2) Pressure Rating: 150 psig (1035 kPa).
 - 3) Gasket: Neoprene or phenolic.
 - 4) Bolt Sleeves: Phenolic or polyethylene.
 - 5) Washers: Phenolic with steel backing washers.
 4. Dielectric Nipples:
 - a. Description:
 - 1) Standard: IAPMO PS 66.
 - 2) Electroplated steel nipple complying with ASTM F1545.
 - 3) Pressure Rating: 300 psig (2070 kPa) at 225 deg F (107 deg C).
 - 4) End Connections: Male threaded or grooved.
 - 5) Lining: Inert and noncorrosive, propylene.
- 2.6 CORROSION-PROTECTION PIPING ENCASEMENT
- A. Encasement for Underground Metal Piping:
1. Standards: ASTM A674 or AWWA C105.
 2. Form: Sheet or tube.
 3. Material: LLDPE film of 0.008-inch (0.20-mm) minimum thickness, or high-density, crosslaminated PE film of 0.004-inch (0.10-mm) minimum thickness.
 4. Color: Black.
- 2.7 GATE VALVES
- A. AWWA, Cast-Iron Gate Valves:
1. 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 (1380 kPa).
 - 3) End Connections: Mechanical joint.
 - 4) Interior Coating: Complying with AWWA C550.
 2. 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 (1380 kPa).
 - 3) End Connections: Mechanical joint.
 - 4) Interior Coating: Complying with AWWA C550.
- 3. Nonrising-Stem, High-Pressure, Resilient-Seated Gate Valves:
 - a. Description: Ductile-iron body and bonnet; with bronze or ductile-iron gate, resilient seats, bronze stem, and stem nut.
 - 1) Standard: AWWA C509.
 - 2) Minimum Pressure Rating: 250 psig (1725 kPa).
 - 3) End Connections: Push on or 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 (1380 kPa).
 - 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 (1380 kPa).
 - 3) End Connections: Flanged.

2.8 GATE VALVE ACCESSORIES AND SPECIALTIES

- A. Tapping-Sleeve Assemblies:
 - 1. 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 (125 mm) 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.
- C. Indicator Posts: UL 789, FMG-approved, vertical-type, cast-iron body with operating wrench, extension rod, and adjustable cast-iron barrel of length required for depth of burial of valve.

2.9 CHECK VALVES

- A. AWWA Check Valves:

1. Description: Swing-check type with resilient seat. Include interior coating according to AWWA C550 and ends to match piping.
 - a. Standard: AWWA C508.
 - b. Pressure Rating: 175 psig (1207 kPa).
- 2.10 DETECTOR CHECK VALVES
 - A. Detector Check Valves:
 1. Description: Galvanized cast-iron body, bolted cover with air-bleed device for access to internal parts, and flanged ends. Include one-piece bronze disc with bronze bushings, pivot, and replaceable seat. Include threaded bypass taps in inlet and outlet for bypass meter connection. Set valve to allow minimal water flow through bypass meter when major water flow is required.
 - a. Standards: UL 312 and FMG approved.
 - b. Pressure Rating: 175 psig (1207 kPa).
 - c. Water Meter: AWWA C700, disc type, at least one-fourth size of detector check valve. Include meter, bypass piping, gate valves, check valve, and connections to detector check valve.
- 2.11 BUTTERFLY VALVES
 - A. AWWA Butterfly Valves:
 1. Description: Rubber seated.
 - a. Standard: AWWA C504.
 - b. Body: Cast or ductile iron.
 - c. Body Type: Wafer or flanged.
 - d. Pressure Rating: 150 psig (1035 kPa).
- 2.12 PLUG VALVES
 - A. Plug Valves:
 1. Description: Resilient-seated eccentric.
 - a. Standard: MSS SP-108.
 - b. Body: Cast iron.
 - c. Pressure Rating: 175-psig (1207-kPa) minimum CWP.
 - d. Seat Material: Suitable for potable-water service.
- 2.13 CURB VALVES
 - A. 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.
 - B. Service Boxes for Curb Valves: Similar to AWWA M44 requirements for cast-iron valve boxes. Include cast-iron telescoping top section of length required for depth of burial of valve, plug with lettering "WATER," and bottom section with base that fits over curb valve and with a barrel approximately 3 inches (75 mm) in diameter.
 1. Shutoff Rods: Steel, tee-handle with one pointed end, stem of length to operate deepest buried valve, and slotted end matching curb valve.
- 2.14 WATER METERS
 - A. Water meters will be furnished by utility company.
- 2.15 DETECTOR-TYPE WATER METERS
 - A. Detector-Type Water Meters:
 - B. Description: Main line, proportional meter with second meter on bypass. Register flow in gallons (liters).

1. Standards: AWWA C703, UL listed, and FMG approved.
 2. Pressure Rating: 150 psig (1035 kPa).
 3. Bypass Meter: PWSA approved type, bronze case.
 - a. Size: At least one-half nominal size of main-line meter.
- C. Remote Registration System:
1. Description: Utility company standard; direct-reading type. Include meter modified with signal-transmitting assembly, low-voltage connecting wiring, and remote register assembly.
 - a. Standard: AWWA C706.
 - b. Registration: Flow in gallons (liters).
- 2.16 BACKFLOW PREVENTERS
- A. Reduced-Pressure-Principle Backflow Preventers:
1. Standard: AWWA C511.
 2. Operation: Continuous-pressure applications.
 3. Pressure Loss: 12 psig (83 kPa) maximum, through middle 1/3 of flow range.
 4. Size: NPS ½" (DN 125mm).
 5. Design Flow Rate: 1,130 gpd.
 6. Selected Unit Flow Range Limits: 0 gpm to 10 gpm.
 7. Pressure Loss at Design Flow Rate: less than 8 psig for NPS 2 (DN 50) and smaller; less than 10 psig for NPS 2-1/2 (DN 65) and larger.
 8. Body: Bronze for NPS 2 (DN 50) and smaller; stainless steel for NPS 2-1/2 (DN 65) and larger.
 9. End Connections: Threaded for NPS 2 (DN 50) and smaller; flanged for NPS 2-1/2 (DN 65) and larger.
 10. Configuration: Designed for horizontal, straight through flow.
 11. Accessories:
 - a. Valves: Ball type with threaded ends on inlet and outlet of NPS 2 (DN 50) and smaller; OS&Y gate type with flanged ends on inlet and outlet of NPS 2-1/2 (DN 65) and larger.
 - b. Air-Gap Fitting: ASME A112.1.2, matching backflow preventer connection.
- B. Double-Check, Backflow-Prevention Assemblies:
1. Standard: AWWA C510.
 2. Operation: Continuous-pressure applications, unless otherwise indicated.
 3. Pressure Loss: 5 psig (35 kPa) maximum, through middle 1/3 of flow range.
 4. Size: NPS 2 ½" (DN 625mm).
 5. Design Flow Rate: as directed by PWSA and ACHD plumbing division.
 6. Selected Unit Flow Range Limits: 0 gpm to 400 gpm.
 7. Pressure Loss at Design Flow Rate: less than 8 psig for NPS 2 (DN 50) and smaller; less than 10 psig for NPS 2-1/2 (DN 65) and larger.
 8. Body: Bronze for NPS 2 (DN 50) and smaller; stainless steel for NPS 2-1/2 (DN 65) and larger.
 9. End Connections: Threaded for NPS 2 (DN 50) and smaller; flanged for NPS 2-1/2 (DN 65) and larger.
 10. Configuration: Designed for horizontal, straight through flow.
 11. Accessories: Ball valves with threaded ends on inlet and outlet of NPS 2 (DN 50) and smaller; OS&Y gate valves with flanged ends on inlet and outlet of NPS 2-1/2 (DN 65) and larger.
- C. Backflow Preventer Test Kits:

1. Description: Factory calibrated, with gages, fittings, hoses, and carrying case with test-procedure instructions.
- 2.17 WATER METER BOXES
- A. Description: Cast-iron body and cover for disc-type water meter, with lettering "WATER METER" in cover; and with slotted, open-bottom base section of length to fit over service piping.
- 2.18 CONCRETE VAULTS
- A. Description: Precast, reinforced-concrete vault, designed for A-16 load designation according to ASTM C857 and made according to ASTM C858.
 1. Ladder: ASTM A36/A36M, steel or polyethylene-encased steel steps.
 2. Manhole: ASTM A48/A48M Class No. 35A minimum tensile strength, gray-iron traffic frame and cover.
 - a. Dimension: 24-inch (610-mm) minimum diameter, unless otherwise indicated.
 3. Drain: ASME A112.6.3, cast-iron floor drain with outlet of size indicated. Include body anchor flange, light-duty cast-iron grate, bottom outlet, and integral or field-installed bronze ball or clapper-type backwater valve.
- 2.19 PROTECTIVE ENCLOSURES
- A. Freeze-Protection Enclosures:
 1. Description: Insulated enclosure designed to protect aboveground water piping, equipment, or specialties from freezing and damage, with heat source to maintain minimum internal temperature of 40 deg F (4 deg C) when external temperatures reach as low as minus 34 deg F (minus 36 deg C).
 - a. Standard: ASSE 1060.
 - b. Class I: For equipment or devices other than pressure or atmospheric vacuum breakers.
 - 1) Housing: Reinforced-aluminum or -fiberglass construction.
 - a) Size: Of dimensions indicated, but not less than those required for access and service of protected unit.
 - b) Drain opening for units with drain connection.
 - c) Access doors with locking devices.
 - d) Insulation inside housing.
 - e) Anchoring devices for attaching housing to concrete base.
 - B. Weather-Resistant Enclosures:
 1. Description: Uninsulated enclosure designed to protect aboveground water piping, equipment, or specialties from weather and damage.
 - a. Standard: ASSE 1060.
 - b. Class III: For equipment or devices other than pressure or atmospheric vacuum breakers.
 - c. Class III-V: For pressure or atmospheric vacuum breaker equipment or devices. Include drain opening in housing.
 - 1) Housing: Reinforced-aluminum or -fiberglass construction.
 - a) Size: Of dimensions indicated, but not less than those required for access and service of protected unit.
 - b) Drain opening for units with drain connection.
 - c) Access doors with locking devices.

- d) Anchoring devices for attaching housing to concrete base.

C. Expanded-Metal Enclosures:

1. Description: Enclosure designed to protect aboveground water piping, equipment, or specialties from damage.
 - a. Material: ASTM F1267, expanded metal side and top panels, of weight and with reinforcement of same metal at edges as required for rigidity.
 - b. Type: Type I, expanded II, expanded and flattened.
 - c. Class: Class 1, uncoated carbon steel 2, hot-dip, zinc-coated carbon steel 3, corrosion-resisting steel.
 - d. Finish: Manufacturer's enamel paint.
 - e. Size: Of dimensions indicated, but not less than those required for access and service of protected unit.
 - f. Locking device.
 - g. Lugs or devices for securing enclosure to base.

D. Enclosure Bases:

1. Description: 4-inch- (100-mm-) 6-inch- (150-mm-) minimum thickness precast concrete, of dimensions required to extend at least 6 inches (150 mm) beyond edges of enclosure housings. Include openings for piping.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Refer to Section 31 2200 Grading and 31 2300 Excavation and Backfill 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 (DN 75 to DN 200) shall be the following:
 1. Ductile-iron, mechanical-joint pipe; ductile-iron, mechanical-joint fittings; and mechanical joints.
- F. Water Meter Box Water-Service Piping NPS 3/4 to NPS 2 (DN 20 to DN 50) shall be same as underground water-service piping.
- G. Aboveground and vault water-service piping NPS 4 to NPS 8 (DN 75 to DN 200) shall be the following:
 1. Ductile-iron, grooved-end pipe; ductile-iron, grooved-end appurtenances; and grooved joints.
- H. Underground Fire-Service-Main Piping NPS 3 to NPS 12 (DN 75 to DN 300) shall be the following:
 1. Ductile-iron, mechanical-joint pipe; ductile-iron, mechanical-joint fittings; and mechanical joints.
- I. Aboveground and Vault Fire-Service-Main Piping NPS 3 to NPS 12 (DN 75 to DN 300) shall be ductile-iron, grooved-end pipe; ductile-iron-pipe appurtenances; and grooved joints.
- J. Underground Combined Water-Service and Fire-Service-Main Piping NPS 6 to NPS 12 (DN 150 to DN 300) shall be the following:

