

PART 2 PACKAGE

TECHNICAL  
SPECIFICATIONS  
VOLUME IV-A  
ISSUED FOR BID  
SUBMITTAL

**Rivertown Water Treatment Plant Project**

CDM Smith P.N.: 6103-237938

JEA P.N.: 8003981

JEA

Jacksonville, FL

DECEMBER 2020



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**TECHNICAL SPECIFICATIONS  
VOLUME IV-A  
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DECEMBER 2020**

A circular professional engineer seal for David John Prah. The outer ring contains the text "DAVID JOHN PRAH" at the top and "PROFESSIONAL ENGINEER" at the bottom, separated by two stars. The inner circle contains the text "LICENSE" at the top, "NO. 43393" in the center, "STATE OF FLORIDA" at the bottom, and a small star on the right side.

**CDM Smith**  
4651 Salisbury Road, Suite 420, Jacksonville, FL 32256  
Phone: (904) 731-7109, FL COA No. EB-0000020

**JEA**  
**RIVERTOWN WATER TREATMENT PLANT PROJECT**

**TECHNICAL SPECIFICATIONS**  
**VOLUME IV-A**

**ISSUED FOR BID SUBMITTAL**

**DECEMBER 2020**

**PROJECT LOCATION:**  
**7612 LONGLEAF PINE PARKWAY**  
**ST. JOHNS, FL 32259**



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Ioannis Polematidis, PE	Date
Florida Registered P.E. No. 75392	
General, Civil, Mechanical	
Specifications: Division 01, 333216.13, 400506	
through 400578.13, Division 43 and Division	
46	

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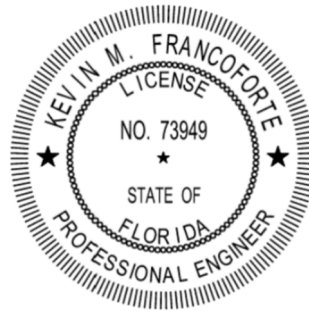
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Kevin M. Francoforte, PE      Date  
Florida Registered P.E. No. 73949  
Structural  
2020 Florida Building Code – Building, Seventh  
Edition  
Chapters: 16, 18, 19, 20, 21, 22  
Specifications: Division 03, 05, 067413, 083483

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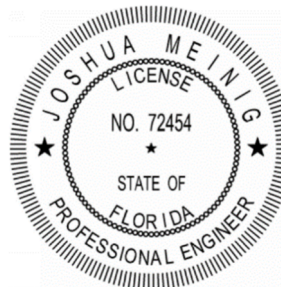
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Joshua Meinig PE	Date
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Mechanical Code, Energy Conservation Code,	
Fire Prevention Code – Seventh Edition	
Specifications: Divisions 21,22, 23	

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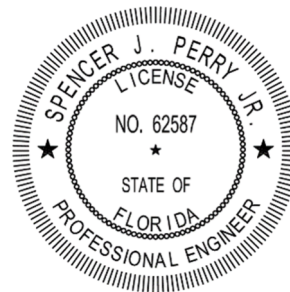
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**ST. JOHNS, FL 32259**



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Spencer J. Perry Jr., PE	Date
Florida Registered P.E. No. 62587	
Electrical	
2020 Florida Building Code – Seventh Edition –	
Chapter 27	
Specifications: Division 26, Section 400593.23	

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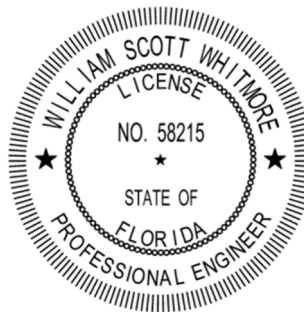
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W. Scott Whitmore, PE	Date
Florida Registered P.E. No. 58215	
Instrumentation	
Specifications: 271523, 406100 through	
407963	

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## SECTION 011000 - SUMMARY

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Consolidation Document, and other Division 01 Specification Sections, apply to this Section.
- B. All work shall comply and be installed per the latest JEA Water and Wastewater Standards Manual (January 2019 or latest), the JEA Facilities Standards Manual and the JEA Security Standards.

#### 1.2 SUMMARY

A. Section Includes:

- 1. Project information and a Summary of the Work for the project.  
Work under this project constitutes of two specific contract design packages, as defined by the consolidation document in the Owner-furnished contract documents. Documents are organized and labeled as **“Part 1 Package”** and **“Part 2 Package.”**
- 2. **Part 1 Package:** Well Nos. 1, 2 and Backup Well No. 3, Production Well Drilling, for the Rivertown Water Treatment Plant (WTP). The package includes the following:
  - a. Technical Specifications for the Rivertown WTP Well Nos. 1, 2 and Backup Well No. 3, Part 1 – Production Well Drilling
  - b. Construction Drawings for Rivertown WTP Well Nos. 1, 2, and Backup Well No. 3, Part 1 – Production Well Drilling
- 3. **Part 2 Package:** Rivertown WTP, Wellhead Mechanical and Facilities and Raw Water Pipelines. The package is comprised of the following Volumes:

Construction Drawings

- a. Volume I – Rivertown WTP – Water Treatment Plant
- b. Volume II – Rivertown WTP – Wells No. 1, Well No. 2 and Backup Well No. 3 Wellhead Mechanical and Facilities
- c. Volume III – Rivertown WTP – Raw Water Pipelines
- d. Volume V – FPL Electrical Power Infrastructure

Specifications

- e. Volume IV – Technical Specifications (All facets of the Part 2 Package).
  - 1) Volume IV A – Rivertown WTP
  - 2) Volume IV B – Wellhead Mechanical and Facilities

3) Volume IV C – Raw Water Pipelines

4. Contractor's use of site and premises.
5. Coordination with occupants.
6. Work restrictions.
7. Specification and Drawing conventions.

B. Related Requirements:

1. Section 017300 "Execution" for coordination of the work.

1.3 DEFINITIONS

- A. Work Package: A group of specifications, drawings, and schedules prepared by the design team to describe the Project Work for pricing, permitting, and construction.

1.4 PROJECT INFORMATION

A. Project Identification:

**Part 1 Package – the Rivertown WTP Well Nos. 1, 2 and Backup Well (No. 3), Part 1 - Production Well Drilling**

- Specifications for the Rivertown WTP Wells Nos. 1, 2 and Backup Well No. 3, Production Well Drilling
- Construction Drawings for the Rivertown WTP Wells Nos. 1, 2 and Backup Well No. 3, Production Well Drilling

**Part 2 Package - Rivertown WTP, Wellhead Mechanical and Facilities, and Raw Water Pipelines**

Construction Drawings

- Volume I, Rivertown WTP - Water Treatment Plant
- Volume II Rivertown WTP, Wells No. 1, Well No. 2 and Backup Well No. 3 – Wellhead Mechanical and Facilities
- Volume III Rivertown WTP, Raw Water Pipelines
- Volume V, FPL Electrical Power Infrastructure

Specifications

- Volume IV A WTP
- Volume IV B Wellhead Mechanical and Facilities

- Volume IV C Raw Water Pipelines

JEA Project No. 8003981.

1. Project Location: 7612 Longleaf Pine Parkway, Jacksonville, FL 32259.
- B. Owner: JEA, 21 W Church Street, Jacksonville, FL 32202.
  1. Owner's Representative: Mickey Willoughby, [willml@jea.com](mailto:willml@jea.com).
- C. Engineer: CDM Smith Inc. (904) 731-7109.
- D. Engineer's Representatives: David J. Prah, 386-689-4026, [prahdj@cdmsmith.com](mailto:prahdj@cdmsmith.com) or Yanni Polematidis, 904-527-6722, [PolematidisIM@cdmsmith.com](mailto:PolematidisIM@cdmsmith.com).
- E. Contractor: **To Be Determined (TBD)** has been engaged as Contractor for this Project.
  1. Contractor Representative: **TBD**
- F. Web-Based Project Software: Project software will be used for purposes of managing communication and documents during the construction stage.
  1. See Section 013100 "Project Management and Coordination" for requirements for using web-based Project software.

## 1.5 WORK COVERED BY CONTRACT DOCUMENTS

- A. The Work of Project is defined by the Contract Documents and includes, but is not limited to, the following:

### General Summary of Work

1. **Part 1 Package**, the work shall consist of the construction of the work as described in Section 01 01 00 (General Requirements) in the Part 1 Package Technical Specifications for the Rivertown WTP Well Nos. 1, 2 and Backup Well (No. 3), Part 1 – Production Well Drilling.
2. **Part 2 Package**, the work shall consist of the construction of a water treatment plant (WTP) with a water production design capacity based upon a Maximum Day Flow (MDF) of 4.7 million gallons per day (mgd) and a Peak Hourly Flow (PHF) of 6.6 mgd. The WTP components are referred to in the contract documents as Volume I work. The Raw Water Wells (Wells Nos. 1, 2 and Backup Well No. 3) components are referred to in the contract documents as Volume II work. The Raw Water Pipeline components are referred to in the contract documents as Volume III work. Volume IV, the technical specifications (broken into three separate subparts), describes all facets of the WTP project work, as shown within Volumes I, II, and III of the drawing sets. Volume V work is FPL Electrical Power Infrastructure work, providing for the installation of empty electrical power conduit and electrical pull boxes (all materials provided by FPL under this contract), to facilitate installation of power feeders, including electrical power supply

wire and service transformers, to each site ( WTP site, Well site No. 2 and Backup Well site No. 3) by FPL.

3. The work for the overall project (**Part 2 Package**) consists of furnishing all labor, equipment, and materials, all temporary utilities, including water, sewer, electric, communication, internet access, and all other utilities required to perform the work, for the components described herein and as shown on the contract drawings and specifications. The general summary of work common to all Volumes of the work is as listed:
  - a. Clearing, grubbing, and site preparation as necessary for the project and as indicated in these Specifications and Drawings.
  - b. Erosion and sediment control as necessary for the project, as indicated in these Specifications and Drawings, and in accordance with all Municipal, County, State, Federal, and other codes and permits that are applicable to this Project.
  - c. All associated mobilization/demobilization; demolition; required staging and work areas; removal, disposal, and replacement of unsuitable soils; and dewatering.
  - d. Maintenance of traffic (vehicular, pedestrian, and bicycle) in accordance with these Specifications and Drawings and with St. Johns County Transportation Development Division requirements and all associated permits.
  - e. Adherence to all permit requirements including sampling and monitoring.
  - f. Project pre-construction and progress photographs and videos. Contractor shall provide one combined set of pre-construction and progress photographs and videos that is required for Part 1 and Part 2 packages.
  - g. Preparation of as-builts and record documents in accordance with JEA Water and Wastewater Standards, latest edition, Section 501, As-Built Drawings and Section 755, Horizontal Directional Drilling (Large Diameter Pipe Greater than 12 Inches), and St. Johns County requirements.
  - h. General Conditions are included for both the (**Part 2**) **Base Bid Item No. 1** and **Part 2 Alternate Bid Item No. 10**, as noted in the Bid Form.
  - i. Permitting is included for both the (**Part 2**) **Base Bid Item No. 2** and (**Part 2**) **Alternate Bid Item No. 11**, as noted in the Bid Form.

B. Rivertown WTP (**[Part 2] Volume I – Base Bid Item No. 6**) components and project requirement shall include the following:

1. An 18-foot wide paved perimeter loop road around the entire plant facility, as shown on the drawings.
2. A High-Service Pump Station (HSPS) Building housing two 60-horsepower (hp) horizontal split case pumps capable of pumping 500 gpm each and three, 150-hp horizontal split case pumps capable of pumping 1,800 gpm, each, with room for a sixth future pump. The HSPS shall be split-single face concrete masonry unit (CMU) wall construction with seam metal roof with approximately 4,300 square feet and include pump room, control room, toilet room, electrical, mechanical, and control rooms. The pump room shall consist of a 2-ton travelling bridge crane and fire-sprinkler system, as shown on the drawings.
3. A 2.0-million gallon (MG) pre-stressed concrete ground storage tank with a 10,000-gpm cascade tray aerator and three (3) powered ventilation fans, fan intake hoods, baffle-curtain, non-slip walkway, handrails, and wrap-around access staircase attached to the tank.

4. A Sodium Hypochlorite Chemical Building (air-conditioned) with an approximate combined 12,000 gallons of storage tank capacity, off-loading station, roll-up door, and chemical metering pumps for disinfection. The building shall be split-single CMU construction with approximately 1,300-ft<sup>2</sup> footprint, and includes a 2-hour fire rated wall and equipped with a full sprinkler system, as shown in the drawings.
5. A 750-KW emergency generator with an integrated sub-base 5,000-gallon diesel fuel storage tank.
6. A 20-inch finished water main extension connecting to an existing 20-inch finished water main along Longleaf Pine Parkway.
7. Over-excavation, dewatering, and importing of structural fill necessary for structures and yard-piping, as shown on the contract drawings and specifications.
8. A stormwater control system including a wet-detention pond and associated FDOT-type catch basins, ditch-bottom invert, and reinforced concrete pipes, as shown on the drawings.
9. All piping, valves, flow meters, and associated components, as shown on the drawings.
10. This project will also include implementation of a new electrical system: a service transformer, a new motor control center, automatic transfer switch, variable frequency drives, interior and exterior LED-type lighting and lightning protection measures; instrumentation features including supervisory control and data acquisition (SCADA), fiber-optic cable with networked equipment, 16-inch magnetic flow meter, pressure gauges, chlorine analyzers, pressure transmitters; overall site and stormwater improvements; site fencing; landscaping; and other miscellaneous site improvements as shown on the drawings.
11. Coordination with JEA Security on the installation of raceways and boxes, as shown on the drawings (Note: JEA Security will be responsible for the purchase and installation of entrance gate operator, beam detectors, intercoms, card readers and cameras, as shown on the electrical drawings).
12. Proper disposal of excess and unsuitable excavation and removal of excess materials.
13. Provide a 6-foot tall temporary security construction fence to restrict access to the WTP and well sites (Volume II) during construction activities and until the work is complete, as well as a permanent security fence and access gate for each facility, once the construction activities are complete and in place.
14. Contractor shall disinfect and conduct bacteriological samples for the product wells, pipelines, and WTP infrastructure for wetted components in accordance to JEA Water Standards and in support of the FDEP PWS requirements.
15. Landscaping within the WTP.
16. Other Work as indicated in the Contract Documents.

C. Rivertown WTP ([Part 2] Volume I – Alternate Bid Items No. 18, 19, and 20) components and project requirement shall include the following:

1. A WTP access road off Longleaf Pine Parkway (Station 15 + 00 to Station 10 + 45).
2. Sanitary Grinder Pump Station: A 30-gpm, duplex, wastewater lift station consisting of a 4-foot diameter fiberglass wetwell for pumping on-site wastewater flows to an existing 16-inch force main on the west side of Longleaf Pine Parkway. The station will include approximately 625 linear feet of 2-inch force main, valve vault, and control panel, as shown on the drawings.
3. Gravity Sanitary Sewer Pipe (4-inch PVC pipe, inclusive of the requirements and all work as noted in the Contract Documents, including fittings and appurtenances, erosion and sediment control, excavation, backfill and compaction, dewatering, excavation support, sheet piling left in place, select fill for pipe bedding as required for areas where

unsuitable soils are encountered, pressure testing, restorative work. This work shall include installation of the 4-inch PVC pipe from the location of the proposed sanitary grinder pump station to a point of connection 275 feet east, connecting to a Developer installed sewer connection at an invert elevation of 21.00 feet  $\pm$ ).

4. This work is listed as alternate bid items on the bid form and shall be constructed if authorized by JEA.
- D. Rivertown Raw Water Wells (**[Part 2] Volume II – Base Bid Item No. 3 and 4**) components to include the following:
1. Well No. 1 includes a raw water wellhead, including a 1,650-gpm capacity vertical turbine well pump, a well pad, wellhead piping, associated valves and fittings, site work, electrical, instrumentation work, fiber optic communications, and all other miscellaneous work noted in the contract documents for this work.
  2. Well No. 2 includes a raw water wellhead, including a 1,650-gpm capacity vertical turbine well pump, a well pad, wellhead piping, associated valves and fittings, site work, access road, landscaping, electrical, instrumentation work, radio communication, and all other miscellaneous work noted in the contract documents for this work.
- E. Rivertown Raw Water Wells (**[Part 2] Volume II – Alternate Bid Items No. 12 and 16**) components and project requirement shall include the following:
1. Backup Well No. 3 includes a raw water wellhead, including a 1,650-gpm capacity vertical turbine well pump, well pad, wellhead piping, associated valves and fittings, site work, access road (from Longleaf Pine Parkway along Owner's easement to the well-site), landscaping, stormwater treatment, site lighting, fencing, electrical, instrumentation, radio communication, and all other miscellaneous work noted in the contract documents for this work.
  2. Backup Well Site No. 3 is located off-site to the north of the WTP and includes an access driveway off Longleaf Pine Parkway. Also included as part of the Rivertown Raw Water Backup Well No. 3 is landscaping, stormwater treatment, and miscellaneous civil and site improvements, structural, electrical, instrumentation and control, site lighting, and fencing work.
  3. 2-inch Reuse Pipe for Well No. 3 (2-inch PVC reuse water piping for irrigation at Well No. 3).
- F. Rivertown Raw Water Pipeline (**[Part 2] Volume III – Base Bid Item No. 5**) components to include the following:
1. The project includes the installation and testing of a raw water system between the Rivertown Water Treatment Plant and Well No. 2. The raw water main system is to be installed along Longleaf Pine Parkway, the Rivertown Water Treatment Plant access road, Well No. 2 access road in accordance with the Drawings and Specifications and the JEA Water and Wastewater Standards, Details, and Materials Manual, latest edition, and St. Johns County Standards and Specifications, latest edition. The 20-inch raw water main (repurposed 20-inch water main) will be extended to the Rivertown WTP as indicated in Rivertown Water Treatment Plant Volume I drawings. The 12-inch raw water main will be extended to the Rivertown Well No. 2 site as indicated in Rivertown Water Treatment Plan Wellhead Mechanical and Facilities Volume II drawings.

2. The work consists of furnishing all labor, equipment, and materials for the raw water main system. The general summary of work is as listed:
  - a. All associated mobilization/demobilization; demolition; required staging and work areas; removal, disposal, and replacement of unsuitable soils; and dewatering.
  - b. Maintenance of traffic (vehicular, pedestrian, and bicycle) in accordance with these Specifications and Drawings and with St. Johns County Transportation Development Division requirements and all associated permits.
  - c. Complete site restoration including any asphalt paving, concrete sidewalk and curb and gutter, and unpaved areas, in accordance with the requirements of these Specifications and Drawings, and the requirements of St. Johns County Growth Management division and JEA, and all associated permits.

East Side of Longleaf Pine Parkway

- a. Approximately 325 linear feet (LF) of 12-inch CLDI (PC350) raw water main by open cut along the east side of Longleaf Pine Parkway, (4) 12-inch CLDI MJ 45° Bends for Case B crossing, and (2) 12-inch CLDI MJ 45° Bends for horizontal alignment.
- b. Tie-in 12-inch CLDI (PC350) raw water main to existing 20-inch water main crossing Longleaf Pine Parkway on the east side of Longleaf Pine Parkway near the Rivertown WTP access road, which will be repurposed as a raw water main with 20-inch CLDI MJ Sleeve, 20-inch CLDI MJ 90° Bend, 20-inch x 12-inch CLDI Reducer, and 12-inch MJ Gate Valve with Box and Cover.
- c. Plug existing 20-inch water main at valve with 20-inch CLDI MJ Plug and Dead-End.
- d. Remove and dispose of four (4) 6-inch Oak trees on east side of Longleaf Pine Parkway as indicated on Drawings.
- e. One (1) Below Ground Flushing/Manual Air Release Valve/Sample Tap Assembly on 20-inch raw water main (repurposed 20-inch water main).
- f. One (1) Below Ground Flushing/Manual Air Release Valve/Sample Tap Assembly on 12-inch raw water main.

Rivertown WTP Access Road

- a. One (1) Below Ground Flushing/Manual Air Release Valve/Sample Tap Assembly on 20-inch raw water main (repurposed 20-inch water main).

G. **Rivertown Raw Water Pipeline ([Part 2] Volume III – Alternate Bid Items No. 13, 14, and 15) components to include the following:**

1. The project includes the installation and testing of a raw water system between the Rivertown Water Treatment Plant and Backup Well No. 3. The raw water main system is to be installed along Longleaf Pine Parkway, the Rivertown Water Treatment Plant access road, and Backup Well No. 3 access road in accordance with the Drawings and Specifications and the JEA Water and Wastewater Standards, Details, and Materials Manual, latest edition, and St. Johns County Standards and Specifications, latest edition.
2. The work consists of furnishing all labor, equipment, and materials for the raw water main system. The general summary of work is as listed:

- a. All associated mobilization/demobilization; demolition; proper disposal of drilling mud and other fluids and materials; required staging and work areas; removal, disposal, and replacement of unsuitable soils; and dewatering.
  - b. Maintenance of traffic (vehicular, pedestrian, and bicycle) in accordance with these Specifications and Drawings and with St. Johns County Transportation Development Division requirements and all associated permits.
  - c. Complete site restoration including any asphalt paving, concrete sidewalk and curb and gutter, and unpaved areas, in accordance with the requirements of these Specifications and Drawings, and the requirements of St. Johns County Growth Management division and JEA, and all associated permits.
3. Specific summary of the raw water pipeline work is provided below, by project area:

Pipeline work along the West Side of Longleaf Pine Parkway (Alternate Bid Item and shall be constructed if authorized by JEA). This is listed as alternate bid items on the bid form and is shown in the Volume III drawing set from Station 1 + 40 to Station 17 + 25, along the westerly right-of-way of Longleaf Pine Parkway.

- a. Approximately 125 LF of 16-inch CLDI (PC250) raw water main by open cut, and approximately 1585 LF of 18-inch HDPE (DR11) raw water main by horizontal directional drill along the west side of Longleaf Pine Parkway. Two (2) transitions between 18-inch HDPE (DR11) and 16-inch CLDI (PC250) raw water main with 18-inch HDPE (DR11) MJ Adapter, 18-inch x 16-inch CLDI MJ Reducer, and 16-inch CLDI MJ 11.25° Bend.
- b. Tie-in 16-inch CLDI (PC250) raw water main to existing 20-inch water main crossing Longleaf Pine Parkway near the Rivertown WTP access road, which will be repurposed as a raw water main with 20-inch x 16-inch CLDI MJ Tee, 20-inch CLDI MJ Sleeve, and 16-inch MJ Gate Valve with Box and Cover.
- c. Provide 16-inch raw water main stub-out on south side of 20-inch water main crossing Longleaf Pine Parkway near the Rivertown WTP access road, which will be repurposed as a raw water main with a 20-inch x 16-inch CLDI MJ Tee, 16-inch MJ Gate Valve with Box and Cover, (4) 16-inch CLDI MJ 45° Bends for Case B crossing, 16-inch CLDI MJ Plug and Dead End.
- d. Provide 16-inch raw water main stub-out on north side of raw water main beyond Backup Well No. 3 access road with 16-inch MJ Gate Valve with Box and Cover, 16-inch CLDI MJ Plug and Dead End.
- e. Tie-in 12-inch CLDI (PC350) raw water main to 12-inch raw water main stub-out on Longleaf Pine Parkway and to 16-inch CLDI (PC250) raw water main on north side of raw water main beyond Backup Well No. 3 with 12-inch CLDI MJ Sleeve, 12-inch MJ Gate Valve with Box and Cover, 12-inch CLDI MJ 90° Bend, and 16-inch x 12-inch CLDI MJ Tee.
- f. Two (2) Below Ground Flushing/Manual Air Release Valve/Sample Tap Assemblies on 16-inch raw water main.



Pipeline work along the Backup Well No. 3 Access Road (Alternate Bid Item and shall be constructed if authorized by JEA). This is listed as an alternate bid item, on the bid form and is shown in the Volume III drawing set from Station 0 + 00 to Station 2+65 and Station 4 + 10 to Station 4 + 55, within the 30-foot access easement to Backup Well site No. 3.

- a. Approximately 310 LF of 12-inch CLDI (PC350) raw water main by open cut along the Backup Well No. 3 access road.
  - b. Tie-in 12-inch CLDI (PC350) raw water main to 12-inch raw water main stub-out on Backup Well No. 3 access road with 12-inch CLDI MJ Sleeve.
  - c. One (1) Below Ground Flushing/Manual Air Release Valve/Sample Tap Assembly on 12-inch raw water main.
  - d. Approximately 315 LF of 2-inch PVC reuse water pipe by open cut along Backup Well No. 3 access road.
- H. FPL Electrical Power Infrastructure Work (**[Part 2] Volume V - Base Bid Items 7a and 7b**) as shown on the drawings, and will provide for the installation of empty electrical power conduit and electrical pull boxes under this contract, to facilitate installation of power feeders, including electrical power supply wire and service transformers, to each site ( WTP site and Well site No. 2), by FPL. This work involves the installation of FPL provided materials.
1. Well Site No. 2
    - a. Installation of 200 LF of 5-inch PVC conduit, electrical pull box, and one concrete transformer pad.
  2. WTP Site
    - a. Installation of 790 LF of 5-inch PVC conduit, electrical pull boxes, and one concrete transformer pad within the WTP site (inside the fence).
  3. The contractor is to include in his schedule and work, the cost to pick up and transport to the job site materials to be provided by FPL for this work. The material is located at the St. Augustine FPL Service Center at 303 Hastings Road, St. Augustine, FL 32084. The contractor is to install all empty power supply conduit, fittings, appurtenances, service transformer concrete pads, and pull boxes, as required and as shown on the drawings for the installation of electrical power wire and service transformers by FPL.
    - a. Note: The above quantities are estimates. The actual installed quantities will be based on the FPL design.
- I. FPL Electrical Power Infrastructure Work (**[Part 2] Volume V – Alternate Bid Item No. 17**) as shown on the drawings, and will provide for the installation of empty electrical power conduit and electrical pull boxes under this contract, to facilitate installation of power feeders, including electrical power supply wire and service transformers, to Backup Well site No. 3), by FPL. This work involves the installation of FPL provided materials.
1. Backup Well Site No. 3

- a. Installation of 460 LF of 5-inch PVC conduit, electrical pull boxes, and one concrete transformer pad.
  2. The contractor is to include in his schedule and work, the cost to pick up and transport to the job site materials to be provided by FPL for this work. The material is located at the St. Augustine FPL Service Center at 303 Hastings Road, St. Augustine, FL 32084. The contractor is to install all empty power supply conduit, fittings, appurtenances, service transformer concrete pads, and pull boxes, as required and as shown on the drawings for the installation of electrical power wire and service transformers by FPL.
    - a. Note: The above quantities are estimates. The actual installed quantities will be based on the FPL design.
- J. FPL Electrical Power Infrastructure Work (**[Part 2] Volume V – Alternate Bid Item No. 21**) as shown on the drawings, and will provide for the installation of empty electrical power conduit and electrical pull boxes under this contract, to facilitate installation of power feeders, including electrical power supply wire and service transformers from Longleaf Pine Parkway to the WTP access gate), by FPL. This work involves the installation of FPL provided materials.
  1. WTP Access Road
    - a. Installation of 460 LF of 5-inch PVC conduit, electrical pull boxes, etc.
  2. The contractor is to include in his schedule and work, the cost to pick up and transport to the job site materials to be provided by FPL for this work. The material is located at the St. Augustine FPL Service Center at 303 Hastings Road, St. Augustine, FL 32084. The contractor is to install all empty power supply conduit, fittings, appurtenances, service transformer concrete pads, and pull boxes, as required and as shown on the drawings for the installation of electrical power wire and service transformers by FPL.
- K. Note: The above quantities are estimates. The actual installed quantities will be based on the FPL design.
- L. Included within the Part 2 Package work described above (Volumes I, II, III, IV, and V) are the following additional items.
  1. Operation and maintenance manuals for all equipment.
  2. Equipment and services for acceptance testing.
  3. Review of equipment installation.
  4. Warranties and bonds.
  5. All calibration, testing, startup, check-out and training as required during construction and startup as listed in the contract documents and the individual equipment specification listed herein.
  6. Compliance to all permits and regulatory requirements necessary to perform the work, certify the work as complete and required to place this equipment into service, including, but not limited to, the FDEP Specific Permit to Construct PWS Components, SJRWMD/FDEP Environmental Resource Permit (ERP), FDEP Generic Permit of Produced Ground Water, St. Johns County Development Review Committee permit (DRC), Special Use Permit for Well Site No. 3, SJRWMD Consumptive Use Permit, and St Johns County Site Clearing Permit and Building Department Permit. Please note as part of compliance to the St. Johns County (SJC) Building Department requirements, the

contractor shall be responsible to submit As-Built information per SJC Land Development Code, Part 6.04.01.C. A physical street address is also required to be posted at the driveway to each site, prior to issuance of final completion and certificate of occupancy. The permits listed above are a list of the permits. There may be additional permits, not listed above, that the contractor will be responsible to be in compliance with.

7. All pressure testing and bacteriological testing required to place the system into operation, as required by the regulatory agency having jurisdiction concerning these requirements and providing potable drinking water into the public drinking water supply distribution system.
8. All other work in these contract documents not covered by the items listed above.
9. The contractor is required to obtain all applicable St. Johns County Building and Site Clearing permits prior to beginning the work.

M. Deductive Alternate Bid Item (s) to (Part 2) **Volume II** work.

1. The following are Deductive Alternate Bid Items and may be deducted or removed from the work, if authorized by JEA. These will be determined after final well drilling and performance testing is concluded at well sites no. 1, 2, and 3.
2. Deductive Alternate Bid Item (s)
  - a. **(Part 2) Bid Item No. 24** – Well No. 1 – 75-hp Well Pump Motor (In lieu of 100-hp Motor)
  - b. **(Part 2) Bid Item No. 25** – Well No. 2 – 75-hp Well Pump Motor. (In lieu of 100-hp Motor)
  - c. **(Part 2) Bid Item No. 26** – Well No. 3 – 75-hp Well Pump Motor. (In lieu of 100-hp Motor)

N. Type of Contract: Type of Contract:

1. Project will be constructed under a single prime contract.

1.6 WORK SEQUENCE AND SCHEDULE

- A. Perform Work in sequence listed below to ensure completion of the Work in the Contract Time. Completion dates of the various stages shall be in accordance with the approved construction schedule submitted by the Contractor.
- B. A general construction sequence for the Part 2 Package is provided in Specification Section 11011. All contractual durations for Part 1 and Part 2 Package work shall be in accordance to the phasing and durations noted in the Consolidation Document in the upfront portion of the contract. Contractor shall adhere to these durations and will be responsible for the development of an integrated project schedule for Engineer and Owner's review and approval prior to project commencement.
- C. Raw Water Well No. 1 is required for startup and testing and to provide a raw water supply source for the treatment components of the water treatment plant.,
- D. The Contractor shall submit a construction schedule including ancillary functions including shop drawing preparation and submittal, off-site and on-site testing, commissioning activities, and performance testing to the Engineer for approval prior to commencing work. Completion

dates of the various stages shall be in accordance with the approved construction schedule submitted by the Contractor.

- E. For the Part 1 work (See Part 1 Package Documents) the drilling Wells No.1, No. 2 and Backup Well No. 3 (referred to as the Part 1 well drilling construction contract), may be completing the well drilling work and activities on the three well sites, during the beginning of the Part 2 work, for the overall Rivertown WTP (Volume I, II, III, IV and V). The Contractor will be required to provide access as required and coordinate his work with the well drilling subcontractor, as required.

#### 1.7 CONTRACTOR'S USE OF SITE AND PREMISES

- A. Limits on Use of Site: Limit use of Project site to Work in areas indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated. **Note: The developer of the Rivertown area has been adamant about not disturbing areas beyond the limits of work/clearing, and the Contractor is required to comply with this requirement.**
  - 1. Driveways, Walkways and Entrances: Keep driveways loading areas, and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or for storage of materials.
    - a. Schedule deliveries to minimize use of driveways and entrances by construction operations.
    - b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.
  - 2. Ground Storage Tank Construction Safety Precautions: During the stress tensioning of the tank, establish zoned-off areas around tank and install appropriate barriers as needed to protect surrounding structures and personnel in the event of a wire break. Tank manufacturer shall address the complete safety requirements in their project safety plan.
- B. Condition of Existing Grounds: Maintain portions of existing grounds, landscaping, and hardscaping affected by construction operations throughout construction period. Repair damage caused by construction operations.
- C. The access road to the Water Treatment Plant site also provides access to the cell tower complex on the east side of the WTP parcel. Several companies have equipment and operations in this fenced area and the contractor is required to maintain access to the site for the project duration.

#### 1.8 COORDINATION WITH OCCUPANTS

- A. Owner Limited Occupancy of Completed Areas of Construction: Owner reserves the right to occupy and to place and install equipment in completed portions of the Work, prior to Substantial Completion of the Work, provided such occupancy does not interfere with completion of the Work. Such placement of equipment and limited occupancy shall not constitute acceptance of the total Work.

1. Engineer will prepare a Certificate of Substantial Completion for each specific portion of the Work to be occupied prior to Owner acceptance of the completed Work.
  2. Obtain a Certificate of Occupancy from authorities having jurisdiction before limited Owner occupancy.
  3. Before limited Owner occupancy, mechanical and electrical systems shall be fully operational, and required tests and inspections shall be successfully completed. On occupancy, Owner will operate and maintain mechanical and electrical systems serving occupied portions of Work.
  4. On occupancy, Owner will assume responsibility for maintenance and custodial service for occupied portions of Work.
- B. As noted previously, a well drilling contractor for drilling Wells No. 1, No. 2 and Backup Well No. 3 (referred to as the Part 1 well drilling construction contract) may be completing the well drilling work and activities on the three well sites during the beginning of this contract, for the overall Rivertown WTP (Volume I, II, III, IV, and V) construction contract. The Contractor will be required to provide access as required and coordinate his work with the well drilling contractor.
- C. Another developer may construct a wastewater pump station southeast of the WTP site. Additionally, the developer may construct a portion of the access roadway between Longleaf Pine Parkway and the entrance to the WTP. If this occurs, the Contractor shall provide cooperation and interface with the developer for access into the WTP site.

#### 1.9 WORK RESTRICTIONS

- A. Comply with restrictions on construction operations.
1. Comply with limitations on use of public streets, work on public streets, rights of way, and other requirements of authorities having jurisdiction.
- B. On-Site Work Hours: Limit work to between 7:00 a.m. to 5:00 p.m., Monday through Friday, unless otherwise indicated. Work hours may be modified to meet Project requirements if approved by Owner and authorities having jurisdiction.
- C. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging for temporary utility services according to requirements indicated:
1. Notify Owner not less than 3 work days in advance of proposed utility interruptions.
  2. Obtain Owner's written permission before proceeding with utility interruptions.
- D. Noise, Vibration, Dust, and Odors: Coordinate operations that may result in high levels of noise and vibration, dust, odors, or other disruption to Owner occupancy with Owner.
1. Notify Owner not less than 3 work days in advance of proposed disruptive operations.
  2. Obtain Owner's written permission before proceeding with disruptive operations.
- E. Smoking and Controlled Substance Restrictions: Use of tobacco products, alcoholic beverages, and other controlled substances on Project site is not permitted.

- F. Employee Identification: Provide identification tags for Contractor personnel working on Project site. Require personnel to use identification tags at all times.
- G. Comply with school schedules, traffic access, and speed limitations affecting traffic along Longleaf Parkway near the vicinity of Bartram Trail High School. If the work within the right-of-way of Longleaf Parkway occurs during periods when school is in session, the contractor will be required to perform any work within the right-of-way outside of normal school hours. The contractor will also be required to coordinate his activities to maintain access to the school site during normal school hours, as well as high traffic volume events associated with all other school events, and maintain vehicular traffic access to the roadway and school entrance and provide safety and signage as required to perform the work and provide safe operations of all school activities and events in a safe manner.
- H. A staging, storage, and stockpile area shall be established by the Contractor at the project site. The contractor is not allowed to store any equipment outside these limits.

#### 1.10 SPECIFICATION AND DRAWING CONVENTIONS

- A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
  - 1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
  - 2. Text Color: Text used in the Specifications, including units of measure, manufacturer and product names, and other text may appear in multiple colors or underlined as part of a hyperlink; no emphasis is implied by text with these characteristics.
  - 3. Hypertext: Text used in the Specifications may contain hyperlinks. Hyperlinks may allow for access to linked information that is not residing in the Specifications. Unless otherwise indicated, linked information is not part of the Contract Documents.
  - 4. Specification requirements are to be performed by Contractor unless specifically stated otherwise.
- B. Division 00 Contracting Requirements: General provisions of the Contract, including General and Supplementary Conditions, apply to all Sections of the Specifications.
- C. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.
- D. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on Drawings to identify materials and products:
  - 1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
  - 2. Abbreviations: Materials and products are identified by abbreviations scheduled on Drawings.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 011000

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## SECTION 011011 – SEQUENCE OF CONSTRUCTION

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Consolidation Document and other Division 01 Specification Sections, apply to this Section.
- B. All work shall comply and be installed per the latest JEA Water and Wastewater Standards Manual (January 2020 or latest), the JEA Facilities Standards Manual and JEA Security Standards.
- C. Contractor shall refer to the Part 1 Package Technical Specifications, Section 010100 (General Requirements) for additional details regarding the sequence of operations for the well drilling and initial site clearing portion of the project. This Section addresses Part 2 Package work and overall schedule for the project in accordance to the upfront consolidation document located in this contract.
- D. Disinfecting of Water Supply Systems shall comply with the latest requirements listed in Section 350 and 351 JEA Water and Wastewater Standards (January 2019 or latest).

#### 1.2 SEQUENCE OF CONSTRUCTION - GENERAL

- A. The Contractor shall develop a detailed overall combined and integrated phased construction sequence for both Part 1 and Part 2 work, that complies with the constraints established in the Consolidation Document and this section. This sequence/schedule shall be coordinated with the Owner and the Engineer and submitted for approval. Work will not commence unless the sequence/schedule has been approved.
- B. The order of construction shall be subject to the approval of the Engineer and Owner; such approval or direction, however, shall in no way relieve the Contractor's responsibility to perform the work in accordance with the Contract Documents. The Contractor shall note the requirements of this Section with regard to the operation of the facility and the phasing of construction when developing his work sequence. The Contractor's work sequence must be specifically detailed in the required schedule.
- C. The following work sequence provides for completing the construction of the project within the requirements of the Owner's scheduled plant operation and schedule limitations. It does not purport to cover any sequences necessitated by the actual construction methods. This is a partial outline only. Portions of the work not specifically itemized must be scheduled by the Contractor and the Owner in accordance with the requirements of the approved construction sequence. The Contractor is required to account for all details in formulating his own complete plan for implementation of the project.

- D. Some of the tasks below may overlap one another in performance of the work. Numerical and alphabetical identification of the tasks does not necessarily conform with actual order of construction.
- E. All new and existing equipment, piping, and water retaining structures, that are constructed with this work and that come in contact with raw water, process water or finished potable water, shall be disinfected and bacteriologically tested per the requirements of the Florida Department of Environmental Protection (FDEP) public water supply permit and the applicable AWWA guideline (ANSI/AWWA C651).
- F. The sequence outline included herein provides a required general order of the work. When listed, work described herein, will require certain activities to occur before additions, activities or outages are allowed. Some of the work, listed herein, can occur independent of a preceding activity. Some of the work listed in the following sequence may also be listed by Phase and Stage. The Phase description provides a general sequence of the work. The Work described as Phase 1 or a preceding phase, is to be conducted and completed before the work in the subsequent phases can be started. Additionally, some of the work in a specific phase may also listed by Stage. The work described as Stage 1 or a preceding stage is to be conducted and completed, before the work in a subsequent stage can be started.
- G. The site preparation and drilling of wells at Well No. 1, Well Site No. 2 and Backup Well Site No. 3, as described by the Part 1 Package may not be completed prior to the start of the Part 2 work. The Contractor is responsible to coordinate his work, with the well drilling subcontractor, as required in sequencing work between Part 1 Package and Part 2 Package activities. The overall combined construction schedule (for the Part 1 and Part 2 work) shall comply with the milestone and completion dates identified in the Consolidation/Organization of Design Packages document and contract documents.

### 1.3 SEQUENCE OF CONSTRUCTION

- A. The following criteria were made as part of this preliminary Sequence of Construction, specific to all of the Part 2 Package Work, as detailed in Volume I ( Rivertown WTP Project), Volume II (Rivertown Wells No. 1, 2 and Backup Well No. 3 Project) Volume III (Rivertown Raw Water Pipeline Project), Volume IV (Technical Specifications for the all facets of the project) and Volume V (FPL Electrical Power Infrastructure Project) as noted in the following project schedule description. A general description of the Part 1 sequence is provided in Section 01 01 00, General Requirements, of the Part 1, technical specifications.
- B. (Part 2) Volume I – Rivertown WTP
  - 1. The construction of the Rivertown WTP shall begin as required for the contractor to comply with the substantial and final completion milestone requirements.
  - 2. The Water Treatment Plant portion of the project does not have a specific sequence of construction; however, specific construction constraints are noted in paragraph 1.5, herein.
  - 3. The Contractor is required to provide a 6-foot tall temporary security construction fence to restrict access to the WTP and well sites (Part 2 Volume II) site, prior to beginning construction activities and until the work is complete and the permanent fence is in place.
  - 4. The Mechanical construction and outfitting of Well No. 1, on the site of the Rivertown WTP site, shall begin at the start of the project, to provide a source of raw water for

startup services, testing and performance compliance of the equipment provided under the Part 2, Volume I (Drawings) and Volume IV A (Technical Specifications).

5. Pressure testing shall allow the use of raw water. All raw water used for pressure testing shall be flushed from the pipe and equipment, prior placing all equipment into service.
6. All raw and finished water pipe and equipment shall be properly disinfected and bacteriologically cleared and released for service by FDEP, prior to placing that system or equipment into service.
7. The Contractor shall be responsible to install, all fittings, valves and appurtenances, as required, to perform all the required pressure testing, and bacteriological clearances.

C. (Part 2) Volume II- Rivertown Wells No. 1, 2 and Backup Well No. 3

Well No. 1

1. The mechanical wellhead construction and outfitting of Well No. 1, on the site of the Rivertown WTP shall begin at the start of the project and will be used to provide a source of raw water for the start up services, test and performance compliance of the equipment provided under Volume I (Drawings) and Volume IV A (Technical Specifications)
2. Pressure testing shall allow the use of raw water. All raw water used for pressure testing shall be flushed from the pipe and equipment, prior placing all equipment into service.
3. All raw and finished water pipe and equipment shall be properly disinfected and bacteriologically cleared and released for service by FDEP, prior to placing that system or equipment into service.
4. The Contractor shall be responsible to install, all fittings, valves and appurtenances, as required, to perform all the required pressure testing, and bacteriological clearances.

Well No. 2

1. The mechanical wellhead construction and outfitting of Well No. 2, one of the two offsite wells, shall begin construction, as required for the Contractor to comply with the substantial and final completion milestone requirements.
2. Pressure testing shall allow the use of raw water. All raw water used for pressure testing shall be flushed from the pipe and equipment, prior placing all equipment into service.
3. All raw water pipe and equipment shall be properly disinfected and bacteriologically cleared and released for service by FDEP, prior to placing that system or equipment into service.
4. The Contractor shall be responsible to install, all fittings, valves and appurtenances, as required, to perform all the required pressure testing, and bacteriological clearances.

Backup Well No. 3 (An alternate bid item, this work shall be performed if authorized by JEA)

1. The mechanical wellhead construction and outfitting of Backup Well No. 3, one of the two offsite wells, shall begin construction, as required for the Contractor to comply with the substantial and final completion milestone requirements.
2. Pressure testing shall allow the use of raw water. All raw water used for pressure testing shall be flushed from the pipe and equipment, prior placing all equipment into service.
3. All raw water pipe and equipment shall be properly disinfected and bacteriologically cleared and released for service by FDEP, prior to placing that system or equipment into service.
4. The Contractor shall be responsible to install, all fittings, valves and appurtenances, as required, to perform all the required pressure testing, and bacteriological clearances.

D. (Part 2) Volume III – Rivertown Raw Water Pipeline

1. The construction of the raw water pipelines from site Well No. 2 and the raw water pipeline from Backup Well No. 3 (An alternate bid item, this work shall be performed if authorized by JEA), shall begin construction as required for the Contractor to comply with the substantial and final completion milestone requirements.
2. The raw water main system project does not have a specific sequence of construction; however, the following requirements are intended to limit impacts to the community.
  - a. Maintenance of Traffic operations shall consider the schedules of nearby schools and other facilities as indicated in the Drawings, and of the schedules of other construction activities for the Rivertown WTP, Well No. 2, and Backup Well No. 3.
  - b. Open cut excavation areas shall be limited to work which can be completed within one workday.
3. Contractor shall obtain all necessary Part 2 permits and documentation for the project prior to initiating construction activities at the site, including:
  - a. Notice of Intent to Use NPDES Generic Permit for Stormwater Discharge from Large and Small Construction Activities;
  - b. Stormwater Pollution Prevention Plan.
4. Contractor shall refer to Part 1 Package Technical Specifications, Section 010100 Part 2.02 for permitting requirements for the well drilling/site clearing portion of the project.
5. Contractor shall submit and receive approval of a Work Plan for all horizontal directional drilling related activities, in accordance with JEA Water and Wastewater Standards, latest edition, Section 755, Horizontal Directional Drilling (Large Diameter Pipe Greater than 12 Inches) prior to initiating any activities related to the horizontal directional drilling of the raw water main.
6. Pressure testing shall allow the use of raw water. All raw water used for pressure testing shall be flushed from the pipe and equipment, prior placing all equipment into service.
7. All raw water pipe and equipment shall be properly disinfected and bacteriologically cleared and released for service by FDEP, prior to placing that system or equipment into service.
8. The Contractor shall be responsible to install, all fittings, valves and appurtenances, as required, to perform all the required pressure testing, and bacteriological clearances.

E. (Part 2) Volume V is the FPL Electrical Power Infrastructure work, as shown on the drawings, providing for the installation of empty electrical power conduit and electrical pull boxes by the Contractor, to facilitate installation of power feeders, including electrical power supply wire and service transformers, to each site (WTP site, Well site No. 2 and Backup Well site No. 3), by FPL.

1. The Contractor is to include in his schedule and work, the cost to pick up and transport to the job site materials to be provided by FPL for this work. The material is located at the St. Augustine FPL Service Center at 303 Hastings Road, St. Augustine, FL 32084. The Contractor shall install all empty power supply conduit, fittings, appurtenances, service transformer concrete pads and pull boxes, as required and as shown on the drawings for the installation of electrical power wire and service transformers by FPL.

#### 1.4 SITE CONDITIONS

- A. Erosion control and temporary fencing of all construction areas shall be performed within 30 days after the Notice to Proceed. All erosion control devices shown on the Drawings shall be installed prior to any clearing and grubbing the areas noted in Volume I, Volume II, Volume III, Volume IV (A, B, C) and Volume V of the contract documents.
- B. Refer to Geotechnical Report dated July 30, 2020 as **Appendix A** of Part 2, Volume IV-A Technical Specifications for geotechnical exploration, subsurface conditions and soil exploratory borings. Contractor shall submit a dewatering system and plan for each phases of the project following confirmation of the groundwater level in each phase of the project that shall be provided in the baseline schedule for the work.
- C. All underground pipes, conduits, cables, duct banks, and structures shall be located by electronic locator equipment and test pits in the raw pipeline areas (Part 2, Volume III) and the FP&L areas (Part 2, Volume V). Working drawings of existing work along Longleaf Pine Parkway and proposed new work shall be prepared to scale and submitted to the Engineer in advance of excavation. The Contractor shall be fully responsible for any process outages caused by disruption of underground facilities including responsibility for regulatory fines and the Owner's costs of dealing with regulatory agencies.
- D. Several areas of construction (raw water main in Part 2, Volume III) under this contract must be coordinated with the JEA's Public Outreach Group to assure that no disruption occurs to nearby St. Johns County Bartram High School traffic schedule. Coordinate the activities with the other contractors, if any, to allow orderly and timely completion of all the work and appropriate sequencing.
- E. When access through construction areas must be disrupted, provide alternate acceptable access for the public traffic or other contractors.
- F. During Start Up Testing, make available the manpower, equipment and manufacturer's representatives required to make any necessary adjustments and training.
- G. In addition to the project schedule requirements listed in Section 013100, the Contractor shall develop a detailed description of the complete sequence of construction. The sequence shall be submitted to the Engineer and Owner for review and approval thirty (30) days following the execution of the Contract Agreement. The overall combined construction schedule (for the Part 1 and Part 2 work) shall comply with the milestone and completion dates identified in the Consolidation/Organization of Design Packages document and contract documents.