1. Ductile-iron, mechanical-joint pipe; ductile-iron, mechanical-joint fittings; and mechanical joints.
- K. Aboveground and Vault Combined Water Service and Fire-Service-Main Piping NPS 6 to NPS 12 (DN 150 to DN 300) shall be ductile-iron, grooved-end pipe; ductile-iron-pipe appurtenances; and grooved joints.
- 3.3 VALVE APPLICATIONS
- A. General Application: Use mechanical-joint-end valves for NPS 3 (DN 80) and larger underground installation. Use threaded- or flanged-end valves for installation in vaults. Use UL/FMG, nonrising-stem gate valves for installation with indicator posts. Use corporation valves and curb valves with ends compatible with piping, for NPS 2 (DN 50) and smaller installation.
- B. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
1. Underground Valves, NPS 3 (DN 80) and Larger: AWWA, cast-iron, nonrising-stem, high-pressure, resilient-seated gate valves with valve box.
 2. Use the following for valves in vaults and aboveground:
 - a. Gate Valves, NPS 2 (DN 50) and Smaller: Bronze, rising stem.
 - b. Gate Valves, NPS 3 (DN 80) and Larger: AWWA, cast iron, OS&Y rising stem, metal seated.
 - c. Check Valves: AWWA C508, swing type.
 3. Pressure-Reducing Valves: Use for water-service piping in vaults and aboveground to control water pressure.
 4. Relief Valves: Use for water-service piping in vaults and aboveground.
 - a. Air-Release Valves: To release accumulated air.
 - b. Air/Vacuum Valves: To release or admit large volume of air during filling of piping.
 - c. Combination Air Valves: To release or admit air.
 5. Detector Check Valves: Use for water-service piping in vaults and aboveground to detect unauthorized use of water.
- 3.4 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 (DN 50) 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.
 5. Install copper tube and fittings according to CDA's "Copper Tube Handbook."
- C. Install ductile-iron, water-service piping according to AWWA C600 and AWWA M41.
- D. Bury piping with depth of cover over top at least 30 inches (750 mm), with top at least 12 inches (300 mm) below level of maximum frost penetration, and according to the following:
1. Under Driveways: With at least 36 inches (910 mm) cover over top.
 2. Under Railroad Tracks: With at least 48 inches (1220 mm) cover over top.
 3. In Loose Gravelly Soil and Rock: With at least 12 inches (300 mm) additional cover.
- E. Install piping by tunneling or jacking, or combination of both, under streets and other obstructions that cannot be disturbed.
- F. 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.
- G. 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.
- 3.5 JOINT CONSTRUCTION
- A. Make pipe joints according to the following:
1. Copper-Tubing, Pressure-Sealed Joints: Join copper tube and pressure-seal fittings with tools and procedures recommended by pressure-seal-fitting manufacturer. Leave insertion marks on pipe after assembly.
 2. Ductile-Iron Piping, Gasketed Joints for Water-Service Piping: AWWA C600 and AWWA M41.
 3. Ductile-Iron Piping, Gasketed Joints for Fire-Service-Main Piping: UL 194.
 4. 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.
 5. PE Piping Insert-Fitting Joints: Use plastic insert fittings and fasteners according to fitting manufacturer's written instructions.
 6. PVC Piping Gasketed Joints: Use joining materials according to AWWA C900. Construct joints with elastomeric seals and lubricant according to ASTM D2774 or ASTM D3139 and pipe manufacturer's written instructions.
 7. Fiberglass Piping Bonded Joints: Use adhesive and procedure recommended by piping manufacturer.
 8. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- 3.6 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.
 2. Gasketed-Joint, PVC Water-Service Piping: According to AWWA M23.
 3. Bonded-Joint Fiberglass, Water-Service Piping: According to AWWA M45.
 4. Fire-Service-Main Piping: According to NFPA 24.
- C. Apply full coat of asphalt or other acceptable corrosion-resistant material to surfaces of installed ferrous anchorage devices.
- 3.7 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/FMG, Gate Valves: Comply with NFPA 24. Install each underground valve and valves in vaults with stem pointing up and with vertical cast-iron indicator post.
- D. UL/FMG, Valves Other Than Gate Valves: Comply with NFPA 24.
- E. MSS Valves: Install as component of connected piping system.

- F. Corporation Valves and Curb Valves: Install each underground curb valve with head pointed up and with service box.
 - G. Pressure-Reducing Valves: Install in vault or aboveground between shutoff valves.
 - H. Relief Valves: Comply with AWWA C512. Install aboveground with shutoff valve on inlet.
- 3.8 DETECTOR-CHECK VALVE INSTALLATION
- A. Install in vault 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, meters, shutoff valves, and piping on brick or concrete piers.
- 3.9 WATER METER INSTALLATION
- A. Install water meters, piping, and specialties according to utility company's written instructions.
 - B. Water Meters: Install PWSA approved type water meters, NPS 2 (DN 50) and smaller, in meter boxes with shutoff valves on water meter inlets. Include valves on water meter outlets and valved bypass around meters unless prohibited by authorities having jurisdiction.
 - C. Water Meters: Install PWSA approved 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.
 - D. 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 VACUUM BREAKER ASSEMBLY INSTALLATION
- A. Install pressure vacuum breaker assemblies of type, size, and capacity indicated. Include valves and test cocks. Install according to requirements of plumbing and health department and authorities having jurisdiction.
 - B. Do not install pressure vacuum breaker assemblies in vault or other space subject to flooding.
- 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 (DN 65) and larger backflow preventers, valves, and piping near floor and on brick or concrete piers.
- 3.12 WATER METER BOX INSTALLATION
- A. Install water meter boxes in paved areas flush with surface.
 - B. Install water meter boxes in grass or earth areas with top 2 inches (50 mm) above surface.
- 3.13 CONCRETE VAULT INSTALLATION
- A. Install precast concrete vaults according to ASTM C891.
- 3.14 PROTECTIVE ENCLOSURE INSTALLATION
- A. Install concrete base level and with top approximately 2 inches (50 mm) above grade.
 - B. Install protective enclosure over valves and equipment.
 - C. Anchor protective enclosure to concrete base.
- 3.15 FIRE HYDRANT INSTALLATION
- A. General: Install each fire hydrant with separate gate valve in supply pipe, anchor with restrained joints or thrust blocks, and support in upright position.
 - B. Wet-Barrel Fire Hydrants: Install with valve below frost line. Provide for drainage.

- C. AWWA Fire Hydrants: Comply with AWWA M17.
 - D. UL/FMG Fire Hydrants: Comply with NFPA 24.
- 3.16 FLUSHING HYDRANT INSTALLATION
- A. Install post-type flushing hydrants with valve below frost line and provide for drainage. Support in upright position. Include separate gate valve or curb valve and restrained joints in supply piping.
 - B. Install ground-type flushing hydrants with valve below frost line and provide for drainage. Install hydrant box flush with grade. Include separate gate valve or curb valve and restrained joints in supply piping.
 - C. Install sampling stations with valve below frost line and provide for drainage. Attach weather-resistant housing and support in upright position. Include separate curb valve in supply piping.
- 3.17 FIRE DEPARTMENT CONNECTION INSTALLATION
- A. Install ball drip valves at each check valve for fire department connection to mains.
 - B. Install protective pipe bollards on two sides of each fire department connection.
- 3.18 ALARM DEVICE INSTALLATION
- A. General: Comply with NFPA 24 for devices and methods of valve supervision. Underground valves with valve box do not require supervision.
 - B. 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.
 - C. Pressure Switches: Drill and thread hole in exposed barrel of fire hydrant. Install switch.
 - D. 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.
 - E. Connect alarm devices to building fire alarm system, if applicable.
- 3.19 CONNECTIONS
- A. Connect water-distribution piping to utility water main. Use tapping sleeve and tapping valve.
 - B. Connect water-distribution piping to interior domestic water and fire-suppression piping.
 - C. Connect waste piping from concrete vault drains to sanitary sewerage system, if applicable.
- 3.20 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 (350-kPa) increments and inspect each joint between increments. Hold at test pressure for 1 hour; decrease to 0 psig (0 kPa). Slowly increase again to test pressure and hold for 1 more hour. Maximum allowable leakage is 2 quarts (1.89 L) per hour per 100 joints. Remake leaking joints with new materials and repeat test until leakage is within allowed limits.
 - C. Prepare reports of testing activities.
- 3.21 IDENTIFICATION
- A. Install continuous underground detectable warning tape during backfilling of trench for underground water-distribution piping. Locate below finished grade, directly over piping.
 - B. Permanently attach equipment nameplate or marker indicating plastic water-service piping, on main electrical meter panel.
- 3.22 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. After standing time, flush system with clean, potable water until no chlorine remains in water coming from system.
 - c. 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

SECTION 221313
FACILITY SANITARY SEWERS

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. PVC pipe and fittings.
 - 2. Nonpressure-type transition couplings.
 - 3. Pressure-type pipe couplings.
 - 4. Expansion joints and deflection fittings.
 - 5. Backwater valves.
 - 6. Cleanouts.
 - 7. Encasement for piping.
 - 8. Concrete.