#### 1.5 CONSTRUCTION CONSTRAINTS

- A. The following is a list of constraints to consider in developing the overall plan for construction. This list is not intended to release the Contractor from the responsibility to coordinate the work.
- B. The site preparation and drilling of wells at Well No. 1, Well Site No. 2 and Backup Well Site No. 3, (Part 1 Package of the Project) may not be completed prior to the start of this work. The contractor is responsible to coordinate his work, with the activities of the Part 1 Package well drilling subcontractor, as required. Contractor shall synchronize scheduling of construction activities such that it does not interfere with the work of the well drilling activities in Part 1 and

well drilling subcontractor. The contractor shall develop and submit a schedule for common work areas between the two work packages (Part 1 and Part 2), to assure no interference or disruption to the well drilling work.

C. WTP Site (Part 2, Volume I)

1. Contractor shall provide temporary security fencing during construction for security and to restrict access to the WTP during construction activities and until the work is complete and the permanent fencing is in place.
2. Contractor shall not impede any access for service providers to the existing Cell Tower Facility during the duration of construction.
3. Contractors shall take precautions on-site from the Well No. 1 blind flange and casing installed under the Part 1 Package..
4. Contractor shall note that the proposed 100-foot, 2.0-MG GST Tank as noted in Section 434163 shall require approximately 15 feet of clearance around the exterior tank wall construction. Temporary grading and schedule of nearby activities shall be taken into consideration for constructability and submitted in the baseline schedule for review by the Engineer.
5. Contractor shall limit the staging areas and stockpile area as referenced on the C-1 Drawing.
6. The northwestern portion of the site contains two areas of a potential future treatment processes for the project. This area shall remain open during the duration of construction.
7. Contractor shall remain within the boundaries of the WTP for all construction activities and not encroach beyond property boundaries.
8. Contractor shall contact FPL Utility Engineer prior to starting any work at WTP to verify service requirements. Refer to Volume I electrical drawings.

D. Wells No. 1, No. 2 and Backup Well No. 3 (Part 2, Volume II)

1. Contractor shall provide temporary security fencing during construction for security and to restrict access to the Well Site No. 2 and Backup Well No. 3 during construction activities and until the work is complete and the permanent fencing is in place.
2. For Well Site No. 2, Contractor is prohibited from clearing or disturbing site outside of the defined limits of clearing, as noted on Drawing 2-C-1 (Part 2, Volume II). Any clearing or disturbance that occurs outside of the defined limits shall be re-planted and restored to match existing, undisturbed condition.
3. Contractor shall install tree protection barricade for Well No. 2 and No. 3 sites in accordance to the Landscape Drawings.
4. Contractors shall take precautions on-site from the Well No. 2 and No. 3 blind flange and casing installed under the Part 1 Package..
5. Contractor shall contact FPL Utility Engineer prior to starting any work at Wells No. 2 and Well No. 3 to verify existing service requirements. Refer to Volume II drawings.
6. Contractor shall remain within the boundaries of the Well No. 2 site, ROW at Longleaf Parkway entrances at Well No. 2 and Well No. 3, for all construction activities and not encroach beyond property boundaries.
7. Contractor shall protect gravel surfacing and retaining wall during at the entrance of Well No. 3 site along Longleaf Pine Parkway. Contractor shall repair the entrance to equal or better condition following the completion of construction activities.

E. Raw Water Pipeline (Part 2, Volume III)

1. The staging areas for the installation of the raw water main system shall be within the right-of-way of Longleaf Pine Parkway or Rivertown WTP site or access road. Refer to Specification Section 01 55 29 in Part 2, Volume IV-C of the Technical Specifications.
2. Contractor shall conform to the HDD drill areas noted on the Part 2, Volume III drawings for the raw water mains between Well No. 3 and the tie-in point at the entrance for the WTP site along Longleaf Pine Parkway.
3. Contractor shall conform to the HDD pull areas, temporary mobile equipment, adherence to pedestrian control/closure of sidewalks in all project areas as shown on the C-Sheets in Part 2, Volume III.
4. Contractor shall maintain a maintenance of traffic for the raw water main construction from Well No. 2 and adhere to the FDOT Index 102-613 (multilane work within the travel way median or outside lane). Refer to C-Sheets and D-Sheets in Part 2, Volume III.

F. FPL Electrical Power Infrastructure (Part 2, Volume V)

1. The contractor shall be required to comply with all the requirements noted on the drawings developed by FPL and adhere to the material and installation requirements required by FPL.

END OF SECTION 011011

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## SECTION 012001 - PRICE AND PAYMENT

### PART 1 - GENERAL

#### 1.1 SECTION INCLUDES

- A. Price and Payment covered by this section are correlated to the Part 2 Package “Rivertown Water Treatment Plant, Wellhead Mechanical and Facilities, and Raw Water Pipeline Bid Workbook.” Refer to the Part 1 Package Bid Workbook and Technical Specifications for price, payment and schedule of value requirements associated with well drilling/site preparation work (See Part 1 Section 010100, General Requirements, paragraph 6.02, list the schedule of values requirements).
- B. Lump sum prices for all Part 2 Package work associated with Volume I – Rivertown Water Treatment Plant work, Volume II – Rivertown Wells No. 1, No. 2 and Backup Well No. 3 Wellhead Mechanical and Facilities work. **The work for Backup Well No. 3 is an alternate bid item and shall be performed if authorized by Owner (JEA).**
- C. Unit Prices for all Part 2 Package work associated with the Volume III – Rivertown Raw Water Pipeline work and Volume V – FP&L Electrical Power Infrastructure work. The total price for all the work associated with the Raw Water Pipeline, will be based upon the quantities and unit prices provided. **The work for the Raw Water Pipeline associated with the pipeline from Backup Well No. 3 site to the connection point of the 20-inch raw water main at the WTP access road is an alternate bid item and shall be performed if authorized by Owner.**

#### 1.2 LUMP SUM PRICES

- A. Payment of the lump sum price bid for Part 2 Package, Item No. 1, 2, 3, 4, 6, 10, 11, 12, 19, 20, 24, 25, and 26 shall constitute full compensation for all labor, materials, tools, equipment, temporary utilities (including water, sewer, electricity, communications and internet access) and incidentals necessary for constructing the complete Rivertown Water Treatment Plant Project for the WTP portion of the work or Volume I and the Rivertown Well No. 1, Well No. 2 and Backup Well No. 3, Wellhead Mechanical and Facilities portion of the work or Volume II., as shown on the drawings and as specified herein.

#### 1.3 UNIT PRICES

- A. Payment of the unit price bid items for Part 2 Package, Item No. 5, 7, 13, 14, 15, 16, 17, 18, and 21 shall constitute full compensation for all labor, materials, tools, equipment, temporary utilities (including water, sewer, electricity, communications and internet access) and incidentals necessary for each unit price item for constructing the complete Rivertown Raw Water Pipeline Project for the portion of the work or Volume III, and the Rivertown FPL Electrical Power Infrastructure project or Volume V, as shown on the drawings and as specified herein.

1.4 ALLOWANCES

- A. Allowances, (Part 2 Base Bid Items No. 8, 9, and Part 2 Alternate Bid Items No. 22, 23) will be performed in accordance with the Owner's General Conditions of the contract documents. These line items are allowances to the project and will be billed in accordance to the OWNER's approval of associated work and in accordance with the contract.

1.5 EXTRA WORK

- A. Extra work, if any, will be performed in accordance with JEA General Conditions of the contract documents.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 012001

## SECTION 012900 - PAYMENT PROCEDURES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes administrative and procedural requirements necessary to prepare and process Applications for Payment.
- B. Related Requirements:
  - 1. "Proposed Schedule of Values Form" for requirements for furnishing proposed schedule of values with bid.
  - 2. Section 013200 "Construction Progress Documentation" for administrative requirements governing the preparation and submittal of the Contractor's construction schedule.

#### 1.3 DEFINITIONS

- A. Schedule of Values: A statement furnished by Contractor allocating portions of the Contract Sum to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

#### 1.4 SCHEDULE OF VALUES

- A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule.
  - 1. Coordinate line items in the schedule of values with items required to be indicated as separate activities in Contractor's construction schedule.
  - 2. Submit the schedule of values to Engineer at earliest possible date, but no later than ten days before the date scheduled for submittal of initial Applications for Payment.
- B. Format and Content: Use Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one line item for each Specification Section.
  - 1. Identification: Include the following Project identification on the schedule of values:
    - a. Project name and location.
    - b. Owner's name.
    - c. Owner's Project number.
    - d. Name of Engineer.

- e. Engineer's Project number.
  - f. Contractor's name and address.
  - g. Date of submittal.
2. Arrange the schedule of values in tabular form, with separate columns to indicate the following for each item listed:
- a. Related Specification Section or division.
  - b. Description of the Work.
  - c. Name of subcontractor.
  - d. Name of manufacturer or fabricator.
  - e. Name of supplier.
  - f. Change Orders (numbers) that affect value.
  - g. Dollar value of the following, as a percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent. Round dollar amounts to whole dollars, with total equal to Contract Sum.
    - 1) Labor.
    - 2) Materials.
    - 3) Equipment.
3. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Provide multiple line items for principal subcontract amounts in excess of five percent of the Contract Sum.
4. Allowances: Provide a separate line item in the schedule of values for each allowance. Show line-item value of unit-cost allowances, as a product of the unit cost, multiplied by measured quantity. Use information indicated in the Contract Documents to determine quantities.
5. Overhead Costs, Proportional Distribution: Include total cost and proportionate share of general overhead and profit for each line item.
6. Schedule of Values Revisions: Revise the schedule of values when Change Orders or Construction Change Directives result in a change in the Contract Sum. Include at least one separate line item for each Change Order and Construction Change Directive.

## 1.5 APPLICATIONS FOR PAYMENT

- A. Each Application for Payment following the initial Application for Payment shall be consistent with previous applications and payments as certified by Engineer and paid for by Owner.
- B. Payment Application Times: The date for each progress payment is indicated in the Owner/Contractor Agreement. The period of construction work covered by each Application for Payment is the period indicated in the Agreement.
  1. Submit draft copy of Application for Payment ten days prior to due date for review by Engineer.
- C. Application Preparation: Complete every entry on form. Execute by a person authorized to sign legal documents on behalf of Contractor. Engineer will return incomplete applications without action.

1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.
  2. Include amounts for work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.
  3. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
  4. Indicate separate amounts for work being carried out under Owner-requested project acceleration.
- D. Stored Materials: Include in Application for Payment amounts applied for materials or equipment purchased or fabricated and stored, but not yet installed.
1. Provide certificate of insurance, evidence of transfer of title to Owner, and consent of surety to payment.
  2. Provide supporting documentation that verifies amount requested, such as paid invoices. Match amount requested with amounts indicated on documentation; do not include overhead and profit on stored materials.
  3. Provide summary documentation for stored materials indicating the following:
    - a. Value of materials previously stored and remaining stored as of date of previous Applications for Payment.
    - b. Value of previously stored materials put in place after date of previous Application for Payment and on or before date of current Application for Payment.
    - c. Value of materials stored since date of previous Application for Payment and remaining stored as of date of current Application for Payment.
- E. Transmittal: Submit signed original PDF copies of each Application for Payment to Engineer by e-mail. Include waivers of lien and similar attachments if required.
1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.
  2. Waiver Forms: Submit executed waivers of lien on forms acceptable to Owner.
- F. Maintain an updated set of drawings to be used as record drawings in accordance with Section 017839. As a prerequisite for monthly progress payments, exhibit the updated record drawings for review by Owner and Engineer for completeness and accuracy.
- G. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
1. List of subcontractors.
  2. Schedule of values.
  3. Contractor's construction schedule.
  4. Schedule of unit prices.
  5. Submittal schedule.
  6. List of Contractor's staff assignments.
  7. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
  8. Initial progress report.
  9. Report of preconstruction conference.

- H. Application for Payment at Substantial Completion: After Engineer issues the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.
1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
    - a. Complete administrative actions, submittals, and Work proceeding this application, as described in Section 017700 "Closeout Procedures."
  2. Include initial submittal of closeout record drawings in accordance with Section 017839.
  3. This application shall reflect Certificate(s) of Substantial Completion issued previously for Owner occupancy of designated portions of the Work.
- I. Final Payment Application: After completing Project closeout requirements, submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:
1. Evidence of completion of Project closeout requirements.
  2. Certification of completion of final punch list items.
  3. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
  4. Final submittal of closeout record drawings in accordance with Section 017839.
  5. Updated final statement, accounting for final changes to the Contract Sum.
  6. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
  7. Proof that taxes, fees, and similar obligations are paid.
  8. Waivers and releases.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 012900

## SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
  - 1. General coordination procedures.
  - 2. Coordination drawings.
  - 3. RFIs.
  - 4. Digital project management procedures.
  - 5. Web-based Project management software package.
  - 6. Project meetings.
- B. Related Requirements:
  - 1. Section 013200 "Construction Progress Documentation" for preparing and submitting Contractor's construction schedule.
  - 2. Section 017300 "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
  - 3. Section 017700 "Closeout Procedures" for coordinating closeout of the Contract.

#### 1.3 DEFINITIONS

- A. RFI: Request for Information. Request from Owner, Engineer, or Contractor seeking information required by or clarifications of the Contract Documents.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:
  - 1. Name, address, telephone number, and email address of entity performing subcontract or supplying products.
  - 2. Number and title of related Specification Section(s) covered by subcontract.
  - 3. Drawing number and detail references, as appropriate, covered by subcontract.

- B. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses. Cellular telephone numbers, and e-mail addresses. Provide names, addresses, and telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project.
  - 1. Post copies of list in Project meeting room, in temporary field office, in web-based Project software directory, and in prominent location in built facility. Keep list current at all times.

## 1.5 GENERAL COORDINATION PROCEDURES

- A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations included in different Sections that depend on each other for proper installation, connection, and operation.
  - 1. Schedule construction operations in sequence required to obtain the best results, where installation of one part of the Work depends on installation of other components, before or after its own installation.
  - 2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
  - 3. Make adequate provisions to accommodate items scheduled for later installation.
- B. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.
  - 1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.
- C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
  - 1. Preparation of Contractor's construction schedule.
  - 2. Preparation of the schedule of values.
  - 3. Installation and removal of temporary facilities and controls.
  - 4. Delivery and processing of submittals.
  - 5. Progress meetings.
  - 6. Preinstallation conferences.
  - 7. Project closeout activities.
  - 8. Startup and adjustment of systems.

## 1.6 REQUEST FOR INFORMATION (RFI)

- A. General: Immediately on discovery of the need for additional information, clarification, or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.



1. Engineer will return without response those RFIs submitted to Engineer by other entities controlled by Contractor.
  2. Coordinate and submit RFIs in a prompt manner to avoid delays in Contractor's work or work of subcontractors.
- B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:
1. Project name.
  2. Owner name.
  3. Owner's Project number.
  4. Name of Engineer.
  5. Engineer's Project number.
  6. Date.
  7. Name of Contractor.
  8. RFI number, numbered sequentially.
  9. RFI subject.
  10. Specification Section number and title and related paragraphs, as appropriate.
  11. Drawing number and detail references, as appropriate.
  12. Field dimensions and conditions, as appropriate.
  13. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
  14. Contractor's signature.
  15. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
    - a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.
- C. RFI Forms: Software-generated form with substantially the same content as indicated above, acceptable to Engineer.
1. Attachments shall be electronic files in PDF format.
- D. Engineer's Action: Engineer will review each RFI, determine action required, and respond. Allow seven days for Engineer's response for each RFI. RFIs received by Engineer after 1:00 p.m. will be considered as received the following working day.
1. The following Contractor-generated RFIs will be returned without action:
    - a. Requests for approval of submittals.
    - b. Requests for approval of substitutions.
    - c. Requests for approval of Contractor's means and methods.
    - d. Requests for coordination information already indicated in the Contract Documents.
    - e. Requests for adjustments in the Contract Time or the Contract Sum.
    - f. Requests for interpretation of Engineer's actions on submittals.
    - g. Incomplete RFIs or inaccurately prepared RFIs.

2. Engineer's action may include a request for additional information, in which case Engineer's time for response will date from time of receipt by Engineer of additional information.
  3. Engineer's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal.
    - a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Engineer in writing within 5 days of receipt of the RFI response.
- E. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log at each monthly progress meeting. Include the following:
1. Project name.
  2. Name and address of Contractor.
  3. Name and address of Engineer.
  4. RFI description.
  5. Date the RFI was submitted.
  6. Date Engineer's response was received.
  7. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.
  8. Identification of related Field Order, Work Change Directive, and Proposal Request, as appropriate.
- F. On receipt of Engineer's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Engineer within seven days if Contractor disagrees with response.

## 1.7 DIGITAL PROJECT MANAGEMENT PROCEDURES

- A. Use of Engineer's Digital Data Files: Digital data files of Engineer's CAD drawings will be provided by Engineer for Contractor's use during construction.
1. Digital data files may be used by Contractor in preparing coordination drawings, Shop Drawings, and Project Record Drawings.
  2. Engineer makes no representations as to the accuracy or completeness of digital data files as they relate to Contract Drawings.
  3. Digital Drawing Software Program: Contract Drawings are available in AutoCAD 2017.
  4. Contractor shall execute a data licensing agreement in the form of Agreement form acceptable to Owner and Engineer.
    - a. Subcontractors, and other parties granted access by Contractor to Engineer's digital data files shall execute a data licensing agreement in the form of Agreement form acceptable to Owner and Engineer.
- B. Web-Based Project Management Software Site: Use Engineer's web-based Project management software site (SharePoint Work Room) for purposes of hosting and managing Project communication and documentation until Final Completion.

1. At completion of Project, provide digital archive in format that is readable by common desktop software applications in format acceptable to Engineer. Provide data in locked format to prevent further changes.
- C. PDF Document Preparation: Where PDFs are required to be submitted to Engineer, prepare as follows:
1. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
  2. Name file with submittal number or other unique identifier, including revision identifier.
  3. Certifications: Where digitally submitted certificates and certifications are required, provide a digital signature with digital certificate on where indicated.

## 1.8 PROJECT MEETINGS

- A. General: Engineer will schedule and conduct meetings at Project site unless otherwise indicated.
- B. Preconstruction Conference: Engineer will schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Contractor, but no later than 15 days after execution of the Agreement.
1. Attendees: Authorized representatives of Owner, Engineer, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
  2. Agenda: Discuss items of significance that could affect progress, including the following:
    - a. Responsibilities and personnel assignments.
    - b. Tentative construction schedule.
    - c. Phasing.
    - d. Critical work sequencing and long lead items.
    - e. Designation of key personnel and their duties.
    - f. Lines of communications.
    - g. Use of web-based Project software.
    - h. Procedures for processing field decisions and Change Orders.
    - i. Procedures for RFIs.
    - j. Procedures for testing and inspecting.
    - k. Procedures for processing Applications for Payment.
    - l. Distribution of the Contract Documents.
    - m. Submittal procedures.
    - n. Preparation of Record Documents.
    - o. Use of the premises and existing building.
    - p. Work restrictions.
    - q. Working hours.
    - r. Owner's occupancy requirements.
    - s. Responsibility for temporary facilities and controls.
    - t. Procedures for moisture and mold control.
    - u. Procedures for disruptions and shutdowns.
    - v. Construction waste management and recycling.

- w. Parking availability.
  - x. Office, work, and storage areas.
  - y. Equipment deliveries and priorities.
  - z. First aid.
  - aa. Security.
  - bb. Progress cleaning.
  - cc. List of major subcontractors and suppliers.
- 3. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.
  - 4. Attendees: Authorized representatives of Owner, Engineer, and their consultants; Contractor and its superintendent and sustainable design coordinator; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
  - 5. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.
- C. Progress Meetings: Engineer will conduct progress meetings at monthly intervals.
- 1. Attendees: In addition to representatives of Owner and Engineer, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
  - 2. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
    - a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
      - 1) Review schedule for next period.
    - b. Review present and future needs of each entity present, including the following:
      - 1) Interface requirements.
      - 2) Sequence of operations.
      - 3) Status of submittals.
      - 4) Deliveries.
      - 5) Off-site fabrication.
      - 6) Access.
      - 7) Site use.
      - 8) Temporary facilities and controls.
      - 9) Progress cleaning.
      - 10) Quality and work standards.
      - 11) Status of correction of deficient items.

- 12) Field observations.
  - 13) Status of RFIs.
  - 14) Status of Proposal Requests.
  - 15) Pending changes.
  - 16) Status of Change Orders.
  - 17) Pending claims and disputes.
  - 18) Documentation of information for payment requests.
3. Minutes: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.
- a. Schedule Updating: Revise Contractor's construction schedule after each progress meeting. Where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 013100

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## SECTION 013200 - CONSTRUCTION PROGRESS DOCUMENTATION

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
  - 1. Contractor's Construction Schedule.
  - 2. Construction schedule updating reports.
  - 3. Daily construction reports.
  - 4. Material location reports.
  - 5. Site condition reports.
  - 6. Unusual event reports.
- B. Related Requirements:
  - 1. Section 014000 "Quality Requirements" for schedule of tests and inspections.
  - 2. Section 012900 "Payment Procedures" for schedule of values and requirements for use of cost-loaded schedule for Applications for Payment.

#### 1.3 DEFINITIONS

- A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction Project. Activities included in a construction schedule consume time and resources.
  - 1. Critical Activity: An activity on the critical path that must start and finish on the planned early start and finish times.
  - 2. Predecessor Activity: An activity that precedes another activity in the network.
  - 3. Successor Activity: An activity that follows another activity in the network.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Format for Submittals: Submit required submittals in the following format:
  - 1. Working electronic copy of schedule file.
  - 2. PDF file.

- B. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.
- C. Construction Schedule Updating Reports: Submit with Applications for Payment.
- D. Daily Construction Reports: Submit at weekly intervals.
- E. Material Location Reports: Submit at monthly intervals.
- F. Site Condition Reports: Submit at time of discovery of differing conditions.
- G. Unusual Event Reports: Submit at time of unusual event.

#### 1.5 COORDINATION

- A. Coordinate Contractor's Construction Schedule with the schedule of values, submittal schedule, progress reports, payment requests, and other required schedules and reports.
  - 1. Secure time commitments for performing critical elements of the Work from entities involved.
  - 2. Coordinate each construction activity in the network with other activities, and schedule them in proper sequence.

#### 1.6 CONTRACTOR'S CONSTRUCTION SCHEDULE

- A. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules.
  - 1. Use Primavera for current Windows operating system (required by JEA)
- B. Time Frame: Extend schedule from date established for the Notice to Proceed to date of Final Completion.
  - 1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.
- C. Activities: Treat each separate area as a separate numbered activity for each main element of the Work. Comply with the following:
  - 1. Activity Duration: Define activities so no activity is longer than 20 days, unless specifically allowed by Engineer.
  - 2. Procurement Activities: Include procurement process activities for the following long lead-time items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
    - a. High Services Pumps
    - b. Vertical Turbine Well Pumps
    - c. Variable Frequency Drives
    - d. Motor Control Center



- e. 750 KW Generator.
  - 3. Submittal Review Time: Include review and resubmittal times indicated in Section 013300 "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's Construction Schedule with submittal schedule.
  - 4. Startup and Testing Time: Include no fewer than 15 days for startup and testing.
  - 5. Commissioning Time: Include no fewer than 15 days for commissioning.
  - 6. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Engineer's administrative procedures necessary for certification of Substantial Completion.
  - 7. Punch List and Final Completion: Include not more than 30 days for completion of punch list items and Final Completion.
- D. Upcoming Work Summary: Prepare summary report indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:
- 1. Unresolved issues.
  - 2. Unanswered Requests for Information.
  - 3. Rejected or unreturned submittals.
  - 4. Notations on returned submittals.
  - 5. Pending modifications affecting the Work and the Contract Time.
- E. Acceptability
- 1. The Engineer's review of the Contractor's construction schedule submittals will only be for conformance with the Contract requirements – including but not limited to contract time and work sequences specified in the contract documents. The Engineer's review of the schedule shall not include the Contractor's means and methods of construction or safety. The Engineer's concurrence, acceptance, or approval of the Contractor's schedule submittals will not relieve the Contractor from responsibility for complying with the Contract Scope, Contract Time or any other contract requirement. Any indication of concurrence, acceptance, or approval of the Contractor's schedule will only indicate a general conformance with the Contract Requirements.
  - 2. Failure to include any element of work required for the performance of this Contract will not excuse the Contractor from completing all Work required within the Contract completion date(s), notwithstanding the review of the network by the Engineer.
- F. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week before each regularly scheduled progress meeting.
- 1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
  - 2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
  - 3. As the Work progresses, indicate Final Completion percentage for each activity. Activities shall not be considered to be complete until they are in fact 100 percent complete.