1.3 DEFINITIONS

- A. FRP: Fiberglass-reinforced plastic.

1.4 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Pipe and fittings.
 - 2. Non-pressure and pressure couplings
 - 3. Expansion joints and deflection fittings.
 - 4. Backwater valves.
 - 5. Cleanouts.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings:
 - 1. Show pipe sizes, locations, and elevations. Show other piping in same trench and clearances from sewer system piping. Indicate interface and spatial relationship between manholes, piping, and proximate structures.
 - 2. Show system piping in profile. Draw profiles to horizontal scale of not less than 1-inch equals 50 feet (1:500) and to vertical scale of not less than 1-inch equals 5 feet (1:50). Indicate manholes and piping. Show types, sizes, materials, and elevations of other utilities crossing system piping.
- B. Product Certificates: For each type of pipe and fitting.
- C. Field quality-control reports.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Do not store plastic manholes, pipe, and fittings in direct sunlight.
- B. Protect pipe, pipe fittings, and seals from dirt and damage.
- C. Handle manholes according to manufacturer's written rigging instructions.

1.7 FIELD CONDITIONS

- A. Interruption of Existing Sanitary Sewerage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:

1. Notify Owner no fewer than two days in advance of proposed interruption of service.
2. Do not proceed with interruption of service without Construction Manager's and Owner's written permission.

PART 2 - PRODUCTS

2.1 PVC PIPE AND FITTINGS

A. PVC Cellular-Core Sewer Piping:

1. Pipe: ASTM F891, Sewer and Drain Series, PS 50 minimum stiffness, PVC cellular-core pipe with plain ends for solvent-cemented joints.
2. Fittings: ASTM D3034, SDR 35, PVC socket-type fittings.

B. PVC Profile Sewer Piping:

1. Pipe: ASTM F794, PVC profile, gravity sewer pipe with bell-and-spigot ends for gasketed joints.
2. Fittings: ASTM D3034, PVC with bell ends.
3. Gaskets: ASTM F477, elastomeric seals.

C. PVC Gravity Sewer Piping:

1. Pipe and Fittings: ASTM F679, T-1 wall thickness, PVC gravity sewer pipe with bell-and-spigot ends and with integral ASTM F477, elastomeric seals for gasketed joints.

2.2 NONPRESSURE-TYPE TRANSITION COUPLINGS

A. Comply with ASTM C1173, elastomeric, sleeve-type, reducing or transition coupling; for joining underground nonpressure piping. Include ends of same sizes as piping to be joined and include corrosion-resistant-metal tension band and tightening mechanism on each end.

B. Sleeve Materials:

1. For Cast-Iron Soil Pipes: ASTM C564, rubber.
2. For Concrete Pipes: ASTM C443 (ASTM C443M), rubber.
3. For Fiberglass Pipes: ASTM F477, elastomeric seal or ASTM D5926, PVC.
4. For Plastic Pipes: ASTM F477, elastomeric seal or ASTM D5926, PVC.
5. For Dissimilar Pipes: ASTM D5926, PVC or other material compatible with pipe materials being joined.

C. Unshielded, Flexible Couplings:

1. Description: Elastomeric sleeve with corrosion-resistant-metal tension band and tightening mechanism on each end.

D. Shielded, Flexible Couplings:

1. Description: ASTM C1460, elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

E. Ring-Type, Flexible Couplings:

1. Description: Elastomeric compression seal with dimensions to fit inside bell of larger pipe and for spigot of smaller pipe to fit inside ring.

2.3 PRESSURE-TYPE PIPE COUPLINGS

- A. Tubular-Sleeve Couplings: AWWA C219, with center sleeve, gaskets, end rings, and bolt fasteners.
- B. Metal, bolted, sleeve-type, reducing or transition coupling; for joining underground pressure piping. Include 150-psig (1035-kPa) minimum pressure rating and ends of same sizes as piping to be joined.
- C. Center-Sleeve Material: Manufacturer's standard.

- D. Gasket Material: Natural or synthetic rubber.
 - E. Metal Component Finish: Corrosion-resistant coating or material.
- 2.4 BACKWATER VALVES
- A. PVC Backwater Valves:
 - 1. Description: Horizontal type; with PVC body, PVC removable cover, and PVC swing check valve.
- 2.5 CLEANOUTS
- A. PVC Cleanouts:
 - 1. Description: PVC body with PVC threaded plug. Include PVC sewer pipe fitting and riser to cleanout of same material as sewer piping.
- 2.6 ENCASEMENT FOR PIPING
- A. Standard: ASTM A674 or AWWA C105/A21.5.
 - B. Material: high-density, cross-laminated polyethylene film of 0.004-inch (0.10-mm) minimum thickness.
 - C. Form: tube.
 - D. Color: natural.
- 2.7 CONCRETE
- A. General: Cast-in-place concrete complying with ACI 318, ACI 350 (ACI 350M), and the following:
 - 1. Cement: ASTM C150/C150M, Type II.
 - 2. Fine Aggregate: ASTM C33/C33M, sand.
 - 3. Coarse Aggregate: ASTM C33/C33M, crushed gravel.
 - 4. Water: Potable.
 - B. Portland Cement Design Mix: 4000 psi (27.6 MPa) minimum, with 0.45 maximum water/cementitious materials ratio.
 - 1. Reinforcing Fabric: ASTM A1064/A1064M, steel, welded wire fabric, plain.
 - 2. Reinforcing Bars: ASTM A615/A615M, Grade 60 (420-MPa) deformed steel.
 - C. Ballast and Pipe Supports: Portland cement design mix, 3000 psi (20.7 MPa) minimum, with 0.58 maximum water/cementitious materials ratio.
 - 1. Reinforcing Fabric: ASTM A1064/A1064M, steel, welded wire fabric, plain.
 - 2. Reinforcing Bars: ASTM A615/A615M, Grade 60 (420-MPa) deformed steel.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Excavating, trenching, and backfilling are specified in Section 31 2200 Grading and 31 2300 Excavation and Fill.

3.2 PIPING INSTALLATION

- A. General Locations and Arrangements: Drawing plans and details to indicate general location and arrangement of underground sanitary sewer piping. Location and arrangement of piping layout take into account design considerations. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.
- B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for using lubricants, cements, and other installation requirements.
- C. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.

- D. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.
- E. When installing pipe under streets or other obstructions that cannot be disturbed, use pipe-jacking process of microtunneling.
- F. Install gravity-flow, nonpressure, drainage piping according to the following:
 - 1. Install piping pitched down in direction of flow, at minimum slope of 1 percent unless otherwise indicated.
 - 2. Install piping NPS 6 (DN 150) and larger with restrained joints at tee fittings and at changes in direction. Use corrosion-resistant rods, pipe or fitting manufacturer's proprietary restraint system, or cast-in-place-concrete supports or anchors.
 - 3. Install piping with 36-inch (915-mm) minimum cover.
 - 4. Install PVC cellular-core sewer piping according to ASTM D2321 and ASTM F1668.
 - 5. Install PVC profile sewer piping according to ASTM D2321 and ASTM F1668.
 - 6. Install PVC gravity sewer piping according to ASTM D2321 and ASTM F1668.

3.3 PIPE JOINT CONSTRUCTION

- A. Join gravity-flow, nonpressure, drainage piping according to the following:
 - 1. Join PVC cellular-core sewer piping according to ASTM D2321 and ASTM F891 for solvent-cemented joints.
 - 2. Join PVC profile sewer piping according to ASTM D2321 for elastomeric-seal joints or ASTM F794 for gasketed joints.
 - 3. Join PVC gravity sewer piping according to ASTM D2321 and ASTM D3034 for elastomeric-seal joints or ASTM D3034 for elastomeric-gasket joints.
 - 4. Join dissimilar pipe materials with nonpressure-type, flexible couplings.
- B. Pipe couplings, expansion joints, and deflection fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
 - 1. Use nonpressure flexible couplings where required to join gravity-flow, nonpressure sewer piping unless otherwise indicated.
 - a. Shielded flexible couplings for pipes of same or slightly different OD.
 - b. Unshielded, increaser/reducer-pattern, flexible couplings for pipes with different OD.
 - c. Ring-type flexible couplings for piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.
 - 2. Use pressure pipe couplings for force-main joints.

3.4 CONCRETE PLACEMENT

- A. Place cast-in-place concrete according to ACI 318.

3.5 BACKWATER VALVE INSTALLATION

- A. Install horizontal-type backwater valves in piping manholes or pits.
- B. Install combination horizontal and manual gate-type valves in piping and in manholes.
- C. Install terminal-type backwater valves on end of piping and in manholes. Secure units to sidewalls.

3.6 CLEANOUT INSTALLATION

- A. Install cleanouts and riser extensions from sewer pipes to cleanouts at grade. Use cast-iron soil pipe fittings in sewer pipes at branches for cleanouts and use cast-iron soil pipe for riser extensions to cleanouts. Install piping so cleanouts open in direction of flow in sewer pipe.
 - 1. Use Light-Duty, top-loading classification cleanouts in earth or unpaved foot-traffic areas.
 - 2. Use Medium-Duty, top-loading classification cleanouts in paved foot-traffic areas.
 - 3. Use Heavy-Duty, top-loading classification cleanouts in vehicle-traffic service areas.
 - 4. Use Extra-Heavy-Duty, top-loading classification cleanouts in roads.

- B. Set cleanout frames and covers in earth in cast-in-place-concrete block, 18 by 18 by 12 inches (450 by 450 by 300 mm) deep. Set with tops 1 inch (25 mm) above surrounding grade.
- C. Set cleanout frames and covers in concrete pavement and roads with tops flush with pavement surface.

3.7 CONNECTIONS

- A. Connect nonpressure, gravity-flow drainage piping to building's sanitary building drains.
- B. Connect force-main piping to building's sanitary force mains. Terminate piping where indicated.
- C. Make connections to existing piping and underground manholes.
 - 1. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe, install wye fitting into existing piping, and encase entire wye fitting plus 6-inch (150-mm) overlap with not less than 6 inches (150 mm) of concrete with 28-day compressive strength of 3000 psi (20.7 MPa).
 - 2. Make branch connections from side into existing piping, NPS 4 to NPS 20 (DN 100 to DN 500). Remove section of existing pipe, install wye fitting into existing piping, and encase entire wye with not less than 6 inches (150 mm) of concrete with 28-day compressive strength of 3000 psi (20.7 MPa).
 - 3. Make branch connections from side into existing piping, NPS 21 (DN 525) or larger, or to underground manholes by cutting opening into existing unit large enough to allow 3 inches (76 mm) of concrete to be packed around entering connection. Cut end of connection pipe passing through pipe or structure wall to conform to shape of, and be flush with, inside wall unless otherwise indicated. On outside of pipe or manhole wall, encase entering connection in 6 inches (150 mm) of concrete for minimum length of 12 inches (300 mm) to provide additional support of collar from connection to undisturbed ground.
 - a. Use concrete that will attain a minimum 28-day compressive strength of 3000 psi (20.7 MPa) unless otherwise indicated.
 - b. Use epoxy-bonding compound as interface between new and existing concrete and piping materials.
 - 4. Protect existing piping and manholes to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.

3.8 CLOSING ABANDONED SANITARY SEWER SYSTEMS

- A. Abandoned Piping: Close open ends of abandoned underground piping indicated to remain in place. Include closures strong enough to withstand hydrostatic and earth pressures that may result after ends of abandoned piping have been closed. Use either procedure below:
 - 1. Close open ends of piping with at least 8-inch- (203-mm-) thick, brick masonry bulkheads.
 - 2. Close open ends of piping with threaded metal caps, plastic plugs, or other acceptable methods suitable for size and type of material being closed. Do not use wood plugs.
- B. Abandoned Manholes: Excavate around manhole as required and use either procedure below:
 - 1. Remove manhole and close open ends of remaining piping.
 - 2. Remove top of manhole down to at least 36 inches (915 mm) below final grade. Fill to within 12 inches (300 mm) of top with stone, rubble, gravel, or compacted dirt. Fill to top with concrete.
- C. Backfill to grade according to Section 31 2200 Grading and 31 2300 Excavation and Fill

3.9 IDENTIFICATION

- A. Arrange for installation of green warning tapes directly over piping and at outside edges of underground manholes.
 - 1. Use warning tape or detectable warning tape over ferrous piping.
 - 2. Use detectable warning tape over nonferrous piping and over edges of underground manholes.

3.10 FIELD QUALITY CONTROL

- A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches (600 mm) of backfill is in place, and again at completion of Project.
 - 1. Submit separate report for each system inspection.
 - 2. Defects requiring correction include the following:
 - a. Alignment: Less than full diameter of inside of pipe is visible between structures.
 - b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
 - c. Damage: Crushed, broken, cracked, or otherwise damaged piping.
 - d. Infiltration: Water leakage into piping.
 - e. Exfiltration: Water leakage from or around piping.
 - 3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
 - 4. Reinspect and repeat procedure until results are satisfactory.
- B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.
 - 1. Do not enclose, cover, or put into service before inspection and approval.
 - 2. Test completed piping systems according to requirements of authorities having jurisdiction.
 - 3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
 - 4. Submit separate report for each test.
 - 5. Hydrostatic Tests: Test sanitary sewerage according to requirements of authorities having jurisdiction and the following:
 - a. Fill sewer piping with water. Test with pressure of at least 10-foot (3-m) head of water and maintain such pressure without leakage for at least 15 minutes.
 - b. Close openings in system and fill with water.
 - c. Purge air and refill with water.
 - d. Disconnect water supply.
 - e. Test and inspect joints for leaks.
 - 6. Air Tests: Test sanitary sewerage according to requirements of authorities having jurisdiction, UNI-B-6, and the following:
 - a. Test plastic gravity sewer piping according to ASTM F1417.
 - 7. Force Main: Perform hydrostatic test after thrust blocks, supports, and anchors have hardened. Test at pressure not less than 1-1/2 times the maximum system operating pressure, but not less than 150 psig (1035 kPa) .
 - a. Ductile-Iron Piping: Test according to AWWA C600, "Hydraulic Testing" Section.
 - b. PVC Piping: Test according to AWWA M23, "Testing and Maintenance" Chapter.
 - 8. Manholes: Perform hydraulic test according to ASTM C969 (ASTM C969M).
- C. Leaks and loss in test pressure constitute defects that must be repaired.
- D. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

3.11 CLEANING

- A. Clean dirt and superfluous material from interior of piping. Flush with potable water.