- G. Recovery Schedule: When periodic update indicates the Work is 14 or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, equipment required to achieve compliance, and date by which recovery will be accomplished.
- H. Distribution: Distribute copies of approved schedule to Engineer Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.
  - 1. Post copies in Project meeting rooms and temporary field offices.
  - 2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

## 1.7 GANTT-CHART SCHEDULE REQUIREMENTS

- A. Gantt-Chart Schedule: Submit a comprehensive, fully developed, horizontal, Gantt-chart-type, Contractor's Construction Schedule within 30 days of date established for the Notice to Proceed.
  - 1. Base schedule on the startup construction schedule and additional information received since the start of Project.
- B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line.
  - 1. For construction activities that require three months or longer to complete, indicate an estimated completion percentage in 10 percent increments within time bar.

## 1.8 REPORTS

- A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:
  - 1. List of subcontractors at Project site.
  - 2. Approximate count of personnel at Project site.
  - 3. Equipment at Project site.
  - 4. Material deliveries.
  - 5. High and low temperatures and general weather conditions, including presence of rain or snow.
  - 6. Testing and inspection.
  - 7. Accidents.
  - 8. Meetings and significant decisions.
  - 9. Unusual events.
  - 10. Stoppages, delays, shortages, and losses.
  - 11. Meter readings and similar recordings.
  - 12. Emergency procedures.
  - 13. Orders and requests of authorities having jurisdiction.
  - 14. Change Orders received and implemented.

15. Work Change Directives received and implemented.
16. Services connected and disconnected.
17. Equipment or system tests and startups.
18. Partial completions and occupancies.
19. Substantial Completions authorized.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 013200

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## SECTION 013233 - PHOTOGRAPHIC DOCUMENTATION

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes administrative and procedural requirements for the following:
  - 1. Preconstruction photographs.
  - 2. Periodic construction photographs.
  - 3. Final Completion construction photographs.
- B. Related Requirements:
  - 1. Section 017700 "Closeout Procedures" for submitting photographic documentation as Project Record Documents at Project closeout.
  - 2. Section 017900 "Demonstration and Training" for submitting video recordings of demonstration of equipment and training of Owner's personnel.
  - 3. Section 311000 "Site Clearing" for photographic documentation before site clearing operations commence.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Key Plan: Submit key plan of Project site and building with notation of vantage points marked for location and direction of each photograph. Indicate elevation or story of construction. Include same information as corresponding photographic documentation.
- B. Digital Photographs: Submit image files within three days of taking photographs.
  - 1. Submit photos by uploading to web-based Project management site. Include copy of key plan indicating each photograph's location and direction.
  - 2. Identification: Provide the following information with each image description in web-based Project management site:
    - a. Name of Project.
    - b. Name and contact information for photographer.
    - c. Name of Engineer.
    - d. Name of Contractor.
    - e. Date photograph was taken.
    - f. Description of location, vantage point, and direction.
    - g. Unique sequential identifier keyed to accompanying key plan.

#### 1.4 QUALITY ASSURANCE

- A. Photographer Qualifications: An individual who has been regularly engaged as a professional photographer of construction projects for not less than three years.

#### 1.5 FORMATS AND MEDIA

- A. Digital Photographs: Provide color images in JPG format, produced by a digital camera with minimum sensor size of 12 megapixels, and at an image resolution of not less than 3200 by 2400 pixels. Use flash in low light levels or backlit conditions.
- B. Digital Images: Submit digital media as originally recorded in the digital camera, without alteration, manipulation, editing, or modifications using image-editing software.
- C. Metadata: Record accurate date and time from camera.
- D. File Names: Name media files with date, Project area, and sequential numbering suffix.
- E. Usage Rights
  - 1. Obtain and transfer copyright usage rights from photographer to Owner for unlimited reproduction of photographic documentation.

#### 1.6 CONSTRUCTION PHOTOGRAPHS

- A. Photographer: Engage a qualified photographer to take construction photographs.
- B. General: Take photographs with maximum depth of field and in focus.
  - 1. Maintain key plan with each set of construction photographs that identifies each photographic location.
- C. Preconstruction Photographs: Before commencement of the Work take photographs of Project site and surrounding properties, including existing items to remain during construction, from different vantage points, as directed by Engineer.
  - 1. Flag construction limits before taking construction photographs.
  - 2. Take 20 photographs to show existing conditions adjacent to property before starting the Work.
  - 3. Take 20 photographs of existing buildings either on or adjoining property to accurately record physical conditions at start of construction.
  - 4. Take additional photographs as required to record settlement or cracking of adjacent structures, pavements, and improvements.
- D. Periodic Construction Photographs: Take 20 photographs monthly coinciding with the cutoff date associated with each Application for Payment. Select vantage points to show status of construction and progress since last photographs were taken.

- E. Final Completion Construction Photographs: Take 50 photographs after date of Substantial Completion for submission as Project Record Documents. Engineer will inform photographer of desired vantage points.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 013233

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## SECTION 013300 - SUBMITTAL PROCEDURES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:

- 1. Submittal schedule requirements.
  - 2. Administrative and procedural requirements for submittals.

- B. Related Requirements:

- 1. Section 012900 "Payment Procedures" for submitting Applications for Payment and the schedule of values.
  - 2. Section 013100 "Project Management and Coordination" for submitting coordination drawings and subcontract list and for requirements for web-based Project software.
  - 3. Section 013200 "Construction Progress Documentation" for submitting schedules and reports, including Contractor's construction schedule.
  - 4. Section 013233 "Photographic Documentation" for submitting preconstruction photographs, periodic construction photographs, and Final Completion construction photographs.
  - 5. Section 014000 "Quality Requirements" for submitting test and inspection reports, and schedule of tests and inspections.
  - 6. Section 017700 "Closeout Procedures" for submitting closeout submittals and maintenance material submittals.
  - 7. Section 017823 "Operation and Maintenance Data" for submitting operation and maintenance manuals.
  - 8. Section 017839 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.
  - 9. Section 017900 "Demonstration and Training" for submitting video recordings of demonstration of equipment and training of Owner's personnel.

#### 1.3 DEFINITIONS

- A. Action Submittals: Written and graphic information and physical samples that require Engineer's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."
- B. Informational Submittals: Written and graphic information and physical samples that do not require Engineer's responsive action. Submittals may be rejected for not complying with

requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."

- C. Mass Submittals: Six or more submittals or items in one day or 15 or more submittals or items in one week.

#### 1.4 SUBMITTAL SCHEDULE

- A. Submittal Schedule: Submit, as an action submittal, a list of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Engineer and additional time for handling and reviewing submittals required by those corrections.
  - 1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
  - 2. Format: Arrange the following information in a tabular format:
    - a. Scheduled date for first submittal.
    - b. Specification Section number and title.
    - c. Submittal Category: Action; informational.
    - d. Name of subcontractor.
    - e. Description of the Work covered.

#### 1.5 SUBMITTAL FORMATS

- A. Numbering System: Utilize the following example submittal identification numbering system to identify submittals and as file names for PDF submissions:
  - 1. First Identifier - Alphabet Character: D, S, M or I which represents Shop Drawing (including working drawings and product data), Sample, Manual (Operating & Maintenance) or Informational, respectively.
  - 2. Second Identifier - Next 6 or 8 Digits: Applicable Specification Section Number. Do not mix submittals from different specification sections into a single submittal.
  - 3. Third Identifier - Next Three Digits: Sequential number of each separate item or drawing submitted under each Specification Section, in chronological order submitted, starting at 001.
  - 4. Fourth Identifier - Last Alphabet Character: A to Z, indicating the submission (or resubmission) of the same submittal, i.e., "A" = 1st submission, "B" = 2nd submission, "C" = 3rd submission, etc.
  - 5. EXAMPLE: D-033000.13-008-B.
    - a. D = Shop Drawing.
    - b. 03 30 00.13 = Section; use only 6 digits for sections that do not include 8 digits.
    - c. 008 = the eighth different submittal under this Section.
    - d. B = the second submission (first resubmission) of that particular shop drawing.

B. Submittal Information: Include the following information in each submittal:

1. Project name.
2. Date.
3. Name of Engineer.
4. Name of Contractor.
5. Name of firm or entity that prepared submittal.
6. Names of subcontractor, manufacturer, and supplier.
7. Category and type of submittal.
8. Submittal purpose and description.
9. Number and title of Specification Section, with paragraph number and generic name for each of multiple items.
10. Drawing number and detail references, as appropriate.
11. Indication of full or partial submittal.
12. Location(s) where product is to be installed, as appropriate.
13. Other necessary identification.
14. Remarks.
15. Signature of transmitter.

C. Options: Identify options requiring selection by Engineer.

D. Deviations and Additional Information: On each submittal, clearly indicate deviations from requirements in the Contract Documents, including minor variations and limitations; include relevant additional information and revisions, other than those requested by Engineer on previous submittals. Indicate by highlighting on each submittal or noting on attached separate sheet.

E. Submittals Utilizing Web-Based Project Software: Prepare submittals as PDF files or other format indicated by Project management software.

## 1.6 SUBMITTAL PROCEDURES

A. Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.

1. Email: Prepare submittals as PDF package and transmit to Engineer via email. Include PDF transmittal form. Include information in email subject line as requested by Engineer.
  - a. Engineer will return annotated file. Annotate and retain one copy of file as a digital Project Record Document file.
2. Web-Based Project Management Software: Prepare submittals in PDF form, and upload submittals over 20-MB, or as to be determined, to web-based Project management software website (SharePoint Work Room). Enter required data in web-based software site to fully identify submittal.

B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.

1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.

2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
  3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
  4. Coordinate transmittal of submittals for related parts of the Work specified in different Sections so processing will not be delayed because of need to review submittals concurrently for coordination.
    - a. Engineer reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
- C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Engineer's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
1. Initial Review: Allow 21 calendar days for initial review of each submittal (and 30 calendar days for multi-discipline reviews). Allow additional time if coordination with subsequent submittals is required. Engineer will advise Contractor when a submittal being processed must be delayed for coordination.
  2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
  3. Resubmittal Review: Allow 15 calendar days for review of each resubmittal.
- D. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
1. Note date and content of previous submittal.
  2. Note date and content of revision in label or title block and clearly indicate extent of revision.
  3. Resubmit submittals until they are marked with approval notation from Engineer's action stamp.
  4. Repetitive Reviews: Shop drawings, O&M manuals, and other submittals will be reviewed no more than twice at the Owner's expense. All subsequent reviews will be performed at the Contractor's expense. Reimburse the Owner for all costs invoiced by Engineer for the third and subsequent reviews.
- E. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.
- F. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Engineer's action stamp.

## 1.7 SUBMITTAL REQUIREMENTS

- A. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
1. If information must be specially prepared for submittal because standard published data are unsuitable for use, submit as Shop Drawings, not as Product Data.

2. Mark each copy of each submittal to show which products and options are applicable.
  3. Include the following information, as applicable:
    - a. Manufacturer's catalog cuts.
    - b. Manufacturer's product specifications.
    - c. Standard color charts.
    - d. Statement of compliance with specified referenced standards.
    - e. Testing by recognized testing agency.
    - f. Application of testing agency labels and seals.
    - g. Notation of coordination requirements.
    - h. Availability and delivery time information.
  4. For equipment, include the following in addition to the above, as applicable:
    - a. Wiring diagrams that show factory-installed wiring.
    - b. Printed performance curves.
    - c. Operational range diagrams.
    - d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
  5. Submit Product Data before Shop Drawings, and before or concurrently with Samples.
- B. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.
1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
    - a. Identification of products.
    - b. Schedules.
    - c. Compliance with specified standards.
    - d. Notation of coordination requirements.
    - e. Notation of dimensions established by field measurement.
    - f. Relationship and attachment to adjoining construction clearly indicated.
    - g. Seal and signature of professional engineer if specified.
- C. Samples: Submit Samples for review of type, color, pattern, and texture for a check of these characteristics with other materials.
1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
  2. Identification: Permanently attach label on unexposed side of Samples that includes the following:
    - a. Project name and submittal number.
    - b. Generic description of Sample.
    - c. Product name and name of manufacturer.
    - d. Sample source.
    - e. Number and title of applicable Specification Section.
    - f. Specification paragraph number and generic name of each item.

3. Web-Based Project Management Software: Prepare submittals in PDF form, and upload submittals over 20 MB, or as to be determined, to web-based Project software website (SharePoint Work Room). Enter required data in web-based software site to fully identify submittal.
  4. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
    - a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
    - b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
  5. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units, showing the full range of colors, textures, and patterns available.
    - a. Number of Samples: Submit one full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Engineer will return submittal with options selected.
  6. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
    - a. Number of Samples: Submit three sets of Samples. Engineer will retain two Sample sets; remainder will be returned. Mark up and retain one returned Sample set as a project record Sample.
      - 1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
      - 2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.
- D. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:
1. Type of product. Include unique identifier for each product indicated in the Contract Documents or assigned by Contractor if none is indicated.
  2. Manufacturer and product name, and model number if applicable.
  3. Number and name of room or space.
  4. Location within room or space.

- E. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.
- F. Design Data: Prepare and submit written and graphic information indicating compliance with indicated performance and design criteria in individual Specification Sections. Include list of assumptions and summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Number each page of submittal.
- G. Certificates:
  - 1. Certificates and Certifications Submittals: Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.
  - 2. Insert definition of Contractor certificates here if required by individual Specification Sections. See the Evaluations.
  - 3. Contractor's Certification: Each shop drawing, working drawing, product data, and sample shall have affixed to it the following Certification Statement:
    - a. "Certification Statement: by this submittal, I hereby represent that I have determined and verified all field measurements, field construction criteria, materials, dimensions, catalog numbers and similar data and I have checked and coordinated each item with other applicable approved shop drawings and all Contract requirements. "
  - 4. Installer Certificates: Submit written statements on manufacturer's letterhead, certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
  - 5. Manufacturer Certificates: Submit written statements on manufacturer's letterhead, certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
  - 6. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
  - 7. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
  - 8. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of AWS B2.1/B2.1M on AWS forms. Include names of firms and personnel certified.
- H. Test and Research Reports:
  - 1. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for substrate preparation and primers required.
  - 2. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
  - 3. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.

4. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
5. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
6. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:
  - a. Name of evaluation organization.
  - b. Date of evaluation.
  - c. Time period when report is in effect.
  - d. Product and manufacturers' names.
  - e. Description of product.
  - f. Test procedures and results.
  - g. Limitations of use.

#### 1.8 PROPOSED PRODUCT LIST

- A. Within 15 days after date of Notice to Proceed, submit list of major products proposed for use, with name of manufacturer, trade name, and model number of each product.
- B. For products specified only by reference standards, indicate manufacturer, trade name, model or catalog designation, and reference standards.

#### 1.9 CONTRACTOR'S REVIEW

- A. Action Submittals and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Engineer.
- B. Contractor Responsible for:
  1. Determination and verification of materials including manufacturer's catalog numbers.
  2. Determination and verification of field measurements and field construction criteria.
  3. Checking and coordinating information in submittal with requirements of Work and of Contract Documents.
  4. Determination of accuracy and completeness of dimensions and quantities.
  5. Confirmation and coordination of dimensions and field conditions at Site.
  6. Construction means, techniques, sequences, and procedures.
  7. Safety precautions.
  8. Coordination and performance of Work of all trades.
  9. Other requirements enumerated in Contract Documents.



- C. Contractor's Approval: Indicate Contractor's approval for each submittal with indication in web-based Project management software. Include name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.
  - 1. Engineer will not review submittals received from Contractor that do not have Contractor's review and approval.

#### 1.10 ENGINEER'S REVIEW

- A. Do not make mass submittals to Engineer. If mass submittals are received, Engineer's review time stated above will be extended as necessary to perform proper review. Engineer will review mass submittals based on priority determined by Engineer after consultation with Owner and Contractor.
- B. Action Submittals: Engineer will review each submittal, indicate corrections or revisions required, and return.
  - 1. Submittals by Web-Based Project Management Software: Engineer will indicate, on Project management software website, the appropriate action.
- C. Informational Submittals: Engineer will review each submittal and will not return it, or will return it if it does not comply with requirements. Engineer will forward each submittal to appropriate party.
- D. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Engineer.
- E. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.
- F. Engineer will return without review submittals received from sources other than Contractor.
- G. Submittals not required by the Contract Documents will be returned by Engineer without action.
- H. Shop drawings will be returned to the Contractor with one of the following codes.
  - 1. "APPROVED" - This code is assigned when there are no notations or comments on the submittal. When returned under this code the Contractor may release the equipment and/or material for manufacture.
  - 2. "APPROVED AS NOTED" - This code is assigned when a confirmation of the notations and comments IS NOT required by the Contractor. The Contractor may release the equipment or material for manufacture; however, all notations and comments must be incorporated into the final product.
  - 3. "APPROVED AS NOTED/CONFIRM" – This combination of codes is assigned when a confirmation of the notations and comments is required by the Contractor. The Contractor may release the equipment or material for manufacture; however, all notation and comments must be incorporated into the final product. This confirmation shall specifically address each omission and nonconforming item that was noted. Confirmation

is to be received by the Engineer within 15 calendars days of the date of the engineer's transmittal requiring confirmation.

4. "APPROVED AS NOTED/RESUBMIT" - This combination of codes is assigned when notations and comments are extensive enough to require a resubmittal of the package. The Contractor may release the equipment or material for manufacture; however, all notations and comments must be incorporated into the final product. The resubmittal is to address all comments, omissions and non-conforming items that were noted. An additional box is checked to indicate whether the resubmission is for the complete package, or for parts of the package. If no box is checked, a complete resubmittal shall be provided. Review code may designate if a partial or full submittal is required. If full submittal is required, a complete resubmittal package addressing all comments shall be provided. If a partial submittal is designated, resubmittal shall only include information pertaining to those items noted in review comments requiring clarification and any portions of submittal impacted as a result of the response. Resubmittal is to be received by the Engineer within 30 calendar days of the date of the Engineer's transmittal requiring the resubmittal.
5. "REJECTED" - This code is assigned when the submittal does not meet the intent of the Contract Documents. The Contractor must resubmit the entire package revised to bring the submittal into conformance. It may be necessary to resubmit using a different manufacturer/vendor to meet the requirements of the Contract Documents.
6. "RECEIPT ACKNOWLEDGED (Not subject to Engineer's Approval)" - This code is assigned to acknowledge receipt of a submittal that is not subject to the Engineer's approval. This code is generally used with submittals involving the Contractor's means and methods of construction work plans, and health and safety plans.

#### 1.11 ELECTRONIC CAD FILES OF PROJECT DRAWINGS

- A. Electronic CAD Files of Project Drawings: May only be used to expedite production of Shop Drawings for the Project. Use for other Projects or purposes is not allowed.
- B. Electronic CAD Files of Project Drawings: Distributed only under the following conditions:
  1. Use of files is solely at receiver's risk. Engineer does not warrant accuracy of files. Receiving files in electronic form does not relieve receiver of responsibilities for measurements, dimensions, and quantities set forth in Contract Documents. In the event of ambiguity, discrepancy, or conflict between information on electronic media and that in Contract Documents, notify Engineer of discrepancy and use information in hard-copy Drawings and Specifications.
  2. CAD files do not necessarily represent the latest Contract Documents, existing conditions, and as-built conditions. Receiver is responsible for determining and complying with these conditions and for incorporating addenda and modifications.
  3. User is responsible for removing information not normally provided on Shop Drawings and removing references to Contract Documents. Shop Drawings submitted with information associated with other trades or with references to Contract Documents will not be reviewed and will be immediately returned.
  4. Receiver shall not hold Engineer responsible for data or file clean-up required to make files usable, nor for error or malfunction in translation, interpretation, or use of this electronic information.

5. Receiver shall understand that even though Engineer has computer virus scanning software to detect presence of computer viruses, there is no guarantee that computer viruses are not present in files or in electronic media.
6. Receiver shall not hold Engineer responsible for such viruses or their consequences, and shall hold Engineer/Engineer harmless against costs, losses, or damage caused by presence of computer virus in files or media.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 013300

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## SECTION 014000 - QUALITY REQUIREMENTS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes administrative and procedural requirements for quality assurance and quality control.
- B. Testing and inspection 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 quality-control requirements for individual work results are specified in their respective Specification Sections. Requirements in individual Sections may also cover production of standard products.
  - 2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and quality-control procedures that facilitate compliance with the Contract Document requirements.
  - 3. Requirements for Contractor to provide quality-assurance and quality-control services required by Engineer, Owner, or authorities having jurisdiction are not limited by provisions of this Section.

#### 1.3 DEFINITIONS

- A. Field Quality-Control Tests and Inspections: Tests and inspections that are performed on-site for installation of the Work and for completed Work.
- B. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, subcontractor, or sub-subcontractor, to perform a particular construction operation, including installation, erection, application, assembly, and similar operations.
  - 1. Use of trade-specific terminology in referring to a Work result does not require that certain construction activities specified apply exclusively to specific trade(s).
- C. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria. Unless otherwise indicated, copies of reports of tests or inspections performed for other than the Project do not meet this definition.
- D. Product Tests: Tests and inspections that are performed by a nationally recognized testing laboratory (NRTL) according to 29 CFR 1910.7, by a testing agency accredited according to

NIST's National Voluntary Laboratory Accreditation Program (NVLAP), or by a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.

- E. Source Quality-Control Tests and Inspections: Tests and inspections that are performed at the source (e.g., plant, mill, factory, or shop).
- F. Testing Agency: An entity engaged to perform specific tests, inspections, or both. The term "testing laboratory" shall have the same meaning as the term "testing agency."
- G. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work, to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.
- H. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work, to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Contractor's quality-control services do not include contract administration activities performed by Engineer.

#### 1.4 CONFLICTING REQUIREMENTS

- A. Conflicting Standards and Other Requirements: If compliance with two or more standards or requirements is specified and the standards or requirements establish different or conflicting requirements for minimum quantities or quality levels, inform the Engineer regarding the conflict and obtain clarification prior to proceeding with the Work. Refer conflicting requirements that are different, but apparently equal, to Engineer for clarification before proceeding.
- B. 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 Engineer for a decision before proceeding.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.

#### 1.6 REPORTS AND DOCUMENTS

- A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:
  - 1. Date of issue.
  - 2. Project title and number.

3. Name, address, telephone number, and email address of testing agency.
  4. Dates and locations of samples and tests or inspections.
  5. Names of individuals making tests and inspections.
  6. Description of the Work and test and inspection method.
  7. Identification of product and Specification Section.
  8. Complete test or inspection data.
  9. Test and inspection results and an interpretation of test results.
  10. Record of temperature and weather conditions at time of sample--taking and testing and inspection.
  11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
  12. Name and signature of laboratory inspector.
  13. Recommendations on retesting and reinspecting.
- B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:
1. Name, address, telephone number, and email address of technical representative making report.
  2. Statement on condition of substrates and their acceptability for installation of product.
  3. Statement that products at Project site comply with requirements.
  4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
  5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
  6. Statement of whether conditions, products, and installation will affect warranty.
  7. Other required items indicated in individual Specification Sections.
- C. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:
1. Name, address, telephone number, and email address of factory-authorized service representative making report.
  2. Statement that equipment complies with requirements.
  3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
  4. Statement of whether conditions, products, and installation will affect warranty.
  5. Other required items indicated in individual Specification Sections.

## 1.7 QUALITY ASSURANCE

- A. Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.
- B. 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. As applicable, procure products

from manufacturers able to meet qualification requirements, warranty requirements, and technical or factory-authorized service representative requirements.

- C. Fabricator Qualifications: A firm experienced in producing products 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 and Inspecting Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspection indicated, as documented in accordance with ASTM E329, and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.
- E. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect, demonstrate, repair and perform service on installations of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- F. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

## 1.8 QUALITY CONTROL

- A. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities, whether specified or not, to verify and document that the Work complies with requirements.
  - 1. Unless otherwise indicated, 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.
  - 2. Engage a qualified testing agency to perform quality-control services.
  - 3. Notify testing agencies at least 7 days hours in advance of time when Work that requires testing or inspection will be performed.
  - 4. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
  - 5. Testing and inspection requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
  - 6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
- B. 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.
- C. Testing Agency Responsibilities: Cooperate with Engineer and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.



1. Notify Engineer and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
  2. Determine the locations from which test samples will be taken and in which in-situ tests are conducted.
  3. Conduct and interpret tests and inspections and state in each report whether tested and inspected Work complies with or deviates from requirements.
  4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
  5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
  6. Do not perform duties of Contractor.
- D. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Section 013300 "Submittal Procedures."
- E. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.
- F. Contractor's Associated Requirements and Services: Cooperate with agencies and representatives performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
1. Access to the Work.
  2. Incidental labor and facilities necessary to facilitate tests and inspections.
  3. Adequate quantities of representative samples of materials that require testing and inspection. Assist agency in obtaining samples.
  4. Facilities for storage and field curing of test samples.
  5. Preliminary design mix proposed for use for material mixes that require control by testing agency.
  6. Security and protection for samples and for testing and inspection equipment at Project site.
- G. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and quality-control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspection.
1. Schedule times for tests, inspections, obtaining samples, and similar activities.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

- A. Test and Inspection Log: 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 Engineer.
  - 4. Identification of testing agency or special inspector conducting test or inspection.
- B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Engineer's reference during normal working hours.
  - 1. Submit log at Project closeout as part of Project Record Documents.