END OF SECTION

SECTION 334200
STORMWATER CONVEYANCE

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. Corrugated HDPE pipe and fittings.
 - 2. PVC pipe and fittings.
 - 3. Non-pressure transition couplings.
 - 4. Backwater valves.
 - 5. Cleanouts.
 - 6. Encasement for piping.
 - 7. Concrete.
 - 8. Stormwater inlets.
 - 9. Subsurface Stormwater Storage

1.3 ACTION SUBMITTALS

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

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Show pipe sizes, locations, and elevations. Show other piping in same trench and clearances from storm drainage system piping. Indicate interface and spatial relationship between manholes, piping, and proximate structures.
- B. Profile Drawings: Show system piping in elevation. Draw profiles at horizontal scale of not less than 1-inch equals 50 feet (1:500) and vertical scale of not less than 1-inch equals 5 feet (1:50). Indicate manholes and piping. Show types, sizes, materials, and elevations of other utilities crossing system piping.
- C. Field quality-control reports.
- D. Submit proposed stormwater detention layout drawings and documentation. Drawings shall include typical section details as well as the required base elevation of stone and piping, minimum cover requirements and configuration. Submit manufacturer's product data, including compressive strength and unit weight. Submit manufacturer's installation instructions. Submit material certificates for geotextile, geogrid, base course and backfill materials.

1.5 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Subsurface stormwater storage installation - Contractor shall demonstrate the following experience:
 - 1. A minimum of three equivalent projects completed within 2 years; and,
 - 2. Contractor experience requirement may be waived if the manufacturer's representative provides on-site training and review during construction.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Do not store plastic manholes, pipe, and fittings in direct sunlight.
- B. Protect pipe, pipe fittings, and seals from dirt and damage.
- C. Handle manholes in accordance with manufacturer's written rigging instructions.
- D. Handle stormwater inlets in accordance with manufacturer's written rigging instructions.
- E. Protect materials from damage during delivery, and store UV sensitive materials under tarp to protect from sunlight when time from delivery to installation exceeds two weeks. Storage of materials should be on smooth surfaces, free from dirt, mud and debris.
 - 1. Handling is to be performed with equipment appropriate to the materials and site conditions, and may include hand, handcart, forklifts, extension lifts, etc.
 - 2. Cold weather:
 - a. Care must be taken when handling plastics when air temperature is 40 degrees or below as plastic becomes brittle.
 - b. Do not use frozen materials or materials mixed or coated with ice or frost.
 - c. Do not build on frozen ground or wet, saturated or muddy subgrade.

1.7 FIELD CONDITIONS

- A. Interruption of Existing Storm Drainage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service in accordance with requirements indicated:
 - 1. Notify Construction Manager and Owner no fewer than two days in advance of proposed interruption of service.
 - 2. Do not proceed with interruption of service without Construction Manager's and Owner's written permission.

PART 2 - PRODUCTS

2.1 CORRUGATED-HDPE PIPE AND FITTINGS

- A. Source Limitations: Obtain corrugated-HDPE pipe and fittings from single manufacturer.

- B. Corrugated-HDPE Dual Wall Drainage Pipe and Fittings NPS 3 to NPS 10 (DN 80 to DN 250): AASHTO M 252, Type S, with smooth waterway for coupling joints..
- C. Corrugated-HDPE Dual Wall Pipe and Fittings NPS 12 to NPS 60 (DN 300 to DN 1500): AASHTO M 294, Type S, with smooth waterway for coupling joints..
- D. Corrugated-HDPE Soiltight Couplings: AASHTO M 294, corrugated, matching pipe and fittings.

2.2 PVC PIPE AND FITTINGS

- A. Source Limitations: Obtain PVC pipe and fittings from single manufacturer.
- B. NSF Marking: Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-drain" for plastic storm drain and "NSF-sewer" for plastic storm sewer piping.
- C. PVC Cellular-Core Piping:
 - 1. PVC Cellular-Core Pipe and Fittings: ASTM F891, Sewer and Drain Series, PS 50 minimum stiffness, PVC cellular-core pipe with plain ends for solvent-cemented joints.
 - 2. Fittings: ASTM D3034, SDR 35, PVC socket-type fittings.
- D. PVC Profile Sewer Piping:
 - 1. Pipe: ASTM F794, PVC profile, gravity sewer pipe with bell-and-spigot ends for gasketed joints.
 - 2. Fittings: ASTM D3034, PVC with bell ends.
 - 3. Gaskets: ASTM F477, elastomeric seals.
- E. PVC Gravity Sewer Piping:
 - 1. Pipe and Fittings: ASTM F679, T-2 wall thickness, PVC gravity sewer pipe with bell-and-spigot ends and with integral ASTM F477, elastomeric seals for gasketed joints.
- F. Adhesive Primer: ASTM F656.

2.3 NON-PRESSURE TRANSITION COUPLINGS

- A. Comply with ASTM C1173, elastomeric, sleeve-type, reducing or transition coupling, for joining underground nonpressure piping. Include ends of same sizes as piping to be joined, and corrosion-resistant-metal tension band and tightening mechanism on each end.
- B. Sleeve Materials:
 - 1. For Plastic Pipes: ASTM F477, elastomeric seal or ASTM D5926, or HDPE.
 - 2. For Dissimilar Pipes: ASTM D5926, PVC, HDPE or other material compatible with pipe materials being joined.
- C. Unshielded, Flexible Couplings:
 - 1. Source Limitations: Obtain unshielded, flexible couplings from single manufacturer.

2. Description: Elastomeric sleeve with corrosion-resistant-metal tension band and tightening mechanism on each end.

D. Shielded, Flexible Couplings:

1. Source Limitations: Obtain shielded, flexible couplings from single manufacturer.
2. Description: ASTM C1460, elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

E. Ring-Type, Flexible Couplings:

1. Source Limitations: Obtain ring-type, flexible couplings from single manufacturer.
2. Description: Elastomeric compression seal with dimensions to fit inside bell of larger pipe and for spigot of smaller pipe to fit inside ring.

2.4 BACKWATER VALVES

A. Inline Elastomeric Backwater Check Valves:

1. Material: Red Valve Tideflex Series 37G Check Valve, or approved equivalent.
2. Description: preassembled in-line check valve, fits inside pipe I.D., with internal corrosion resistant expansion clamp providing compression between valve and pipe I.D. for a face-to-face press-fit. Valve shall operate with a 1"-2" influent cracking pressure.

2.5 CLEANOUTS

A. Cast-Iron Cleanouts:

1. Source Limitations: Obtain cast-iron cleanouts from single manufacturer.
2. Description: ASME A112.36.2M, round, gray-iron housing with clamping device and round, secured, scoriated, gray-iron cover. Include gray-iron ferrule with inside caulk or spigot connection and countersunk, tapered-thread, brass closure plug.
3. Top-Loading Classification(s): Heavy Duty .
4. Sewer Pipe Fitting and Riser to Cleanout: ASTM A74, Service class, cast-iron soil pipe and fittings.

B. PVC Cleanouts:

1. Source Limitations: Obtain PVC cleanouts from single manufacturer.
2. Description: PVC body with PVC threaded plug. Include PVC sewer pipe fitting and riser to cleanout of same material as sewer piping.

C. HDPE Cleanouts:

1. Source Limitations: Obtain HDPE cleanouts from single manufacturer.
2. Description: HDPE body with HDPE threaded plug. Include HDPE sewer pipe fitting and riser to cleanout of same material as sewer piping.

2.6 ENCASEMENT FOR PIPING

- A. Standard: ASTM A674 or AWWA C105/A21.5.
- B. Material: Linear low-density polyethylene film of 0.008-inch (0.20-mm) minimum thickness.
- C. Form: tube.
- D. Color: natural

2.7 CONCRETE

- A. General: Cast-in-place concrete in accordance with ACI 318, ACI 350, and the following:
 - 1. Cement: ASTM C150/C150M, Type II.
 - 2. Fine Aggregate: ASTM C33/C33M, sand.
 - 3. Coarse Aggregate: ASTM C33/C33M, crushed gravel.
 - 4. Water: Potable.
- B. Portland Cement Design Mix: 4000 psi minimum, with 0.45 maximum water/cementitious materials ratio.
 - 1. Reinforcing Fabric: ASTM A1064/A1064M, steel, welded wire fabric, plain.
 - 2. Reinforcing Bars: ASTM A615/A615M, Grade 60 (420 MPa) deformed steel.

2.8 STORMWATER INLETS

- A. Stormwater inlet boxes, covers, frames, and grates shall be in accordance with Pennsylvania Department of Transportation standards.
- B. Geosynthetics
 - 1. Geotextile. A geotextile envelope is required to prevent backfill material from entering the detention system.
 - a. Standard Application: The standard geotextile shall be an 8 oz per square yard nonwoven geotextile (ACF N080 or equivalent).
 - b. Infiltration Applications: When water must infiltrate/exfiltrate through the geotextile as a function of the system design, a woven monofilament (ACF M200 or equivalent) shall be used.
 - 2. Geogrid. For installations subject to traffic loads and/or when required by project plans, install geogrid (ACF BX12 or equivalent) to reinforce backfill above the detention system.
- C. Backfill & Cover Materials
 - 1. Bedding Materials: Stone (angular and smaller than 1.5" in diameter) or soil (GW, GP, SW, or SP as classified by the Unified Soil Classification System) shall be used below the Detention system (3" minimum). Material must be free from lumps, debris, and any sharp objects that could cut the geotextile. Material shall be within 3 percent of the optimum moisture content as determined by ASTM D698 at the time of installation. For infiltration applications bedding material shall be free draining.

2. Side and Top Backfill: Material must be free from lumps, debris and any sharp objects that could cut the geotextile. Material shall be within 3 percent of the optimum moisture content as determined by ASTM D698 at the time of installation.
 - a. Traffic Applications - Free draining material shall be used adjacent to (24" minimum) and above (for the first 12") the Detention system.
 - 1) Backfill materials shall be free draining stone (angular and smaller than 1.5" in diameter) or soil (GW, GP, SW, or SP as classified by the Unified Soil Classification System).
 - b. Non-Traffic / Green Space Applications - For all Detention modules installed in green spaces and not subjected to vehicular loads, backfill materials may either follow the guidelines for Traffic Applications above, or the top backfill layer (12" minimum) may consist of AASHTO #57 stone blended with 30-40% (by volume) topsoil to aid in establishing vegetation.
3. Additional Cover Materials: Structural Fill shall consist of granular materials meeting the gradational requirements of SM, SP, SW, GM, GP or GW as classified by the Unified Soil Classification System. Structural fill shall have a maximum of 25 percent passing the No. 200 sieve, shall have a maximum clay content of 10 percent and a maximum Plasticity Index of 4. Material shall be within 3 percent of the optimum moisture content as determined by ASTM D698 at the time of installation.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Excavation, trenching, and backfilling are specified in Section 31 2200 "Grading" and Section 31 2300 "Excavation and Fill."

3.2 PIPING INSTALLATION

- A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground storm drainage piping. Location and arrangement of piping layout take into account design considerations. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.
- B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings in accordance with manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
- C. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.
- D. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.
- E. When installing pipe under streets or other obstructions that cannot be disturbed, use pipe-jacking process of microtunneling.
- F. Install gravity-flow, nonpressure drainage piping in accordance with the following:
 1. Install piping pitched down in direction of flow.

2. Install piping NPS 6 (DN 150) and larger with restrained joints at tee fittings and at changes in direction. Use corrosion-resistant rods, pipe or fitting manufacturer's proprietary restraint system, or cast-in-place concrete supports or anchors.
3. Install piping with 36-inch- (915 mm-) minimum cover.
4. Install PVC cellular-core piping in accordance with ASTM D2321 and ASTM F1668.
5. Install corrugated-HDPE and PVC sewer piping in accordance with ASTM D2321 and ASTM F1668.
6. Install corrugated-HDPE and PVC profile gravity sewer piping in accordance with ASTM D2321 and ASTM F1668.

3.3 PIPE JOINT CONSTRUCTION

- A. Join gravity-flow, nonpressure drainage piping in accordance with the following:
 1. Join PVC cellular-core piping in accordance with ASTM D2321 and ASTM F891 for solvent-cemented joints.
 2. Join corrugated-HDPE and PVC sewer piping in accordance with ASTM D2321 and ASTM D3034 for elastomeric-seal joints or ASTM D3034 for elastomeric-gasketed joints.
 3. Join corrugated-HDPE and PVC profile gravity sewer piping in accordance with ASTM D2321 for elastomeric-seal joints or ASTM F794 for gasketed joints.

3.4 BACKWATER VALVE INSTALLATION

- A. Install horizontal-type backwater valves in piping where indicated.
- B. Install combination horizontal and manual gate-valve type in piping and in manholes where indicated.
- C. Install terminal-type backwater valves on end of piping and in manholes where indicated.