3.2 REPAIR AND PROTECTION

- A. General: On completion of testing, inspection, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
  - 1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Section 017300 "Execution."
- 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 014000

## SECTION 014200 - REFERENCES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 DEFINITIONS

- A. General: Basic Contract definitions are included in the Conditions of the Contract.
- B. "Approved": When used to convey Engineer's action on Contractor's submittals, applications, and requests, "approved" is limited to Engineer's duties and responsibilities as stated in the Conditions of the Contract.
- C. "Directed": A command or instruction by Engineer. Other terms including "requested," "authorized," "selected," "required," and "permitted" have the same meaning as "directed."
- D. "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."
- E. "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.
- F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.
- G. "Install": Unload, temporarily store, unpack, assemble, erect, place, anchor, apply, work to dimension, finish, cure, protect, clean, and similar operations at Project site.
- H. "Provide": Furnish and install, complete and ready for the intended use.
- I. "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.

#### 1.3 INDUSTRY STANDARDS

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

- B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.
- C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.
  - 1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.

#### 1.4 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 indicated in Gale's "Encyclopedia of Associations: National Organizations of the U.S." or in Columbia Books' "National Trade & Professional Associations of the United States."
- B. 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. The information in this list is subject to change and is believed to be accurate as of the date of the Contract Documents.
  - 1. AABC - Associated Air Balance Council; [www.aabc.com](http://www.aabc.com).
  - 2. AAMA - American Architectural Manufacturers Association; [www.aamanet.org](http://www.aamanet.org).
  - 3. AAPFCO - Association of American Plant Food Control Officials; [www.aapfco.org](http://www.aapfco.org).
  - 4. AASHTO - American Association of State Highway and Transportation Officials; [www.transportation.org](http://www.transportation.org).
  - 5. AATCC - American Association of Textile Chemists and Colorists; [www.aatcc.org](http://www.aatcc.org).
  - 6. ABMA - American Bearing Manufacturers Association; [www.americanbearings.org](http://www.americanbearings.org).
  - 7. ABMA - American Boiler Manufacturers Association; [www.abma.com](http://www.abma.com).
  - 8. ACI - American Concrete Institute; (Formerly: ACI International); [www.concrete.org](http://www.concrete.org)
  - 9. ACPA - American Concrete Pipe Association; [www.concrete-pipe.org](http://www.concrete-pipe.org).
  - 10. AEIC - Association of Edison Illuminating Companies, Inc. (The); [www.aeic.org](http://www.aeic.org).
  - 11. AF&PA - American Forest & Paper Association; [www.afandpa.org](http://www.afandpa.org).
  - 12. AGA - American Gas Association; [www.aga.org](http://www.aga.org).
  - 13. AHAM - Association of Home Appliance Manufacturers; [www.aham.org](http://www.aham.org).
  - 14. AHRI - Air-Conditioning, Heating, and Refrigeration Institute (The); [www.ahrinet.org](http://www.ahrinet.org).
  - 15. AI - Asphalt Institute; [www.asphaltinstitute.org](http://www.asphaltinstitute.org).
  - 16. AIA - American Institute of Architects (The); [www.aia.org](http://www.aia.org).
  - 17. AISC - American Institute of Steel Construction; [www.aisc.org](http://www.aisc.org).
  - 18. AISI - American Iron and Steel Institute; [www.steel.org](http://www.steel.org).
  - 19. AITC - American Institute of Timber Construction; [www.aitc-glulam.org](http://www.aitc-glulam.org).
  - 20. AMCA - Air Movement and Control Association International, Inc.; [www.amca.org](http://www.amca.org).
  - 21. ANSI - American National Standards Institute; [www.ansi.org](http://www.ansi.org).
  - 22. AOSA - Association of Official Seed Analysts, Inc.; [www.aosaseed.com](http://www.aosaseed.com).
  - 23. APA - APA - The Engineered Wood Association; [www.apawood.org](http://www.apawood.org).
  - 24. APA - Architectural Precast Association; [www.archprecast.org](http://www.archprecast.org).
  - 25. API - American Petroleum Institute; [www.api.org](http://www.api.org).
  - 26. ARI - Air-Conditioning & Refrigeration Institute; (See AHRI).
  - 27. ARI - American Refrigeration Institute; (See AHRI).

28. ARMA - Asphalt Roofing Manufacturers Association; [www.asphaltroofing.org](http://www.asphaltroofing.org).
29. ASCE - American Society of Civil Engineers; [www.asce.org](http://www.asce.org).
30. ASCE/SEI - American Society of Civil Engineers/Structural Engineering Institute; (See ASCE).
31. ASHRAE - American Society of Heating, Refrigerating and Air-Conditioning Engineers; [www.ashrae.org](http://www.ashrae.org).
32. ASME - ASME International; (American Society of Mechanical Engineers); [www.asme.org](http://www.asme.org).
33. ASSE - American Society of Safety Engineers (The); [www.asse.org](http://www.asse.org).
34. ASSE - American Society of Sanitary Engineering; [www.asse-plumbing.org](http://www.asse-plumbing.org).
35. ASTM - ASTM International; [www.astm.org](http://www.astm.org).
36. ATIS - Alliance for Telecommunications Industry Solutions; [www.atis.org](http://www.atis.org).
37. AWEA - American Wind Energy Association; [www.awea.org](http://www.awea.org).
38. AWI - Architectural Woodwork Institute; [www.awinet.org](http://www.awinet.org).
39. AWMAC - Architectural Woodwork Manufacturers Association of Canada; [www.awmac.com](http://www.awmac.com).
40. AWPA - American Wood Protection Association; [www.awpa.com](http://www.awpa.com).
41. AWS - American Welding Society; [www.aws.org](http://www.aws.org).
42. AWWA - American Water Works Association; [www.awwa.org](http://www.awwa.org).
43. BHMA - Builders Hardware Manufacturers Association; [www.buildershardware.com](http://www.buildershardware.com).
44. BIA - Brick Industry Association (The); [www.gobrick.com](http://www.gobrick.com).
45. BICSI - BICSI, Inc.; [www.bicsi.org](http://www.bicsi.org).
46. BIFMA - BIFMA International; (Business and Institutional Furniture Manufacturer's Association); [www.bifma.org](http://www.bifma.org).
47. BISSC - Baking Industry Sanitation Standards Committee; [www.bissc.org](http://www.bissc.org).
48. BWF - Badminton World Federation; (Formerly: International Badminton Federation); [www.bissc.org](http://www.bissc.org).
49. CDA - Copper Development Association; [www.copper.org](http://www.copper.org).
50. CE - Conformite Europeenne; <http://ec.europa.eu/growth/single-market/ce-marking/>
51. CEA - Canadian Electricity Association; [www.electricity.ca](http://www.electricity.ca).
52. CEA - Consumer Electronics Association; [www.ce.org](http://www.ce.org).
53. CFFA - Chemical Fabrics and Film Association, Inc.; [www.chemicalfabricsandfilm.com](http://www.chemicalfabricsandfilm.com).
54. CFSEI - Cold-Formed Steel Engineers Institute; [www.cfsei.org](http://www.cfsei.org).
55. CGA - Compressed Gas Association; [www.cganet.com](http://www.cganet.com).
56. CIMA - Cellulose Insulation Manufacturers Association; [www.cellulose.org](http://www.cellulose.org).
57. CISCA - Ceilings & Interior Systems Construction Association; [www.cisca.org](http://www.cisca.org).
58. CISPI - Cast Iron Soil Pipe Institute; [www.cispi.org](http://www.cispi.org).
59. CLFMI - Chain Link Fence Manufacturers Institute; [www.chainlinkinfo.org](http://www.chainlinkinfo.org).
60. CPA - Composite Panel Association; [www.pbmdf.com](http://www.pbmdf.com).
61. CRI - Carpet and Rug Institute (The); [www.carpet-rug.org](http://www.carpet-rug.org).
62. CRRC - Cool Roof Rating Council; [www.coolroofs.org](http://www.coolroofs.org).
63. CRSI - Concrete Reinforcing Steel Institute; [www.crsi.org](http://www.crsi.org).
64. CSA - CSA Group; [www.csagroup.com](http://www.csagroup.com).
65. CSA - CSA International; [www.csa-international.org](http://www.csa-international.org).
66. CSI - Construction Specifications Institute (The); [www.csinet.org](http://www.csinet.org).
67. CSSB - Cedar Shake & Shingle Bureau; [www.cedarbureau.org](http://www.cedarbureau.org).
68. CTI - Cooling Technology Institute; (Formerly: Cooling Tower Institute); [www.cti.org](http://www.cti.org).
69. CWC - Composite Wood Council; (See CPA).
70. DASMA - Door and Access Systems Manufacturers Association; [www.dasma.com](http://www.dasma.com).
71. DHI - Door and Hardware Institute; [www.dhi.org](http://www.dhi.org).
72. ECA - Electronic Components Association; (See ECIA).

73. ECAMA - Electronic Components Assemblies & Materials Association; (See ECIA).
74. ECIA - Electronic Components Industry Association; [www.eciaonline.org](http://www.eciaonline.org).
75. EIA - Electronic Industries Alliance; (See TIA).
76. EIMA - EIFS Industry Members Association; [www.eima.com](http://www.eima.com).
77. EJMA - Expansion Joint Manufacturers Association, Inc.; [www.ejma.org](http://www.ejma.org).
78. ESD - ESD Association; (Electrostatic Discharge Association); [www.esda.org](http://www.esda.org).
79. ESTA - Entertainment Services and Technology Association; (See PLASA).
80. ETL - Intertek (See Intertek); [www.intertek.com](http://www.intertek.com).
81. EVO - Efficiency Valuation Organization; [www.evo-world.org](http://www.evo-world.org).
82. FCI - Fluid Controls Institute; [www.fluidcontrolsintstitute.org](http://www.fluidcontrolsintstitute.org).
83. FIBA - Federation Internationale de Basketball; (The International Basketball Federation); [www.fiba.com](http://www.fiba.com).
84. FIVB - Federation Internationale de Volleyball; (The International Volleyball Federation); [www.fivb.org](http://www.fivb.org).
85. FM Approvals - FM Approvals LLC; [www.fmglobal.com](http://www.fmglobal.com).
86. FM Global - FM Global; (Formerly: FMG - FM Global); [www.fmglobal.com](http://www.fmglobal.com).
87. FRSA - Florida Roofing, Sheet Metal & Air Conditioning Contractors Association, Inc.; [www.floridarroof.com](http://www.floridarroof.com).
88. FSA - Fluid Sealing Association; [www.fluidsealing.com](http://www.fluidsealing.com).
89. FSC - Forest Stewardship Council U.S.; [www.fscus.org](http://www.fscus.org).
90. GA - Gypsum Association; [www.gypsum.org](http://www.gypsum.org).
91. GANA - Glass Association of North America; [www.glasswebsite.com](http://www.glasswebsite.com).
92. GS - Green Seal; [www.greenseal.org](http://www.greenseal.org).
93. HI - Hydraulic Institute; [www.pumps.org](http://www.pumps.org).
94. HI/GAMA - Hydronics Institute/Gas Appliance Manufacturers Association; (See AHRI).
95. HMMA - Hollow Metal Manufacturers Association; (See NAAMM).
96. HPVA - Hardwood Plywood & Veneer Association; [www.hpva.org](http://www.hpva.org).
97. HPW - H. P. White Laboratory, Inc.; [www.hpwhite.com](http://www.hpwhite.com).
98. IAPSC - International Association of Professional Security Consultants; [www.iapsc.org](http://www.iapsc.org).
99. IAS - International Accreditation Service; [www.iasonline.org](http://www.iasonline.org).
100. ICBO - International Conference of Building Officials; (See ICC).
101. ICC - International Code Council; [www.iccsafe.org](http://www.iccsafe.org).
102. ICEA - Insulated Cable Engineers Association, Inc.; [www.icea.net](http://www.icea.net).
103. ICPA - International Cast Polymer Alliance; [www.icpa-hq.org](http://www.icpa-hq.org).
104. ICRI - International Concrete Repair Institute, Inc.; [www.icri.org](http://www.icri.org).
105. IEC - International Electrotechnical Commission; [www.iec.ch](http://www.iec.ch).
106. IEEE - Institute of Electrical and Electronics Engineers, Inc. (The); [www.ieee.org](http://www.ieee.org).
107. IES - Illuminating Engineering Society; (Formerly: Illuminating Engineering Society of North America); [www.ies.org](http://www.ies.org).
108. IESNA - Illuminating Engineering Society of North America; (See IES).
109. IEST - Institute of Environmental Sciences and Technology; [www.iest.org](http://www.iest.org).
110. IGMA - Insulating Glass Manufacturers Alliance; [www.igmaonline.org](http://www.igmaonline.org).
111. IGSHPA - International Ground Source Heat Pump Association; [www.igshpa.okstate.edu](http://www.igshpa.okstate.edu).
112. ILI - Indiana Limestone Institute of America, Inc.; [www.iliai.com](http://www.iliai.com).
113. Intertek - Intertek Group; (Formerly: ETL SEMCO; Intertek Testing Service NA); [www.intertek.com](http://www.intertek.com).
114. ISA - International Society of Automation (The); (Formerly: Instrumentation, Systems, and Automation Society); [www.isa.org](http://www.isa.org).
115. ISAS - Instrumentation, Systems, and Automation Society (The); (See ISA).

116. ISFA - International Surface Fabricators Association; (Formerly: International Solid Surface Fabricators Association); [www.isfanow.org](http://www.isfanow.org).
117. ISO - International Organization for Standardization; [www.iso.org](http://www.iso.org).
118. ISSFA - International Solid Surface Fabricators Association; (See ISFA).
119. ITU - International Telecommunication Union; [www.itu.int/home](http://www.itu.int/home).
120. KCMA - Kitchen Cabinet Manufacturers Association; [www.kcma.org](http://www.kcma.org).
121. LMA - Laminating Materials Association; (See CPA).
122. LPI - Lightning Protection Institute; [www.lightning.org](http://www.lightning.org).
123. MBMA - Metal Building Manufacturers Association; [www.mbma.com](http://www.mbma.com).
124. MCA - Metal Construction Association; [www.metalconstruction.org](http://www.metalconstruction.org).
125. MFMA - Maple Flooring Manufacturers Association, Inc.; [www.maplefloor.org](http://www.maplefloor.org).
126. MFMA - Metal Framing Manufacturers Association, Inc.; [www.metalframingmfg.org](http://www.metalframingmfg.org).
127. MHIA - Material Handling Industry of America; [www.mhia.org](http://www.mhia.org).
128. MIA - Marble Institute of America; [www.marble-institute.com](http://www.marble-institute.com).
129. MMPA - Moulding & Millwork Producers Association; [www.wmmpa.com](http://www.wmmpa.com).
130. MPI - Master Painters Institute; [www.paintinfo.com](http://www.paintinfo.com).
131. MSS - Manufacturers Standardization Society of The Valve and Fittings Industry Inc.; [www.mss-hq.org](http://www.mss-hq.org).
132. NAAMM - National Association of Architectural Metal Manufacturers; [www.naamm.org](http://www.naamm.org).
133. NACE - NACE International; (National Association of Corrosion Engineers International); [www.nace.org](http://www.nace.org).
134. NADCA - National Air Duct Cleaners Association; [www.nadca.com](http://www.nadca.com).
135. NAIMA - North American Insulation Manufacturers Association; [www.naima.org](http://www.naima.org).
136. NBGQA - National Building Granite Quarries Association, Inc.; [www.nbgqa.com](http://www.nbgqa.com).
137. NBI - New Buildings Institute; [www.newbuildings.org](http://www.newbuildings.org).
138. NCAA - National Collegiate Athletic Association (The); [www.ncaa.org](http://www.ncaa.org).
139. NCMA - National Concrete Masonry Association; [www.ncma.org](http://www.ncma.org).
140. NEBB - National Environmental Balancing Bureau; [www.nebb.org](http://www.nebb.org).
141. NECA - National Electrical Contractors Association; [www.necanet.org](http://www.necanet.org).
142. NeLMA - Northeastern Lumber Manufacturers Association; [www.nelma.org](http://www.nelma.org).
143. NEMA - National Electrical Manufacturers Association; [www.nema.org](http://www.nema.org).
144. NETA - InterNational Electrical Testing Association; [www.netaworld.org](http://www.netaworld.org).
145. NFHS - National Federation of State High School Associations; [www.nfhs.org](http://www.nfhs.org).
146. NFPA - National Fire Protection Association; [www.nfpa.org](http://www.nfpa.org).
147. NFPA - NFPA International; (See NFPA).
148. NFRC - National Fenestration Rating Council; [www.nfrc.org](http://www.nfrc.org).
149. NHLA - National Hardwood Lumber Association; [www.nhla.com](http://www.nhla.com).
150. NLGA - National Lumber Grades Authority; [www.nlga.org](http://www.nlga.org).
151. NOFMA - National Oak Flooring Manufacturers Association; (See NWFA).
152. NOMMA - National Ornamental & Miscellaneous Metals Association; [www.nomma.org](http://www.nomma.org).
153. NRCA - National Roofing Contractors Association; [www.nrca.net](http://www.nrca.net).
154. NRMCA - National Ready Mixed Concrete Association; [www.nrmca.org](http://www.nrmca.org).
155. NSF - NSF International; [www.nsf.org](http://www.nsf.org).
156. NSPE - National Society of Professional Engineers; [www.nspe.org](http://www.nspe.org).
157. NSSGA - National Stone, Sand & Gravel Association; [www.nssga.org](http://www.nssga.org).
158. NTMA - National Terrazzo & Mosaic Association, Inc. (The); [www.ntma.com](http://www.ntma.com).
159. NWFA - National Wood Flooring Association; [www.nwfa.org](http://www.nwfa.org).
160. PCI - Precast/Prestressed Concrete Institute; [www.pci.org](http://www.pci.org).
161. PDI - Plumbing & Drainage Institute; [www.pdionline.org](http://www.pdionline.org).



162. PLASA - PLASA; (Formerly: ESTA - Entertainment Services and Technology Association); [www.plasa.org](http://www.plasa.org).
163. RCSC - Research Council on Structural Connections; [www.boltcouncil.org](http://www.boltcouncil.org).
164. RFCI - Resilient Floor Covering Institute; [www.rfci.com](http://www.rfci.com).
165. RIS - Redwood Inspection Service; [www.redwoodinspection.com](http://www.redwoodinspection.com).
166. SAE - SAE International; [www.sae.org](http://www.sae.org).
167. SCTE - Society of Cable Telecommunications Engineers; [www.scte.org](http://www.scte.org).
168. SDI - Steel Deck Institute; [www.sdi.org](http://www.sdi.org).
169. SDI - Steel Door Institute; [www.steeldoor.org](http://www.steeldoor.org).
170. SEFA - Scientific Equipment and Furniture Association (The); [www.sefalabs.com](http://www.sefalabs.com).
171. SEI/ASCE - Structural Engineering Institute/American Society of Civil Engineers; (See ASCE).
172. SIA - Security Industry Association; [www.siaonline.org](http://www.siaonline.org).
173. SJI - Steel Joist Institute; [www.steeljoist.org](http://www.steeljoist.org).
174. SMA - Screen Manufacturers Association; [www.smainfo.org](http://www.smainfo.org).
175. SMACNA - Sheet Metal and Air Conditioning Contractors' National Association; [www.smacna.org](http://www.smacna.org).
176. SMPTE - Society of Motion Picture and Television Engineers; [www.smpte.org](http://www.smpte.org).
177. SPFA - Spray Polyurethane Foam Alliance; [www.sprayfoam.org](http://www.sprayfoam.org).
178. SPIB - Southern Pine Inspection Bureau; [www.spib.org](http://www.spib.org).
179. SPRI - Single Ply Roofing Industry; [www.spri.org](http://www.spri.org).
180. SRCC - Solar Rating & Certification Corporation; [www.solar-rating.org](http://www.solar-rating.org).
181. SSINA - Specialty Steel Industry of North America; [www.ssina.com](http://www.ssina.com).
182. SSPC - SSPC: The Society for Protective Coatings; [www.sspc.org](http://www.sspc.org).
183. STI - Steel Tank Institute; [www.steeltank.com](http://www.steeltank.com).
184. SWI - Steel Window Institute; [www.steelwindows.com](http://www.steelwindows.com).
185. SWPA - Submersible Wastewater Pump Association; [www.swpa.org](http://www.swpa.org).
186. TCA - Tilt-Up Concrete Association; [www.tilt-up.org](http://www.tilt-up.org).
187. TCNA - Tile Council of North America, Inc.; [www.tileusa.com](http://www.tileusa.com).
188. TEMA - Tubular Exchanger Manufacturers Association, Inc.; [www.tema.org](http://www.tema.org).
189. TIA - Telecommunications Industry Association (The); (Formerly: TIA/EIA - Telecommunications Industry Association/Electronic Industries Alliance); [www.tiaonline.org](http://www.tiaonline.org).
190. TIA/EIA - Telecommunications Industry Association/Electronic Industries Alliance; (See TIA).
191. TMS - The Masonry Society; [www.masonrysociety.org](http://www.masonrysociety.org).
192. TPI - Truss Plate Institute; [www.tpinst.org](http://www.tpinst.org).
193. TPI - Turfgrass Producers International; [www.turfgrasssod.org](http://www.turfgrasssod.org).
194. TRI - Tile Roofing Institute; [www.tilerroofing.org](http://www.tilerroofing.org).
195. UL - Underwriters Laboratories Inc.; <http://www.ul.com>.
196. UNI - Uni-Bell PVC Pipe Association; [www.uni-bell.org](http://www.uni-bell.org).
197. USAV - USA Volleyball; [www.usavolleyball.org](http://www.usavolleyball.org).
198. USGBC - U.S. Green Building Council; [www.usgbc.org](http://www.usgbc.org).
199. USITT - United States Institute for Theatre Technology, Inc.; [www.usitt.org](http://www.usitt.org).
200. WA - Wallcoverings Association; [www.wallcoverings.org](http://www.wallcoverings.org).
201. WASTEC - Waste Equipment Technology Association; [www.wastec.org](http://www.wastec.org).
202. WCLIB - West Coast Lumber Inspection Bureau; [www.wclib.org](http://www.wclib.org).
203. WCMA - Window Covering Manufacturers Association; [www.wcmanet.org](http://www.wcmanet.org).
204. WDMA - Window & Door Manufacturers Association; [www.wdma.com](http://www.wdma.com).
205. WI - Woodwork Institute; [www.wicnet.org](http://www.wicnet.org).
206. WSRCA - Western States Roofing Contractors Association; [www.wsrca.com](http://www.wsrca.com).



207. WWPA - Western Wood Products Association; [www.wwpa.org](http://www.wwpa.org).

C. Code Agencies: 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 believed to be accurate as of the date of the Contract Documents.

1. DIN - Deutsches Institut für Normung e.V.; [www.din.de](http://www.din.de).
2. IAPMO - International Association of Plumbing and Mechanical Officials; [www.iapmo.org](http://www.iapmo.org).
3. ICC - International Code Council; [www.iccsafe.org](http://www.iccsafe.org).
4. ICC-ES - ICC Evaluation Service, LLC; [www.icc-es.org](http://www.icc-es.org).

D. Federal Government Agencies: 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. Information is subject to change and is up to date as of the date of the Contract Documents.

1. COE - Army Corps of Engineers; [www.usace.army.mil](http://www.usace.army.mil).
2. CPSC - Consumer Product Safety Commission; [www.cpsc.gov](http://www.cpsc.gov).
3. DOC - Department of Commerce; National Institute of Standards and Technology; [www.nist.gov](http://www.nist.gov).
4. DOD - Department of Defense; [www.quicksearch.dla.mil](http://www.quicksearch.dla.mil).
5. DOE - Department of Energy; [www.energy.gov](http://www.energy.gov).
6. EPA - Environmental Protection Agency; [www.epa.gov](http://www.epa.gov).
7. FAA - Federal Aviation Administration; [www.faa.gov](http://www.faa.gov).
8. FG - Federal Government Publications; [www.gpo.gov/fdsys](http://www.gpo.gov/fdsys).
9. GSA - General Services Administration; [www.gsa.gov](http://www.gsa.gov).
10. HUD - Department of Housing and Urban Development; [www.hud.gov](http://www.hud.gov).
11. LBL - Lawrence Berkeley National Laboratory; Environmental Energy Technologies Division; [www.eetd.lbl.gov](http://www.eetd.lbl.gov).
12. OSHA - Occupational Safety & Health Administration; [www.osha.gov](http://www.osha.gov).
13. SD - Department of State; [www.state.gov](http://www.state.gov).
14. TRB - Transportation Research Board; National Cooperative Highway Research Program; The National Academies; [www.trb.org](http://www.trb.org).
15. USDA - Department of Agriculture; Agriculture Research Service; U.S. Salinity Laboratory; [www.ars.usda.gov](http://www.ars.usda.gov).
16. USDA - Department of Agriculture; Rural Utilities Service; [www.usda.gov](http://www.usda.gov).
17. USDOJ - Department of Justice; Office of Justice Programs; National Institute of Justice; [www.ojp.usdoj.gov](http://www.ojp.usdoj.gov).
18. USP - U.S. Pharmacopeial Convention; [www.usp.org](http://www.usp.org).
19. USPS - United States Postal Service; [www.usps.com](http://www.usps.com).

E. Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the standards and regulations in the following list. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.

1. CFR - Code of Federal Regulations; Available from Government Printing Office; [www.gpo.gov/fdsys](http://www.gpo.gov/fdsys).
2. DOD - Department of Defense; Military Specifications and Standards; Available from DLA Document Services; [www.quicksearch.dla.mil](http://www.quicksearch.dla.mil).
3. DSCC - Defense Supply Center Columbus; (See FS).

4. FED-STD - Federal Standard; (See FS).
5. FS - Federal Specification; Available from DLA Document Services;  
[www.quicksearch.dla.mil](http://www.quicksearch.dla.mil).
  - a. Available from Defense Standardization Program; [www.dsp.dla.mil](http://www.dsp.dla.mil).
  - b. Available from General Services Administration; [www.gsa.gov](http://www.gsa.gov).
  - c. Available from National Institute of Building Sciences/Whole Building Design Guide; [www.wbdg.org](http://www.wbdg.org).
6. MILSPEC - Military Specification and Standards; (See DOD).
7. USAB - United States Access Board; [www.access-board.gov](http://www.access-board.gov).
8. USATBCB - U.S. Architectural & Transportation Barriers Compliance Board; (See USAB).

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 014200

## SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.
- B. Related Requirements:
  - 1. Section 011000 "Summary" for work restrictions and limitations on utility interruptions.
  - 2. Section 312000 "Earthwork" for disposal of ground water at Project site.

#### 1.3 USE CHARGES

- A. General: Installation and removal of and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities engaged in the Project to use temporary services and facilities without cost, including, but not limited to, Owner's construction forces, Engineer, occupants of Project, testing agencies, and authorities having jurisdiction.
- B. Water and Sewer Service from Existing System: Water from Owner's existing water system is available for use without payment of use charges. Provide connections and extensions of services as required for construction operations.
- C. Electric Power Service from Service Provider (FP&L): Electric power from FP&L is available for use on the site. The contractor is responsible to contact and coordinate with FP&L for any temporary service requirements for power on site needed to perform the work. Provide connections and extensions of services as required for construction operations.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Site Utilization Plan: Show temporary facilities, temporary utility lines and connections, staging areas, construction site entrances, vehicle circulation, and parking areas for construction personnel.
- B. Implementation and Termination Schedule: Within 15 days of date established for commencement of the Work, submit schedule indicating implementation and termination dates of each temporary utility.

- C. Fire-Safety Program: Show compliance with requirements of NFPA 241 and authorities having jurisdiction. Indicate Contractor personnel responsible for management of fire-prevention program.

## 1.5 QUALITY ASSURANCE

- A. Temporary facilities shall comply with all applicable state and local ordinances, codes and regulations.
- B. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.
- C. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

## 1.6 PROJECT CONDITIONS

- A. Temporary Use of Permanent Facilities: Engage Installer of each permanent service to assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Chain-Link Fencing: Minimum 2-inch, 0.148-inch-thick, galvanized-steel, chain-link fabric fencing; minimum 6 feet high with galvanized-steel pipe posts; minimum 2-3/8-inch-OD line posts and 2-7/8-inch-OD corner and pull posts, with 1-5/8-inch-OD top rails.
- B. Portable Chain-Link Fencing: Minimum 2-inch, 0.148-inch-thick, galvanized-steel, chain-link fabric fencing; minimum 6 feet high with galvanized-steel pipe posts; minimum 2-3/8-inch-OD line posts and 2-7/8-inch-OD corner and pull posts, with 1-5/8-inch-OD top and bottom rails. Provide concrete or galvanized-steel bases for supporting posts.
- C. Fencing Windscreen Privacy Screen: Polyester fabric scrim with grommets for attachment to chain link fence, sized to height of fence, in color selected by Engineer from manufacturer's standard colors.

### 2.2 TEMPORARY FACILITIES

- A. Field Offices, General: Contractor shall provide an air-conditioned interior space for field offices for duration of Project.
- B. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.

1. Store combustible materials apart from building.

## 2.3 EQUIPMENT

- A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.

## PART 3 - EXECUTION

### 3.1 TEMPORARY FACILITIES, GENERAL

- A. Conservation: Coordinate construction and use of temporary facilities with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.
  1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. See other Sections for disposition of salvaged materials that are designated as Owner's property.

### 3.2 INSTALLATION, GENERAL

- A. Locate facilities where shown on the Drawings or where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work. Engineer's trailer shall be set up and ready for occupancy within 30 days of the Notice to Proceed.
  1. Locate facilities to limit site disturbance as specified in Section 011000 "Summary."
- B. Provide each facility ready for use within 30 days of the Notice to Proceed and prior to Commencement of Work at the site. Do not remove until approved by Engineer or are replaced by authorized use of completed permanent facilities.

### 3.3 CONTRACTOR'S FIELD OFFICE

- A. Provide a temporary field office(s) for the Contractor's use for the duration of the project. An authorized representative of the Contractor shall be present at all times while the Work is in progress. Instructions received at the Contractors field office from the Engineer shall be considered delivered to the Contractor.
- B. Locate field office(s) in accordance with approved shop drawings and as directed by the Owner.
- C. Establish and occupy field office within 30 days of the Notice to Proceed, unless otherwise approved by the Engineer or Owner.

### 3.4 TEMPORARY UTILITY INSTALLATION

- A. General: Install temporary service or connect to existing service, if approved by Owner.
  - 1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.
- B. Sewers and Drainage: Provide temporary utilities to remove effluent lawfully.
  - 1. Connect temporary sewers to municipal system as directed by authorities having jurisdiction.
- C. Water Service: If approved, connect to Owner's existing water service facilities. Clean and maintain water service facilities in a condition acceptable to Owner. At Final Completion, restore these facilities to condition existing before initial use.
- D. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.
  - 1. Toilets: Use of Owner's existing toilet facilities will be permitted, as long as facilities are cleaned and maintained in a condition acceptable to Owner. At Final Completion, restore these facilities to condition existing before initial use.
- E. Temporary Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.
  - 1. Provide temporary dehumidification systems when required to reduce ambient and substrate moisture levels to level required to allow installation or application of finishes and their proper curing or drying.
- F. Isolation of Work Areas in Occupied Facilities: Prevent dust, fumes, and odors from entering occupied areas.
  - 1. Prior to commencing work, isolate the HVAC system in area where work is to be performed.
    - a. Disconnect supply and return ductwork in work area from HVAC systems servicing occupied areas.
    - b. Maintain negative air pressure within work area using HEPA-equipped air-filtration units, starting with commencement of temporary partition construction, and continuing until removal of temporary partitions is complete.
  - 2. Maintain dust partitions during the Work. Use vacuum collection attachments on dust-producing equipment. Isolate limited work within occupied areas using portable dust-containment devices.
  - 3. Perform daily construction cleanup and final cleanup using approved, HEPA-filter-equipped vacuum equipment.

- G. The Contractor shall furnish temporary light and power, including 220 Volt service for welding, complete with wiring, lamps and similar equipment as required to adequately light all work areas and with sufficient power capacity to meet the project needs. Make all necessary arrangements with the local electric company for temporary electric service and pay all expenses in connection therewith.
- H. Electric Power Service: Contractor is responsible to provide temporary electrical power on site to perform the work. Maintain equipment in a condition acceptable to Owner.
- I. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.
  - 1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.

### 3.5 SUPPORT FACILITIES INSTALLATION

- A. General: Comply with the following:
  - 1. Maintain support facilities until Engineer schedules Final Completion inspection. Remove just before Final Completion.
- B. Temporary Use of Planned Permanent Roads and Paved Areas: Locate temporary roads and paved areas in same location as permanent roads and paved areas. Construct and maintain temporary roads and paved areas adequate for construction operations. Extend temporary roads and paved areas, within construction limits indicated, as necessary for construction operations.
  - 1. Coordinate elevations of temporary roads and paved areas with permanent roads and paved areas.
  - 2. Prepare subgrade and install subbase and base for temporary roads and paved areas according to Section 312000 "Earthwork."
  - 3. Recondition base after temporary use, including removing contaminated material, regrading, proofrolling, compacting, and testing.
- C. Traffic Controls: Comply with requirements of authorities having jurisdiction.
  - 1. Protect existing site improvements to remain including curbs, pavement, and utilities.
  - 2. Maintain access for fire-fighting equipment and access to fire hydrants.
- D. Parking: Provide temporary parking areas for construction personnel.
- E. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.
  - 1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties or endanger permanent Work or temporary facilities.
- F. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction. Comply with progress cleaning requirements in Section 017300 "Execution."

### 3.6 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.
  - 1. Where access to adjacent properties is required in order to affect protection of existing facilities, obtain written permission from adjacent property owner to access property for that purpose.
- B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.
  - 1. Comply with work restrictions specified in Section 011000 "Summary."
- C. Temporary Erosion and Sedimentation Control: Comply with requirements specified in Section 311000 "Site Clearing."
- D. Stormwater Control: Comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.
- E. Tree and Plant Protection: Comply with requirements specified in Section 015639 "Temporary Tree and Plant Protection."
- F. Site Enclosure Fence: Before construction operations begin, furnish and install site enclosure fence in a manner that will prevent people from easily entering site except by entrance gates.
  - 1. Extent of Fence: As indicated on Drawings.
  - 2. Maintain security by limiting number of keys and restricting distribution to authorized personnel. Furnish one set of keys to Owner.
- G. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.
- H. Temporary Egress: Maintain temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction.
- I. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.
  - 1. Where heating or cooling is needed and permanent enclosure is incomplete, insulate temporary enclosures.

### 3.7 OPERATION, TERMINATION, AND REMOVAL

- A. Maintenance: Maintain facilities in good operating condition until removal.



1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.
- B. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Final Completion.
- C. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Final Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
1. Materials and facilities that constitute temporary facilities are property of Contractor.
  2. Remove temporary roads and paved areas not intended for or acceptable for integration into permanent construction. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.
  3. Just prior to Final Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 017700 "Closeout Procedures."

END OF SECTION 015000

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## SECTION 016000 - PRODUCT REQUIREMENTS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.
- B. Related Requirements:
  - 1. Section 011000 "Summary" for Contractor requirements related to Owner-furnished products.
  - 2. Section 014200 "References" for applicable industry standards for products specified.
  - 3. Section 017700 "Closeout Procedures" for submitting warranties.

#### 1.3 DEFINITIONS

- A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
  - 1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature that is current as of date of the Contract Documents.
  - 2. New Products: Items that have not previously been incorporated into another project or facility. Salvaged items or items reused from other projects are not considered new products. Items that are manufactured or fabricated to include recycle contract materials are considered new products, unless indicated otherwise.
  - 3. Comparable Product: Product by named manufacturer that is demonstrated and approved through the comparable product submittal process described in Part 2 "Comparable Products" Article, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.
- B. Basis-of-Design Product Specification: A specification in which a single manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation. Published attributes and characteristics of basis-of-design product establish salient characteristics of products.

1. Evaluation of Comparable Products: In addition to the basis-of-design product description, product attributes and characteristics may be listed to establish the significant qualities related to type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other special features and requirements for purposes of evaluating comparable products of additional manufacturers named in the specification.
- C. Subject to Compliance with Requirements: Where the phrase "Subject to compliance with requirements" introduces a product selection procedure in an individual Specification Section, provide products qualified under the specified product procedure. In the event that a named product or product by a named manufacturer does not meet the other requirements of the specifications, select another named product or product from another named manufacturer that does meet the requirements of the specifications; submit a comparable product request or substitution request, if applicable.
- D. Comparable Product Request Submittal: An action submittal requesting consideration of a comparable product, including the following information:
  1. Identification of basis-of-design product or fabrication or installation method to be replaced, including Specification Section number and title and Drawing numbers and titles.
  2. Data indicating compliance with the requirements specified in Part 2 "Comparable Products" Article.
- E. Basis-of-Design Product Specification Submittal: An action submittal complying with requirements in Section 013300 "Submittal Procedures."
- F. Substitution: Refer to Section 012500 "Substitution Procedures" for definition and limitations on substitutions.

#### 1.4 QUALITY ASSURANCE

- A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.
  1. Resolution of Compatibility Disputes between Multiple Contractors:
    - a. Contractors are responsible for providing products and construction methods compatible with products and construction methods of other contractors.
    - b. If a dispute arises between the multiple contractors over concurrently selectable but incompatible products, Engineer will determine which products shall be used.
- B. Identification of Products: Except for required labels and operating data, do not attach or imprint manufacturer or product names or trademarks on exposed surfaces of products or equipment that will be exposed to view in occupied spaces or on the exterior.
  1. Labels: Locate required product labels and stamps on a concealed surface, or, where required for observation following installation, on a visually accessible surface that is not conspicuous.

2. Equipment Nameplates: Provide a permanent nameplate on each item of service- or power-operated equipment. Locate on a visually accessible but inconspicuous surface. Include information essential for operation, including the following:
  - a. Name of product and manufacturer.
  - b. Model and serial number.
  - c. Capacity.
  - d. Speed.
  - e. Ratings.
3. See individual identification Sections in Divisions 21, 22, 23, and 26 for additional equipment identification requirements.

#### 1.5 COORDINATION

- A. Modify or adjust affected work as necessary to integrate work of approved comparable products and approved substitutions.

#### 1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products, using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.
- B. Delivery and Handling:
  1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
  2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
  3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
  4. Inspect products on delivery to determine compliance with the Contract Documents and that products are undamaged and properly protected.
- C. Storage:
  1. Provide a secure location and enclosure at Project site for storage of materials and equipment.
  2. Store products to allow for inspection and measurement of quantity or counting of units.
  3. Store materials in a manner that will not endanger Project structure.
  4. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation and with adequate protection for wind.
  5. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.

6. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
7. Protect stored products from damage and liquids from freezing.
8. Provide a secure location and enclosure at Project site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.

## 1.7 PRODUCT WARRANTIES

- A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
  1. Manufacturer's Warranty: Written standard warranty form furnished by individual manufacturer for a particular product and issued in the name of the Owner or endorsed by manufacturer to Owner.
  2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner and issued in the name of the Owner or endorsed by manufacturer to Owner.
- B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.
  1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
  2. Specified Form: When specified forms are included in the Project Manual, prepare a written document, using indicated form properly executed.
  3. See other Sections for specific content requirements and particular requirements for submitting special warranties.
- C. Submittal Time: Comply with requirements in Section 017700 "Closeout Procedures."

## PART 2 - PRODUCTS

### 2.1 PRODUCT SELECTION PROCEDURES

- A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.
  1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
  2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
  3. Owner reserves the right to limit selection to products with warranties meeting requirements of the Contract Documents.
  4. Where products are accompanied by the term "as selected," Engineer will make selection.

5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.
6. Or Equal: For products specified by name and accompanied by the term "or equal," "or approved equal," or "or approved," comply with requirements in "Comparable Products" Article to obtain approval for use of an unnamed product.
  - a. Submit additional documentation required by Engineer in order to establish equivalency of proposed products. Unless otherwise indicated, evaluation of "or equal" product status is by the Engineer, whose determination is final.

B. Product Selection Procedures:

1. Sole Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
  - a. Sole product may be indicated by the phrase "Subject to compliance with requirements, provide the following."
2. Sole Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
  - a. Sole manufacturer/source may be indicated by the phrase "Subject to compliance with requirements, provide products by the following."
3. Limited List of Products: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience **will not** be considered.
  - a. Limited list of products may be indicated by the phrase "Subject to compliance with requirements, provide one of the following."
4. Non-Limited List of Products: Where Specifications include a list of names of both available manufacturers and products, provide one of the products listed, or an unnamed product that complies with requirements.
  - a. Non-limited list of products is indicated by the phrase "Subject to compliance with requirements, available products that may be incorporated in the Work include, but are not limited to, the following."
  - b. Provision of an unnamed product is not considered a substitution, if the product complies with requirements.
5. Limited List of Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience **will not** be considered

- a. Limited list of manufacturers is indicated by the phrase "Subject to compliance with requirements, provide products by one of the following."
6. Non-Limited List of Manufacturers: Where Specifications include a list of available manufacturers, provide a product by one of the manufacturers listed, or a product by an unnamed manufacturer that complies with requirements.
  - a. Non-limited list of manufacturers is indicated by the phrase "Subject to compliance with requirements, available manufacturers whose products may be incorporated in the Work include, but are not limited to, the following."
  - b. Provision of products of an unnamed manufacturer is not considered a substitution, if the product complies with requirements.
7. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications may additionally indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.
- C. Visual Matching Specification: Where Specifications require the phrase "match Engineer's sample," provide a product that complies with requirements and matches Engineer's sample. Engineer's decision will be final on whether a proposed product matches.
- D. Visual Selection Specification: Where Specifications include the phrase "as selected by Engineer from manufacturer's full range" or a similar phrase, select a product that complies with requirements. Engineer will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.
- E. Sustainable Product Selection: Where Specifications require product to meet sustainable product characteristics, select products complying with indicated requirements. Comply with requirements in Division 01 sustainability requirements Section and individual Specification Sections.
  1. Select products for which sustainable design documentation submittals are available from manufacturer.

## 2.2 COMPARABLE PRODUCTS

- A. Conditions for Consideration of Comparable Products: Engineer will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Engineer may return requests without action, except to record noncompliance the following requirements:
  1. Evidence that proposed product does not require revisions to the Contract Documents, is consistent with the Contract Documents, will produce the indicated results, and is compatible with other portions of the Work.
  2. Detailed comparison of significant qualities of proposed product with those of the named basis-of-design product. Significant product qualities include attributes, such as type,



- function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other specific features and requirements.
  - 3. Evidence that proposed product provides specified warranty.
  - 4. List of similar installations for completed projects, with project names and addresses and names and addresses of Engineers and owners, if requested.
  - 5. Samples, if requested.
- B. Engineer's Action on Comparable Products Submittal: If necessary, Engineer will request additional information or documentation for evaluation, as specified in Section 013300 "Submittal Procedures."
- 1. Form of Approval of Submittal: As specified in Section 013300 "Submittal Procedures."
  - 2. Use product specified if Engineer does not issue a decision on use of a comparable product request within time allocated.
- C. Submittal Requirements, Two-Step Process: Approval by the Engineer of Contractor's request for use of comparable product is not intended to satisfy other submittal requirements. Comply with specified submittal requirements.
- D. Submittal Requirements, Single-Step Process: When acceptable to Engineer, incorporate specified submittal requirements of individual Specification Section in combined submittal for comparable products. Approval by the Engineer of Contractor' request for use of comparable product and of individual submittal requirements will also satisfy other submittal requirements.

### PART 3 - EXECUTION (NOT USED)

END OF SECTION 016000

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## SECTION 017300 - EXECUTION

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes general administrative and procedural requirements governing execution of the Work, including, but not limited to, the following:
  - 1. Construction layout.
  - 2. Field engineering and surveying.
  - 3. Installation of the Work.
  - 4. Cutting and patching.
  - 5. Progress cleaning.
  - 6. Starting and adjusting.
  - 7. Protection of installed construction.
- B. Related Requirements:
  - 1. Section 011000 "Summary" for coordination of, and limits on use of Project site.
  - 2. Section 013300 "Submittal Procedures" for submitting surveys.
  - 3. Section 017700 "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, replacing defective work, and final cleaning.

#### 1.3 DEFINITIONS

- A. Cutting: Removal of in-place construction necessary to permit installation or performance of subsequent work.
- B. Patching: Fitting and repair work required to restore construction to original conditions after installation of subsequent work.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For land surveyor.
- B. Certified Surveys: Submit two copies signed by land surveyor.
- C. Certificates: Submit certificate signed by land surveyor, certifying that location and elevation of improvements comply with requirements.

## 1.5 CLOSEOUT SUBMITTALS

- A. Final Property Survey: Submit 10 copies showing the Work performed and record survey data.

## 1.6 QUALITY ASSURANCE

- A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in the State of Florida and who is experienced in providing land-surveying services of the kind indicated.
- B. Professional Engineer Qualifications: Refer to Section 014000 "Quality Requirements."
- C. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.
  - 1. Structural Elements: When cutting and patching structural elements, or when encountering the need for cutting and patching of elements, whose structural function is not known, notify Engineer of locations and details of cutting and await directions from Engineer before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection.
  - 2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety.
  - 3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety.
  - 4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Engineer's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.
- D. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of specified products and equipment.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Comply with requirements specified in other Sections.
- B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.

1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Engineer for the visual and functional performance of in-place materials. Use materials that are not considered hazardous.
- C. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities, mechanical and electrical systems, and other construction affecting the Work.
1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, and water-service piping; underground electrical services; and other utilities.
  2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.
- B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
  2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
  3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
- C. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

### 3.2 PREPARATION

- A. Existing Utility Information: Furnish information to Owner that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.
- B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before

fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

- C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.
- D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to Engineer in accordance to requirements in Section 013100 "Project Management and Coordination."

### 3.3 CONSTRUCTION LAYOUT

- A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks and existing conditions. If discrepancies are discovered, notify Engineer promptly.
- B. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.
- C. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.
- D. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Engineer.

### 3.4 FIELD ENGINEERING

- A. Identification: Owner will identify existing benchmarks, control points, and property corners.
- B. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.
  - 1. Do not change or relocate existing benchmarks or control points without prior written approval of Engineer. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Engineer before proceeding.
  - 2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.
- C. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.

1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
  2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
  3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.
- D. Final Property Survey: Engage a land surveyor to prepare a final property survey showing significant features (real property) for Project. Include on the survey a certification, signed by land surveyor, that principal metes, bounds, lines, and levels of Project are accurately positioned as shown on the survey.
1. Show boundary lines, streets, site improvements and utilities, existing improvements and significant vegetation, adjoining properties, and the distance and bearing from a site corner to a legal point.
  2. Recording: At Substantial Completion, have the final property survey recorded by or with authorities having jurisdiction as the official "property survey."

### 3.5 INSTALLATION

- A. Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
1. Make vertical work plumb, and make horizontal work level.
  2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
  3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
  4. Maintain minimum headroom clearance of 96 inches in occupied spaces and 90 inches in unoccupied spaces, unless otherwise indicated on Drawings.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- C. Install products at the time and under conditions that will ensure satisfactory results as judged by Engineer. Maintain conditions required for product performance until Substantial Completion.
- D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy of type expected for Project.
- E. Sequence the Work and allow adequate clearances to accommodate movement of construction items onsite and placement in permanent locations.
- F. Tools and Equipment: Select tools or equipment that minimize production of excessive noise levels.
- G. Templates: Obtain and distribute to the parties involved templates for Work specified to be factory prepared and field installed. Check Shop Drawings of other portions of the Work to

confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.

- H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions with manufacturer.
  - 1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Engineer.
  - 2. Allow for building movement, including thermal expansion and contraction.
  - 3. Coordinate installation of anchorages. 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.
- I. Joints: Make joints of uniform width. Where joint locations in exposed Work are not indicated, arrange joints for the best visual effect, as judged by Engineer. Fit exposed connections together to form hairline joints.
- J. Repair or remove and replace damaged, defective, or nonconforming Work.
  - 1. Comply with Section 017700 "Closeout Procedures" for repairing or removing and replacing defective Work.

### 3.6 CUTTING AND PATCHING

- A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
  - 1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
- B. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.
- C. Temporary Support: Provide temporary support of Work to be cut.
- D. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
- E. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching in accordance with requirements in Section 011000 "Summary."



- F. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to prevent interruption to occupied areas.
- G. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
  - 1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
  - 2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
  - 3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
  - 4. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
  - 5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
- H. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as practicable, as judged by Engineer. Provide materials and comply with installation requirements specified in other Sections, where applicable.
  - 1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
  - 2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
    - a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
    - b. Restore damaged pipe covering to its original condition.
  - 3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
    - a. Where patching occurs in a painted surface, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch, corner to corner of wall and edge to edge of ceiling. Provide additional coats until patch blends with adjacent surfaces.
  - 4. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.

- I. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

### 3.7 PROGRESS CLEANING

- A. Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.
  - 1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
  - 2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F.
  - 3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
    - a. Use containers intended for holding waste materials of type to be stored.
- B. Site: Maintain Project site free of waste materials and debris.
- C. Work Areas: Clean areas where Work is in progress to the level of cleanliness necessary for proper execution of the Work.
  - 1. Remove liquid spills promptly.
  - 2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
- D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.
- E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.
- F. Exposed Surfaces: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
- G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Section 017419 "Construction Waste Management and Disposal."
- H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.
- I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

### 3.8 STARTING AND ADJUSTING

- A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
- B. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.
- C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Manufacturer's Field Service: Comply with qualification requirements in Section 014000 "Quality Requirements."

### 3.9 PROTECTION AND REPAIR OF INSTALLED CONSTRUCTION

- A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.
- B. Repair Work previously completed and subsequently damaged during construction period  
Repair to like-new condition.
- C. Protection of Existing Items: Provide protection and ensure that existing items to remain undisturbed by construction are maintained in condition that existed at commencement of the Work.
- D. Comply with manufacturer's written instructions for temperature and relative humidity.

END OF SECTION 017300

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## SECTION 017419 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes administrative and procedural requirements for the following:
  - 1. Salvaging nonhazardous demolition and construction waste.
  - 2. Recycling nonhazardous demolition and construction waste.
  - 3. Disposing of nonhazardous demolition and construction waste.

#### 1.3 DEFINITIONS

- A. Construction Waste: Building, structure, and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.
- B. Demolition Waste: Building, structure, and site improvement materials resulting from demolition operations.
- C. Disposal: Removal of demolition or construction waste and subsequent salvage, sale, recycling, or deposit in landfill, incinerator acceptable to authorities having jurisdiction, or designated spoil areas on Owner's property. All waste that are disposed off-site shall be done so, in compliance with all applicable regulatory requirements.
- D. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.
- E. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.
- F. Salvage and Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.

#### 1.4 MATERIALS OWNERSHIP

- A. Unless otherwise indicated, demolition and construction waste becomes property of Contractor.

## 1.5 ACTION SUBMITTALS

- A. Waste Management Plan: Submit plan within 30 days of date established for the Notice to Proceed.

## 1.6 INFORMATIONAL SUBMITTALS

- A. Waste Reduction Progress Reports: Concurrent with each Application for Payment, submit report. Use Owner's designated form. Include the following information:
  - 1. Material category.
  - 2. Generation point of waste.
  - 3. Total quantity of waste in tons.
  - 4. Quantity of waste salvaged, both estimated and actual in tons.
  - 5. Quantity of waste recycled, both estimated and actual in tons.
  - 6. Total quantity of waste recovered (salvaged plus recycled) in tons.
  - 7. Total quantity of waste recovered (salvaged plus recycled) as a percentage of total waste.
- B. Waste Reduction Calculations: Before request for Substantial Completion, submit calculated end-of-Project rates for salvage, recycling, and disposal as a percentage of total waste generated by the Work.
- C. Recycling and Processing Facility Records: Indicate receipt and acceptance of recyclable waste by recycling and processing facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.
- D. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills and incinerator facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.
- E. Qualification Data: For waste management coordinator.

## 1.7 QUALITY ASSURANCE

- A. Waste Management Coordinator Qualifications: Experienced firm, or individual employed and assigned by General Contractor, with a record of successful waste management coordination of projects with similar requirements. Superintendent may serve as Waste Management Coordinator.
- B. Regulatory Requirements: Comply with transportation and disposal regulations of authorities having jurisdiction.

## 1.8 WASTE MANAGEMENT PLAN

- A. General: Develop a waste management plan according to requirements in this Section. Plan shall consist of waste identification, waste reduction work plan, and cost/revenue analysis. Distinguish between demolition and construction waste. Indicate quantities by weight or volume, but use same units of measure throughout waste management plan.

- B. Waste Identification: Indicate anticipated types and quantities of demolition site-clearing and construction waste generated by the Work. Use Owner's designated form. Include estimated quantities and assumptions for estimates.
- C. Waste Reduction Work Plan: List each type of waste and whether it will be salvaged, recycled, or disposed of in landfill or incinerator. Use Owner's designated form. Include points of waste generation, total quantity of each type of waste, quantity for each means of recovery, and handling and transportation procedures.
  - 1. Recycled Materials: Include list of local receivers and processors and type of recycled materials each will accept. Include names, addresses, and telephone numbers.
  - 2. Disposed Materials: Indicate how and where materials will be disposed of. Include name, address, and telephone number of each landfill and incinerator facility.
  - 3. Handling and Transportation Procedures: Include method that will be used for separating recyclable waste including sizes of containers, container labeling, and designated location where materials separation will be performed.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. General: Achieve end-of-Project rates for salvage/recycling of 50 percent by weight of total nonhazardous solid waste generated by the Work. Practice efficient waste management in the use of materials in the course of the Work. Use all reasonable means to divert construction and demolition waste from landfills and incinerators. Facilitate recycling and salvage of materials, including the following:
  - 1. Demolition Waste:
    - a. Concrete.
    - b. Concrete reinforcing steel.
    - c. Concrete masonry units.
    - d. Wood studs.
    - e. Wood joists.
    - f. Plywood and oriented strand board.
    - g. Wood paneling.
    - h. Wood trim.
    - i. Structural and miscellaneous steel.
    - j. Rough hardware.
    - k. Doors and frames.
    - l. Door hardware.
    - m. Windows.
    - n. Glazing.
    - o. Metal studs.
    - p. Gypsum board.
    - q. Acoustical tile and panels.
    - r. Demountable partitions.
    - s. Equipment.
    - t. Cabinets.

- u. Plumbing fixtures.
- v. Piping.
- w. Supports and hangers.
- x. Valves.
- y. Mechanical equipment.
- z. Electrical conduit.
- aa. Copper wiring.
- bb. Lighting fixtures.
- cc. Lamps.
- dd. Ballasts.
- ee. Electrical devices.
- ff. Switchgear and panelboards.
- gg. Transformers.

2. Construction Waste:

- a. Masonry and CMU.
- b. Lumber.
- c. Wood sheet materials.
- d. Wood trim.
- e. Metals.
- f. Insulation.
- g. Gypsum board.
- h. Piping.
- i. Electrical conduit.
- j. Packaging: Regardless of salvage/recycle goal indicated in "General" Paragraph above, salvage or recycle 100 percent of the following uncontaminated packaging materials:
  - 1) Paper.
  - 2) Cardboard.
  - 3) Boxes.
  - 4) Plastic sheet and film.
  - 5) Polystyrene packaging.
  - 6) Wood crates.
  - 7) Wood pallets.
  - 8) Plastic pails.
- k. Construction Office Waste: Regardless of salvage/recycle goal indicated in "General" Paragraph above, salvage or recycle 100 percent of the following construction office waste materials:
  - 1) Paper.
  - 2) Aluminum cans.
  - 3) Glass containers.



## PART 3 - EXECUTION

### 3.1 PLAN IMPLEMENTATION

- A. General: Implement approved waste management plan. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.
- B. Waste Management Coordinator: Engage a waste management coordinator to be responsible for implementing, monitoring, and reporting status of waste management work plan.
- C. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work.
  - 1. Distribute waste management plan to everyone concerned within three days of submittal return.
  - 2. Distribute waste management plan to entities when they first begin work on-site. Review plan procedures and locations established for salvage, recycling, and disposal.
- D. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
  - 1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged and recycled.

### 3.2 RECYCLING DEMOLITION AND CONSTRUCTION WASTE, GENERAL

- A. General: Recycle paper and beverage containers used by on-site workers.
- B. Preparation of Waste: Prepare and maintain recyclable waste materials according to recycling or reuse facility requirements. Maintain materials free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to the recycling process.
- C. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical according to approved construction waste management plan.
  - 1. Provide appropriately marked containers or bins for controlling recyclable waste until removed from Project site. Include list of acceptable and unacceptable materials at each container and bin.
    - a. Inspect containers and bins for contamination and remove contaminated materials if found.
  - 2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
  - 3. Stockpile materials away from construction area. Do not store within drip line of remaining trees.
  - 4. Store components off the ground and protect from the weather.

5. Remove recyclable waste from Owner's property and transport to recycling receiver or processor as often as required to prevent overfilling bins.

### 3.3 RECYCLING DEMOLITION WASTE

- A. Concrete: Remove reinforcement and other metals from concrete and sort with other metals.
  1. Pulverize concrete to maximum 4-inch size.
- B. Masonry: Remove metal reinforcement, anchors, and ties from masonry and sort with other metals.
  1. Pulverize masonry to maximum 4-inch size.
  2. Clean and stack undamaged, whole masonry units on wood pallets.
- C. Wood Materials: Sort and stack members according to size, type, and length. Separate lumber, engineered wood products, panel products, and treated wood materials.
- D. Metals: Separate metals by type.
  1. Structural Steel: Stack members according to size, type of member, and length.
  2. Remove and dispose of bolts, nuts, washers, and other rough hardware.
- E. Carpet Tile: Remove debris, trash, and adhesive.
  1. Stack tile on pallet and store clean, dry carpet in a closed container or trailer provided by carpet reclamation agency or carpet recycler.
- F. Piping: Reduce piping to straight lengths and store by material and size. Separate supports, hangers, valves, sprinklers, and other components by material and size.
- G. Conduit: Reduce conduit to straight lengths and store by material and size.
- H. Lamps: Separate lamps by type and store according to requirements in 40 CFR 273.

### 3.4 RECYCLING CONSTRUCTION WASTE

- A. Packaging:
  1. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.
  2. Polystyrene Packaging: Separate and bag materials.
  3. Pallets: As much as possible, require deliveries using pallets to remove pallets from Project site. For pallets that remain on-site, break down pallets into component wood pieces and comply with requirements for recycling wood.
  4. Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.

- B. Wood Materials:
  - 1. Clean Cut-Offs of Lumber: Grind or chip into small pieces.
  - 2. Clean Sawdust: Bag sawdust that does not contain painted or treated wood.
- C. Paint: Seal containers and store by type.

### 3.5 DISPOSAL OF WASTE

- A. General: Except for items or materials to be salvaged or recycled, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.
  - 1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
  - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
  - 3. All waste that are disposed off-site shall be done so, in compliance with all applicable regulatory requirements.
- B. Burning: Do not burn waste materials.

END OF SECTION 017419

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## SECTION 017700 - CLOSEOUT PROCEDURES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes administrative and procedural requirements for Contract closeout, including, but not limited to, the following:
  - 1. Substantial Completion procedures.
  - 2. Final completion procedures.
  - 3. Warranties.
  - 4. Final cleaning.
- B. Related Requirements:
  - 1. Section 012900 "Payment Procedures" for requirements for Applications for Payment for Substantial Completion and Final Completion.
  - 2. Section 013233 "Photographic Documentation" for submitting Final Completion construction photographic documentation.
  - 3. Section 017823 "Operation and Maintenance Data" for additional operation and maintenance manual requirements.
  - 4. Section 017839 "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
  - 5. Section 017900 "Demonstration and Training" for requirements to train the Owner's maintenance personnel to adjust, operate, and maintain products, equipment, and systems.

#### 1.3 DEFINITIONS

- A. List of Incomplete Items: Contractor-prepared list of items to be completed or corrected, prepared for the Engineer's use prior to Engineer's inspection, to determine if the Work is substantially complete.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of cleaning agent.
- B. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.
- C. Certified List of Incomplete Items: Final submittal at Final Completion.

1.5 CLOSEOUT SUBMITTALS

- A. Certificates of Release: From authorities having jurisdiction.
- B. Certificate of Insurance: For continuing coverage.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Schedule of Maintenance Material Items: For maintenance material submittal items required by other Sections.

1.7 SUBSTANTIAL COMPLETION PROCEDURES

- A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's "punch list"), indicating the value of each item on the list and reasons why the Work is incomplete.
- B. Submittals Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
  - 1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction, permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
  - 2. Submit closeout submittals specified in other Division 01 Sections, including Project Record Documents, operation and maintenance manuals, damage or settlement surveys, property surveys, and similar final record information.
  - 3. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
  - 4. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Engineer. Label with manufacturer's name and model number.
  - 5. Submit testing, adjusting, and balancing records.
  - 6. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
- C. Procedures Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
  - 1. Advise Owner of pending insurance changeover requirements.
  - 2. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
  - 3. Complete startup and testing of systems and equipment.
  - 4. Perform preventive maintenance on equipment used prior to Substantial Completion.
  - 5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems as specified in Section 017900 "Demonstration and Training."

6. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
  7. Complete final cleaning requirements.
  8. Touch up paint and otherwise repair and restore marred exposed finishes to eliminate visual defects.
- D. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 10 days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Engineer will either proceed with inspection or notify Contractor of unfulfilled requirements. Engineer will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Engineer, that must be completed or corrected before certificate will be issued.
1. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
  2. Results of completed inspection will form the basis of requirements for Final Completion.

#### 1.8 FINAL COMPLETION PROCEDURES

- A. Submittals Prior to Final Completion: Before requesting final inspection for determining Final Completion, complete the following:
1. Submit a final Application for Payment in accordance with Section 012900 "Payment Procedures."
  2. Certified List of Incomplete Items: Submit certified copy of Engineer's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Engineer. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
  3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
  4. Submit Final Completion photographic documentation.
- B. Inspection: Submit a written request for final inspection to determine acceptance a minimum of 10 days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Engineer will either proceed with inspection or notify Contractor of unfulfilled requirements. Engineer will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.
1. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

#### 1.9 LIST OF INCOMPLETE ITEMS

- A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.

1. Organize list of spaces in sequential order,, listed by room or space number.
2. Organize items applying to each space by major element, including categories for ceilings, individual walls, floors, equipment, and building systems.
3. Include the following information at the top of each page:
  - a. Project name.
  - b. Date.
  - c. Name of Engineer.
  - d. Name of Contractor.
  - e. Page number.

#### 1.10 SUBMITTAL OF PROJECT WARRANTIES

- A. Time of Submittal: Submit written warranties on request of Engineer for designated portions of the Work where warranties are indicated to commence on dates other than date of Substantial Completion, or when delay in submittal of warranties might limit Owner's rights under warranty.
- B. Warranty Electronic File: Provide warranties and bonds in PDF format. Assemble complete warranty and bond submittal package into a single electronic PDF file with bookmarks enabling navigation to each item. Provide bookmarked table of contents at beginning of document.
  1. Submit by uploading to web-based project software site.
- C. Provide copies of each warranty to include in operation and maintenance manuals.

### PART 2 - PRODUCTS

#### 2.1 MATERIALS

- A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

### PART 3 - EXECUTION

#### 3.1 FINAL CLEANING

- A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.
- B. Cleaning: Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
  1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:



- a. Clean Project site of rubbish, waste material, litter, and other foreign substances.
- b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
- c. Remove tools, construction equipment, machinery, and surplus material from Project site.
- d. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
- e. Clean flooring, removing debris, dirt, and staining: clean according to manufacturer's recommendations.
- f. Vacuum and mop concrete.
- g. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Polish mirrors and glass, taking care not to scratch surfaces.
- h. Remove labels that are not permanent.
- i. Wipe surfaces of mechanical and electrical equipment and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
- j. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
- k. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
- l. Clean luminaires, lamps, globes, and reflectors to function with full efficiency.
- m. Clean strainers.
- n. Leave Project clean and ready for occupancy.

- C. Construction Waste Disposal: Comply with waste disposal requirements in Section 017419 "Construction Waste Management and Disposal."

### 3.2 REPAIR OF THE WORK

- A. Complete repair and restoration operations required by Section 017300 "Execution" before requesting inspection for determination of Substantial Completion.

END OF SECTION 017700

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## SECTION 017824 - OPERATION AND MAINTENANCE DATA AND ASSET MANAGEMENT

### PART 1 GENERAL

#### 1.01 SCOPE OF WORK

- A. This Section includes procedural requirements for compiling and submitting operation and maintenance data required to complete the project. In addition to the requirements specified herein, Contractor operations and maintenance data shall be as required in JEA Water and Wastewater Standards – Section 445.

#### 1.02 RELATED WORK

- A. Submittals are included in Section 013300.
- B. Contract closeout is included in Section 017700.

#### 1.03 OPERATING MANUALS

- A. The Manufacturer shall provide specific operation and maintenance instructions for all electrical, mechanical, and instrumentation & controls equipment furnished under various technical specifications Sections.
- B. Three complete sets of operation and maintenance manuals approved by the Engineer covering all equipment furnished under other Divisions shall be delivered at least 30 days prior to scheduled start-up directly to the Owner. One set of originals must be part of the three sets of operation and maintenance instructions required, including original manuals covering components manufactured by others.
- C. An electronic copy of the manual will be provided with each hard copy submittal.
- D. Separate manuals shall be provided for each type of equipment, or each Section number. Each manual shall contain the following specific requirements. Manuals that do not meet the requirements will be rejected and Equipment Supplier/Manufacturer will bear all expenses to resubmit the manual to meet the following requirements.

##### 1. Format and Materials.

##### a. Binders:

- 1) Commercial quality three ring binders with durable and cleanable plastic covers.
- 2) Maximum ring width capacity: 3 inches.
- 3) When multiple binders are used, correlate the data into related consistent groupings/volumes.

##### b. Identification: Identify each volume on the cover and spine with typed or printed title "OPERATING AND MAINTENANCE INSTRUCTIONS". Include the following:

- 1) Title of Project.
- 2) Identify the general subject matter covered in the manual.
- 3) Identify structure(s) and/or location(s), of the equipment provided.

4) Specification Section number.

- c. 20 lb loose leaf paper, with hole reinforcement.
- d. Page size: 8-1/2 inch by 11 inch.
- e. Provide heavy-duty fly leaves (section separators), matching the table of contents, for each separate product, each piece of operating equipment, and organizational sections of the manual.
- f. Provide reinforced punched binder tab; bind in with text.
- g. Reduce larger drawings and fold to the size of text pages - but not larger than 11 inches x 17 inches - or provide a suitable clear plastic pocket (with drawing identification) for such folded drawings/diagrams.

2. Contents.

- a. A table of contents/Index, divided into section reflective of the major components provided.
- b. Specific description of each system and components.
- c. Name, address, telephone number(s) and e-mail address(es) of vendor(s) and local service representative(s).
- d. Equipment Supplier/Manufacturer shall clearly strike out portions of manual that do not apply to the project. Manual will be rejected until inapplicable information is deleted and only applicable information is clearly indicated.
- e. Specific on-site operating instructions (including starting and stopping procedures).
- f. Safety considerations.
- g. Project specific operational procedures and recommended log sheet(s).
- h. Project specific maintenance procedures.
- i. Manufacturer's operating and maintenance instructions – specific to the project.
- j. Copy of each wiring diagram.
- k. Copy of approved shop drawing(s) and Contractor's coordination/layout drawing(s).
- l. List of spare parts and recommended quantities.
- m. Product Data: Mark each sheet to clearly identify specific products and component parts and data applicable to installation. Delete inapplicable information.
- n. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams.
- o. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions specified.
- p. Warranties and Bonds, as specified in the General Conditions.
- q. Equipment attributes sheet for submittal of nameplate data.
- r. Electronic copy of manual on CD.
- s. Equipment Attribute Information:

1) Equipment Attribute Worksheets as presented at the end of this Specification shall be provided for all equipment meeting the asset definition as follows:

- a) Maintenance is recommended.
- b) Assets have a value greater than \$1,000.00.
- c) Assets are complete and usable, and perform a distinct function independently.

2) This asset definition is intended to give a general indication of which equipment must be included in the Equipment Attribute Worksheets. The Engineer will

provide the specific list of equipment that the Contractor must provide information for:

- a) The information requirements are shown in detail in the table at the end of this Specification. The data requirements include nameplate data, manufacturer and supplier information, information specific to the type of equipment, and recommended preventative maintenance activities.
- b) An electronic copy of the Equipment Attribute Worksheets must be delivered in Excel format and submitted to the Engineer on CD-ROM and submitted with the O&M Manuals. It is not necessary to submit printed copies of the Equipment Attribute Worksheets.

3. Transmittals.

- a. Prepare separate transmittal sheets for each manual. Each transmittal sheet shall include at least the following: Contractor's name and address, Owner's name, project name, project number, submittal number, description of submittal and number of copies submitted.
- b. Submittals shall be transmitted or delivered directly to the office of the Engineer, as indicated in the Contact Documents or as otherwise directed by the Engineer.
- c. Provide copies of transmittals (only, i.e., without copies of the respective submittal) directly to the Resident Project Representative.

E. Manuals for Equipment and Systems - In addition to the requirements listed above, for each System, provide the following:

1. Overview of system and description of unit or system and component parts. Identify function, normal operating characteristics and limiting conditions. Include legible performance curves, with engineering data and tests and complete nomenclature and commercial number of replaceable parts.
2. Panelboard circuit directories including electrical service characteristics, controls and communications and color-coded wiring diagrams as installed.
3. Operating procedures: include start-up, break-in and routine normal operating instructions and sequences; regulation, control, stopping, shut-down and emergency instructions; and summer, winter and any special operating instructions.
4. Maintenance Requirements.
  - a. Procedures and guides for trouble-shooting; disassembly, repair, and reassembly instructions.
  - b. Alignment, adjusting, balancing and checking instructions.
  - c. Servicing and lubrication schedule and list of recommended lubricants.
  - d. Manufacturer's printed operation and maintenance instructions.
  - e. Sequence of operation by instrumentation and controls manufacturer.
  - f. Original manufacturer's parts list, illustrations, assembly drawings and diagrams required for maintenance.
5. Control diagrams by controls manufacturer as installed (as-built).
6. Contractor's coordination drawings, with color coded piping diagrams, as installed (as-built).
7. Charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams. Include equipment and instrument tag numbers on diagrams.

8. List of original manufacturer's spare parts and recommended quantities to be maintained in storage.
  9. Test and balancing reports, as required.
  10. Additional Requirements as specified in individual product specification.
  11. Design data for systems engineered by the Contractor or its Suppliers.
  12. Equipment attribute information.
    - a. Equipment Attribute Worksheets as presented at the end of this Section shall be provided for all equipment meeting the asset definition as follows:
      - 1) Asset Definition.
        - a) Maintenance is recommended.
        - b) Assets have a value greater than \$1,000.
        - c) Assets are complete and usable, and perform a distinct function independently (i.e., they pump waste, remove solids, etc.).
      - b. This asset definition is intended to give a general indication of which equipment must be included in the Equipment Attribute Worksheets. The Engineer will provide the specific list of equipment that the Vendor must provide information for.
      - c. The information requirements are shown in detail in the table. The data requirements include nameplate data, manufacturer and supplier information, information specific to the type of equipment, and recommended preventative maintenance activities.
      - d. An electronic copy of the Equipment Attribute Worksheets must be delivered in Excel format and submitted to the Engineer on CD-ROM and submitted with the O&M manuals. It is not necessary to submit printed copies of the Equipment Attribute Worksheets.
- F. Manual for Materials and Finishes - In addition to the requirements listed above, for each material or finish, provide the following:
1. Building Products, Applied Materials and Finishes: Include product data, with catalog number, size, composition and color and texture designations. Provide information for re-ordering custom manufactured products.
  2. Instructions for Care and Maintenance: Include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods and recommended schedule for cleaning and maintenance.
  3. Moisture Protection and Weather Exposed Products: Include product data listing, applicable reference standards, chemical composition, and details of installation. Provide recommendations for inspections, maintenance and repair.
  4. Additional Requirements: As specified in individual product specifications.
- G. Electronic Transmission of O&M Manuals
1. Unless otherwise approved by the Engineer, O&M manuals may not be transmitted by electronic means other than by CD-ROM or USB flash drive. Electronic O&M manuals shall meet the following conditions:
    - a. The above-specified transmittal form is included.
    - b. All other requirements specified above have been met, including, but not limited to, coordination by the Contractor, review and approval by the Contactor.