3.5 CLEANOUT INSTALLATION

- A. Install cleanouts and riser extensions from sewer pipes to cleanouts at grade. Use cast-iron soil pipe fittings in sewer pipes at branches for cleanouts and cast-iron soil pipe for riser extensions to cleanouts. Install piping so cleanouts open in direction of flow in sewer pipe.
 1. Use Light-Duty, top-loading classification cleanouts in earth or unpaved foot-traffic areas.
 2. Use Medium-Duty, top-loading classification cleanouts in paved foot-traffic areas.
 3. Use Heavy-Duty, top-loading classification cleanouts in vehicle-traffic service areas.
 4. Use Extra-Heavy-Duty, top-loading classification cleanouts in roads.
- B. Set cleanout frames and covers in earth in cast-in-place concrete block, 18 by 18 by 12 (450 by 450 by 300 inches (mm) deep. Set with tops 1 inch (25 mm) above surrounding earth grade.
- C. Set cleanout frames and covers in concrete pavement and roads with tops flush with pavement surface.

3.6 CONCRETE PLACEMENT

- A. Place cast-in-place concrete in accordance with ACI 318 (ACI 318M).

3.7 CONNECTIONS

- A. Connect nonpressure, gravity-flow drainage piping in building's storm building drains as specified herein and on the contract drawings.
- B. Make connections to existing piping and underground manholes.
 - 1. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe; install wye fitting into existing piping; and encase entire wye fitting, plus 6-inch (150-mm) overlap, with not less than 6 inches (150 mm) of concrete with 28-day compressive strength of 3000 psi (20.7 MPa).
 - 2. Make branch connections from side into existing piping, NPS 4 to NPS 20 (DN 100 to DN 500). Remove section of existing pipe, install wye fitting into existing piping, and encase entire wye with not less than 6 inches (150 mm) of concrete with 28-day compressive strength of 3000 psi (20.7 MPa).
 - 3. Make branch connections from side into existing piping, NPS 21 (DN 525) or larger, or to underground manholes and structures by cutting into existing unit and creating an opening large enough to allow 3 inches (76 mm) of concrete to be packed around entering connection. Cut end of connection pipe passing through pipe or structure wall to conform to shape of and be flush with inside wall unless otherwise indicated. On outside of pipe, manhole, or structure wall, encase entering connection in 6 inches (150 mm) of concrete for minimum length of 12 inches (300 mm) to provide additional support of collar from connection to undisturbed ground.
 - a. Use concrete that will attain a minimum 28-day compressive strength of 3000 psi (20.7 MPa) unless otherwise indicated.
 - b. Use epoxy-bonding compound as interface between new and existing concrete and piping materials.
 - 4. Protect existing piping, manholes, and structures to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.
- C. Pipe couplings, expansion joints, and deflection fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
 - 1. Use nonpressure-type flexible couplings where required to join gravity-flow, nonpressure sewer piping unless otherwise indicated.
 - a. Shielded flexible couplings for same or minor difference OD pipes.
 - b. Unshielded, increaser/reducer-pattern, flexible couplings for pipes with different OD.
 - c. Ring-type flexible couplings for piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.
 - 2. Use pressure-type pipe couplings for force-main joints.

3.8 SUBSURFACE STORMWATER STORAGE

- A. Assembly of detention system
 - 1. Assembly of system shall be performed in accordance with the manufacturer's installation procedure.

B. Layout and Excavation

1. Installer shall stake out, excavate, and prepare the subgrade area to the required plan grades and dimensions needed to install the detention piping and free draining backfill materials.
2. All excavations must be prepared with OSHA approved excavated sides and sufficient working space.
3. Protect partially completed installation against damage from other construction traffic by establishing a perimeter with high visibility construction tape, fencing, barricades, or other means until construction is complete.
4. Base of the excavation shall be uniform, level, and free of lumps or debris and soft or yielding subgrade areas. A minimum 2,000 pounds per square foot bearing capacity is required.
 - a. Standard Applications: Compact subgrade to a minimum of 95% of Standard Proctor (ASTM D698) density or as required by the Owner's engineer.
 - b. Infiltration Applications: Subgrade shall be prepared in accordance with the contract documents. Compaction of subgrade should not be performed in infiltration applications.
5. Unsuitable Soils or Conditions: All questions about the base of the excavation shall be directed to the owner's engineer, who will approve the subgrade conditions prior to placement of stone. In no case shall a bearing capacity of less than 2,000 pounds per square foot be provided.
 - a. If unsuitable soils are encountered at the subgrade, or if the subgrade is pumping or appears excessively soft, repair the area in accordance with contract documents and/or as directed by the owner's engineer.
 - b. If indications of the water table are observed during excavation, the engineer shall be contacted to provide recommendations.
 - c. Do not start installation of the detention system until unsatisfactory subgrade conditions are corrected and the subgrade conditions are accepted by the owner's engineer.

C. Abandoned Piping: Close open ends of abandoned underground piping indicated to remain in place. Include closures strong enough to withstand hydrostatic and earth pressures that may result after ends of abandoned piping have been closed. Use either procedure below:

1. Close open ends of piping with at least 8- (203-) inch- (mm-) thick, brick masonry bulkheads.
2. Close open ends of piping with threaded metal caps, plastic plugs, or other acceptable methods suitable for size and type of material being closed. Do not use wood plugs.

D. Abandoned Manholes and Structures: Excavate around manholes and structures as required and use one procedure below:

1. Remove manhole or structure and close open ends of remaining piping.
2. Remove top of manhole or structure down to at least 36 inches (915 mm) below final grade. Fill to within 12 (300) inches (mm) of top with stone, rubble, gravel, or compacted dirt. Fill to top with concrete.

E. Backfill to grade in accordance with Section 31 2300 "Excavation and Fill"

3.9 IDENTIFICATION

- A. Arrange for installation of green warning tape directly over piping and at outside edge of underground structures.

1. Use warning tape or detectable warning tape over ferrous piping.
2. Use detectable warning tape over nonferrous piping and over edges of underground structures.

3.10 FIELD QUALITY CONTROL

- A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches (610 mm) of backfill is in place, and again at completion of Project.
 1. Submit separate reports for each system inspection.
 2. Defects requiring correction include the following:
 - a. Alignment: Less than full diameter of inside of pipe is visible between structures.
 - b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
 - c. Damage: Crushed, broken, cracked, or otherwise damaged piping.
 - d. Infiltration: Water leakage into piping.
 - e. Exfiltration: Water leakage from or around piping.
 3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
 4. Reinspect and repeat the procedure until results are satisfactory.
- B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.
 1. Do not enclose, cover, or put into service before inspection and approval.
 2. Test completed piping systems in accordance with requirements of authorities having jurisdiction.
 3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
 4. Submit a separate report for each test.
 5. Gravity-Flow Storm Drainage Piping: Test in accordance with requirements of authorities having jurisdiction, UNI-B-6, and the following:
 - a. Exception: Piping with soiltight joints unless required by authorities having jurisdiction.
 - b. Option: Test plastic piping in accordance with ASTM F1417.
- C. Leaks and loss in test pressure constitute defects that must be repaired.
- D. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

3.11 CLEANING

- A. Clean interior of piping of dirt and superfluous materials. Flush with potable water.

END OF SECTION 334200