- c. The submittal contains no pages or sheets large than 11 x 17 inches.
  - d. With the exception of the transmittal sheet, the entire submittal is included in a single file.
  - e. Files are Portable Document Format (PDF) – with the printing function enabled.
  - f. The Vendor provided equipment, sub-system, or system manuals shall be in PDF format, compliant with the Adobe PDF Specification Version 1.7. The manual shall be Searchable Image. The Optical Character Recognition of the image shall be at a 95% confidence level. The manuals shall be linked and bookmarked as follows:
    - 1) Provide links from all Table of Contents, List of Tables, List of Figures, etc., entries to the actual occurrence in the body of the manual.
    - 2) Create bookmarks for all linked Table of Content entries.
  - g. All drawings shall be in PDF format, compliant with the Adobe PDF Specification Version 1.7. The manual shall be PDF Searchable Image. The Optical Character Recognition of the image shall be at a 95% confidence level. The drawings shall be linked as follows:
    - 1) External links from the Drawing Index (if it exists) to each drawing.
    - 2) External links from references within drawings to other drawings.
  - h. All scanned manufacturer's O&M manuals must be quality checked after scanning to ensure the page are not crooked and all information is legible.
- 2. When electronic copies are provided, transmit two hard copy (paper) originals to the Engineer with an electronic copy on CD-ROM.
  - 3. The electronic copy of the O&M manual shall be identical in organization, format and content to the hard copies of the manual.
  - 4. The electronic O&M Manual shall be bookmarked identically to the paper manual table of contents to allow quick access to information. Electronic submittals that require extensive scrolling will not be accepted. The document shall be indexed and searchable.

## PART 2 PRODUCTS (NOT USED)

## PART 3 EXECUTION

### 3.01 SUBMITTAL SCHEDULE

- A. Operation and maintenance manuals shall be delivered directly to the office of the Engineer, as follows:
  - 1. Provide preliminary copies of each manual to the office of the Engineer, no later than 30 days following approval of the respective shop drawings.
  - 2. Provide final copies of each completed manual prior to testing.
  - 3. Provide a letter that grants the Engineer and Owner to the limited right to use and reproduce each manual (in it its entirety or any portion thereof) from the respective equipment manufacturer(s). Such limited right shall allow the Engineer and Owner to use each manual or and portion thereof for:

- a. The potential assembly of a comprehensive facility operation and maintenance manual for the sole benefit of the Owner; and,
  - b. Supplemental training of the Owner's personnel and operators, over and above the required vendor's training, regarding operation of the facility as a system.
- B. The Engineer will review Operation and Maintenance manuals submittals for operating equipment for conformance with the requirements of the applicable specification Section. The review will generally be based on the O&M Manual Review Checklist appended to this Section.
- C. If during test and start-up of equipment, any changes were made to the equipment, provide two hard copies of as-built drawings or any other amendments for insertion, by the Contractor, in the previously transmitted final manuals. In addition, provide one revised electronic version including the as-built drawings and any other amendments. The manuals shall be completed, including updates, if any, within 30 days of start-up and testing of the facility.

### 3.02 VENDOR TRAINING/INSTRUCTIONS (TO OWNER'S PERSONNEL)

- A. Before final initiation of operation, Contractor's vendors shall train/instruct Owner's designated personnel in the operation, adjustment, and maintenance of products, equipment and systems at times convenient to the Owner.
- B. Unless specified otherwise under the respective equipment specification section, vendor training/instruction shall consist of eight hours of training for each type of equipment. Such training/instruction shall be scheduled and held at times to accommodate the work schedules of Owner's personnel, including splitting the required training/instruction time into separate sessions and/or presented at reasonable times other than the Contractor's "normal working hours" or the Owner's normal day shift.
- C. Use operation and maintenance manuals as basis for instruction. Train/instruct the Owner's personnel, in detail, based on the contents of manual explaining all aspects of operation and maintenance of the equipment. If the respective equipment is inter-related to the operation of other equipment, all interlock, constraints, and permissives shall be explained.
- D. At least two weeks prior to the schedule for vendor training, a detailed lesson plan, representative of the material to be covered during instruction, shall be submitted to the Engineer for approval. Lesson plans shall consist of in-depth outlines of the training material, including a table of contents, resume of the instructor, materials to be covered, start-up procedures, maintenance requirements, safety considerations, and shut-down procedures.
- E. Prepare and insert additional data in each Operation and Maintenance Manual when the need for such data becomes apparent during training/instruction.
- F. Vendor's training/instruction will be considered acceptable based on the completed Owner's Acknowledgement of Manufacturer's Instruction as indicated on the Equipment Manufacturer's Certification of Installation, Testing, and Instruction appended to this Section.

END OF SECTION 017824



## O&M Manual Review Checklist

Submittal No.: \_\_\_\_\_

Project No.: \_\_\_\_\_

Manufacturer: \_\_\_\_\_

Equipment Submitted: \_\_\_\_\_

Specification Section: \_\_\_\_\_

Date of Submittal: \_\_\_\_\_

<b>General Data</b>		
1.	Are the area representative's name, address, e-mail address and telephone number included?	
2.	Is the nameplate data for each component included?	
3.	Are all associated components related to the specific equipment included?	
4.	Is non-pertinent data crossed out or deleted?	
5.	Are drawings neatly folded and/or inserted into packets?	
6.	Are all pages properly aligned and scanned legibly?	
7.	Is the .PDF document bookmarked according to the table of contents?	
<b>Operations and Maintenance Data</b>		
8.	Is an overview description of the equipment and/or process included?	
9.	Does the description include the practical theory of operation?	
10.	Does each equipment component include specific details (design characteristics, operating parameters, control descriptions, and selector switch positions and functions)?	
11.	Are alarm and shutdown conditions specific to the equipment provided on this project clearly identified? Does it describe possible causes and recommended remedies?	
12.	Are step procedures for starting, stopping, and troubleshooting specific to the equipment provided included?	
13.	Is a list of operational parameters to monitor and record specific to the equipment provided included?	
14.	Is a proposed operating log sheet specific to the equipment provided included?	
15.	Is a spare parts inventory list included for each component?	
16.	Is a lubrication schedule for each component specific to the equipment provided included - or does it clearly state "No Lubrication Required"?	
17.	Is a maintenance schedule for each component specific to the equipment provided included?	
18..	Is a copy of the warranty information included?	

## Review Comments

Is the submittal fully approved (yes/no)? \_\_\_\_\_

If not, the following points of rejection must be addressed and require resubmittal by the Contractor:

### Item No.

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_
4. \_\_\_\_\_
5. \_\_\_\_\_
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13. \_\_\_\_\_
14. \_\_\_\_\_
15. \_\_\_\_\_

Reviewed By: \_\_\_\_\_ Date: \_\_\_\_\_

### Legend

- 1 = OK
- 2 = Not Adequate
- 3 = Not Included

Note: This submittal has been reviewed for compliance with the Contract Documents.

## **ASSET MANAGEMENT FORMS**

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Water Treatment Plant Asset List - RIVERTOWN WTP

Asset Information							Attributes required for all equipment				NAME PLATE DATA								Additional Attributes				
Location	Location Description	Parent Asset ID	Asset Description	Parent or Child Asset ID	Asset Description	CAPITAL (Yes/No)	COMMISSION DATE / SUBSTANTIAL COMPLETION DATE	WARRANTY END DATE	PURCHASE COST	FINAL INSTALLED COST	MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	MANUF PART #	PURCHASE COST	VENDOR	DATE MANUFACTURED	DATE PURCHASED	TYPE				
WT-DXK	RIVERTOWN WTP	TANK-01	RESERVOIR 1, RIVERTOWN WTP	AERATOR-1	AERATOR, RESERVOIR 1, RIVERTOWN WTP	Y																	
Location	Location Description	Parent Asset ID	Asset Description	Parent or Child Asset ID	Asset Description	Capital Asset (Yes / No)	COMMISSION DATE / SUBSTANTIAL COMPLETION DATE	WARRANTY END DATE	FINAL INSTALLED COST	FINAL INSTALLED COST	MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	MANUF PART #	PURCHASE COST	VENDOR	DATE MANUFACTURED	DATE PURCHASED					
GRS-XXXXXX	WELL #2, RIVERTOWN WTP			ANTENNA-1	ANTENNA, WELL #2, RIVERTOWN WTP	Y																	
GRS-XXXXXX	WELL #3, RIVERTOWN WTP			ANTENNA-2	ANTENNA, WELL #3, RIVERTOWN WTP	Y																	
WT-DXK	RIVERTOWN WTP			ANTENNA-3	ANTENNA, RIVERTOWN WTP	Y																	
Location	Location Description	Parent Asset ID	Asset Description	Parent or Child Asset ID	Asset Description	CAPITAL (Yes/No)	COMMISSION DATE / SUBSTANTIAL COMPLETION DATE	WARRANTY END DATE	PURCHASE COST	FINAL INSTALLED COST	MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	MANUF PART #	PURCHASE COST	VENDOR	DATE MANUFACTURED	DATE PURCHASED	VALVE SIZE	VALVE TYPE	BODY MATERIAL	DATE INSTALLED	
RT-01	BLDG 1 / PUMP ROOM RIVERTOWN WTP	ASBLY-1	HIGH SERVICE PUMP ASSEMBLY #1	ARV-1	AIR RELEASE VALVE, SERVICE PUMP #1, RIVERTOWN WTP	Y																	
RT-01	BLDG 1 / PUMP ROOM RIVERTOWN WTP	ASBLY-2	HIGH SERVICE PUMP ASSEMBLY #2	ARV-2	AIR RELEASE VALVE, SERVICE PUMP #2, RIVERTOWN WTP	Y																	
RT-01	BLDG 1 / PUMP ROOM RIVERTOWN WTP	ASBLY-3	HIGH SERVICE PUMP ASSEMBLY #3	ARV-3	AIR RELEASE VALVE, SERVICE PUMP #3, RIVERTOWN WTP	Y																	
RT-01	BLDG 1 / PUMP ROOM RIVERTOWN WTP	ASBLY-4	HIGH SERVICE PUMP ASSEMBLY #4	ARV-4	AIR RELEASE VALVE, SERVICE PUMP #4, RIVERTOWN WTP	Y																	
RT-01	BLDG 1 / PUMP ROOM RIVERTOWN WTP	ASBLY-5	HIGH SERVICE PUMP ASSEMBLY #5	ARV-5	AIR RELEASE VALVE, SERVICE PUMP #5, RIVERTOWN WTP	Y																	
RT-01	BLDG 1 / PUMP ROOM RIVERTOWN WTP	ASBLY-6	HIGH SERVICE PUMPS DISCHARGE MANIFOLD PIPING, RIVERTOWN WTP	ARV-6	ARV ON HIGH SERVICE PUMPS DISCHARGE MANIFOLD PIPING	Y																	
GRS-XXXXXX	WELL #1, RIVERTOWN WTP	ASBLY-9	WELL PUMP #1 ASSEMBLY, RIVERTOWN WTP	ARV-7	WELL PUMP #1, AIR RELIEF VALVE A, RIVERTOWN WTP	Y																	
GRS-XXXXXX	WELL #1, RIVERTOWN WTP	ASBLY-9	WELL PUMP #1 ASSEMBLY, RIVERTOWN WTP	ARV-8	WELL PUMP #1, AIR RELIEF VALVE B, RIVERTOWN WTP	Y																	
GRS-XXXXXX	WELL #2, RIVERTOWN WTP	ASBLY-10	WELL PUMP #2 ASSEMBLY, RIVERTOWN WTP	ARV-9	WELL PUMP #2, AIR RELIEF VALVE #1, RIVERTOWN WTP	Y																	
GRS-XXXXXX	WELL #2, RIVERTOWN WTP	ASBLY-10	WELL PUMP #2 ASSEMBLY, RIVERTOWN WTP	ARV-10	WELL PUMP #2, AIR RELIEF VALVE #2, RIVERTOWN WTP	Y																	
GRS-XXXXXX	WELL #3, RIVERTOWN WTP	ASBLY-11	WELL PUMP #3 ASSEMBLY, RIVERTOWN WTP	ARV-11	WELL PUMP #3, AIR RELIEF VALVE #1, RIVERTOWN WTP	Y																	
GRS-XXXXXX	WELL #3, RIVERTOWN WTP	ASBLY-11	WELL PUMP #3 ASSEMBLY, RIVERTOWN WTP	ARV-12	WELL PUMP #3, AIR RELIEF VALVE #2, RIVERTOWN WTP	Y																	
Location	Location Description	Parent Asset ID	Asset Description	Parent or Child Asset ID	Asset Description	CAPITAL (Yes/No)	COMMISSION DATE / SUBSTANTIAL COMPLETION DATE	WARRANTY END DATE	PURCHASE COST	FINAL INSTALLED COST	MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	MANUF PART #	PURCHASE COST	VENDOR	DATE MANUFACTURED	DATE PURCHASED					
WT-DXK	RIVERTOWN WTP			BFP-01	BACK FLOW PREVENTER, RIVERTOWN WTP	N																	
Location	Location Description	Parent Asset ID	Asset Description	Parent or Child Asset ID	Asset Description	CAPITAL (Yes/No)	COMMISSION DATE / SUBSTANTIAL COMPLETION DATE	WARRANTY END DATE	PURCHASE COST	FINAL INSTALLED COST	MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	MANUF PART #	PURCHASE COST	VENDOR	DATE MANUFACTURED	DATE PURCHASED	CONTINUOUS AMP RATING	VOLTAGE	PHASE	SIZE	
RT-02	BLDG 2 / ELECTRICAL ROOM RIVERTOWN WTP			BRKR-1	MAIN BREAKER, 1600 AMP, RIVERTOWN WTP	Y																	
RT-02	BLDG 2 / ELECTRICAL ROOM RIVERTOWN WTP	MCC-1	MCC, RIVERTOWN WTP	BRKR-2	MAIN BREAKER 1600 AMP, MCC-1 RIVERTOWN WTP	Y																	
RT-02	BLDG 2 / ELECTRICAL ROOM RIVERTOWN WTP	MCC-1	MCC, RIVERTOWN WTP	BRKR-3	BREAKER, SERVICE PUMP #1, 400 AMP, RIVERTOWN WTP	Y																	
RT-02	BLDG 2 / ELECTRICAL ROOM RIVERTOWN WTP	MCC-1	MCC, RIVERTOWN WTP	BRKR-4	BREAKER, SERVICE PUMP #2, 400 AMP, RIVERTOWN WTP	Y																	
RT-02	BLDG 2 / ELECTRICAL ROOM RIVERTOWN WTP	MCC-1	MCC, RIVERTOWN WTP	BRKR-5	BREAKER, SERVICE PUMP #3, 400 AMP, RIVERTOWN WTP	Y																	
RT-02	BLDG 2 / ELECTRICAL ROOM RIVERTOWN WTP	MCC-1	MCC, RIVERTOWN WTP	BRKR-6	BREAKER, SERVICE PUMP #4, 400 AMP, RIVERTOWN WTP	Y																	
RT-02	BLDG 2 / ELECTRICAL ROOM RIVERTOWN WTP	MCC-1	MCC, RIVERTOWN WTP	BRKR-7	BREAKER, SERVICE PUMP #5, 400 AMP, RIVERTOWN WTP	Y																	
RT-02	BLDG 2 / ELECTRICAL ROOM RIVERTOWN WTP	MCC-1	MCC, RIVERTOWN WTP	BRKR-8	BREAKER, FUTURE SERVICE PUMP, 400 AMP, RIVERTOWN WTP	Y																	
RT-02	BLDG 2 / ELECTRICAL ROOM RIVERTOWN WTP	MCC-1	MCC, RIVERTOWN WTP	BRKR-9	BREAKER TO WELL 1, 400 AMP, RIVERTOWN WTP	Y																	
GRS-XXXXXX	WELL #3, RIVERTOWN WTP	MCC-1	MCC, RIVERTOWN WTP	BRKR-10	BREAKER, TO CHEMICAL BUILDING, 100 AMP, RIVERTOWN WTP	N																	
NW-04	BLDG 4 / GENERATOR RIVERTOWN WTP	GEN-1	GENERATOR - MAIN, 2500 AMP, RIVERTOWN WTP (601-G-1-1)	BRKR-11	GENERATOR (MAIN) BREAKER, 1600 AMP, RIVERTOWN WTP	Y																	
GRS-XXXXXX	WELL #1, RIVERTOWN WTP	CP-1	CONTROL PANEL, WELL 1, RIVERTOWN WTP	BRKR-12	MAIN BREAKER, WELL 1, RIVERTOWN WTP	N																	
GRS-XXXXXX	WELL #2, RIVERTOWN WTP	CP-2	CONTROL PANEL, WELL 2, RIVERTOWN WTP	BRKR-13	MAIN BREAKER, WELL 2, RIVERTOWN WTP	N																	
GRS-XXXXXX	WELL #3, RIVERTOWN WTP	CP-3	CONTROL PANEL, WELL 3, RIVERTOWN WTP	BRKR-14	MAIN BREAKER, WELL 3, RIVERTOWN WTP	N																	
Location	Location Description	Parent Asset ID	Asset Description	Parent or Child Asset ID	Asset Description	CAPITAL (Yes/No)	COMMISSION DATE / SUBSTANTIAL COMPLETION DATE	WARRANTY END DATE	PURCHASE COST	FINAL INSTALLED COST	MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	MANUF PART #	PURCHASE COST	VENDOR	DATE MANUFACTURED	DATE PURCHASED	TYPE	PART NUMBER			
GRS-XXXXXX	WELL #1, RIVERTOWN WTP	SCADA-2	SCADA ASSEMBLY, WELL PUMP #1	CARD-1	A I CARD, WELL 1, RIVERTOWN WTP	N																	
GRS-XXXXXX	WELL #2, RIVERTOWN WTP	SCADA-3	SCADA ASSEMBLY, WELL PUMP #2	CARD-2	A I CARD, WELL 2, RIVERTOWN WTP	N																	
GRS-XXXXXX	WELL #3, RIVERTOWN WTP	SCADA-4	SCADA ASSEMBLY, WELL PUMP #3	CARD-3	A I CARD, WELL 3, RIVERTOWN WTP	N																	
GRS-XXXXXX	WELL #1, RIVERTOWN WTP	SCADA-2	SCADA ASSEMBLY, WELL PUMP #1	CARD-4	A O CARD, WELL 1, RIVERTOWN WTP	N																	
GRS-XXXXXX	WELL #2, RIVERTOWN WTP	SCADA-3	SCADA ASSEMBLY, WELL PUMP #2	CARD-5	A O CARD, WELL 2, RIVERTOWN WTP	N																	
GRS-XXXXXX	WELL #3, RIVERTOWN WTP	SCADA-4	SCADA ASSEMBLY, WELL PUMP #3	CARD-6	A O CARD, WELL 3, RIVERTOWN WTP	N																	
GRS-XXXXXX	WELL #1, RIVERTOWN WTP	SCADA-2	SCADA ASSEMBLY, WELL PUMP #1	CARD-7	D I CARD, WELL 1, RIVERTOWN WTP	N																	
GRS-XXXXXX	WELL #2, RIVERTOWN WTP	SCADA-3	SCADA ASSEMBLY, WELL PUMP #2	CARD-8	D I CARD, WELL 2, RIVERTOWN WTP	N																	
GRS-XXXXXX	WELL #3, RIVERTOWN WTP	SCADA-4	SCADA ASSEMBLY, WELL PUMP #3	CARD-9	D I CARD, WELL 3, RIVERTOWN WTP	N																	
GRS-XXXXXX	WELL #1, RIVERTOWN WTP	SCADA-2	SCADA ASSEMBLY, WELL PUMP #1	CARD-10	D O CARD, WELL 1, RIVERTOWN WTP	N																	
GRS-XXXXXX	WELL #2, RIVERTOWN WTP	SCADA-3	SCADA ASSEMBLY, WELL PUMP #2	CARD-11	D O CARD, WELL 2, RIVERTOWN WTP	N																	
GRS-XXXXXX	WELL #3, RIVERTOWN WTP	SCADA-4	SCADA ASSEMBLY, WELL PUMP #3	CARD-12	D O CARD, WELL 3, RIVERTOWN WTP	N																	
RT-02	BLDG 2 / ELECTRICAL ROOM RIVERTOWN WTP	SCADA-1	SCADA ASSEMBLY PLANT	CARD-13	CARD A I, RIVERTOWN WTP	N																	
RT-02	BLDG 2 / ELECTRICAL ROOM RIVERTOWN WTP	SCADA-1	SCADA ASSEMBLY PLANT	CARD-14	CARD A O, RIVERTOWN WTP	N																	
RT-02	BLDG 2 / ELECTRICAL ROOM RIVERTOWN WTP	SCADA-1	SCADA ASSEMBLY PLANT	CARD-15	CARD D I, RIVERTOWN WTP	N																	
RT-02	BLDG 2 / ELECTRICAL ROOM RIVERTOWN WTP	SCADA-1	SCADA ASSEMBLY PLANT	CARD-16	CARD D O, RIVERTOWN WTP	N																	
Location	Location Description	Parent Asset ID	Asset Description	Parent or Child Asset ID	Asset Description	Capital Asset (Yes / No)	COMMISSION DATE / SUBSTANTIAL COMPLETION DATE	WARRANTY END DATE	PURCHASE COST	FINAL INSTALLED COST	MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	MANUF PART #	PURCHASE COST	VENDOR	DATE MANUFACTURED	DATE PURCHASED	Casing Diameter	Depth	Length	Material	
GRS-XXXXXX	WELL #1, RIVERTOWN WTP	ASBLY-9	WELL PUMP #1 ASSEMBLY, RIVERTOWN WTP	CASING-1	WELL CASING #1, 30"	Y																	
GRS-XXXXXX	WELL #2, RIVERTOWN WTP	ASBLY-10	WELL PUMP #2 ASSEMBLY #																				

Water Treatment Plant Asset List - RIVERTOWN WTP

Asset Information						Attributes required for all equipment					NAME PLATE DATA								Additional Attributes						
Location		Parent Asset ID	Asset Description	Parent or Child Asset ID	Asset Description	CAPITAL (Yes/No)	COMMISSION DATE / SUBSTANTIAL COMPLETION DATE	WARRANTY END DATE	PURCHASE COST	FINAL INSTALLED COST	MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	MANUF PART #	PURCHASE COST	VENDOR	DATE MANUFACTURED	DATE PURCHASED	RPM	CFM					
WT-00X	RIVERTOWN WTP	TANK-1	RESERVOIR 1, RIVERTOWN WTP	FAN-1	FAN 1, RESERVOIR 1, RIVERTOWN WTP	N																			
WT-00X	RIVERTOWN WTP	TANK-1	RESERVOIR 1, RIVERTOWN WTP	FAN-2	FAN 2, RESERVOIR 1, RIVERTOWN WTP	N																			
WT-00X	RIVERTOWN WTP	TANK-1	RESERVOIR 1, RIVERTOWN WTP	FAN-3	FAN 3, RESERVOIR 1, RIVERTOWN WTP	N																			
WT-00X	RIVERTOWN WTP	RT-01	BLDG 1 / PUMP ROOM RIVERTOWN WTP	FAN-4	EXHAUST FAN 1, PUMP ROOM, RIVERTOWN WTP	Y																			
WT-00X	RIVERTOWN WTP	RT-01	BLDG 1 / PUMP ROOM RIVERTOWN WTP	FAN-5	EXHAUST FAN 2, PUMP ROOM, RIVERTOWN WTP	Y																			
WT-00X	RIVERTOWN WTP	RT-01	BLDG 1 / PUMP ROOM RIVERTOWN WTP	FAN-6	EXHAUST FAN 3, PUMP ROOM, RIVERTOWN WTP	Y																			
WT-00X	RIVERTOWN WTP	RT-03	BLDG 3 / HYPO CHLORITE RIVERTOWN WTP	FAN-7	EXHAUST FAN 1, HYPOCHLORITE, RIVERTOWN WTP	Y																			
WT-00X	RIVERTOWN WTP	RT-03	BLDG 3 / HYPO CHLORITE RIVERTOWN WTP	FAN-8	EXHAUST FAN 2, HYPOCHLORITE, RIVERTOWN WTP	Y																			
WT-00X	RIVERTOWN WTP	RT-03	BLDG 3 / HYPO CHLORITE RIVERTOWN WTP	FAN-9	EXHAUST FAN 3, HYPOCHLORITE, RIVERTOWN WTP	Y																			
WT-00X	RIVERTOWN WTP	RT-04	BLDG 4 / GENERATOR RIVERTOWN WTP	GEN-1	GENERATOR - MAIN, 2500 AMP, RIVERTOWN WTP (601-G-1-1)	Y																			
WT-00X	RIVERTOWN WTP	TANK-1	RESERVOIR 1, RIVERTOWN WTP	GAUGE-1	LIQUID LEVEL INDICATOR, RESERVOIR #1	N																			
RT-02	BLDG 2 / ELECTRICAL ROOM RIVERTOWN WTP	SCADA-1	SCADA ASSEMBLY PLANT	HMI-1	INTERFACE DISPLAY PANEL, RIVERTOWN WTP	Y																			
WT-00X	RIVERTOWN WTP	RT-03	BLDG 3 / HYPO CHLORITE RIVERTOWN WTP	INJECT-1	HYPO CHLORITE INJECTOR #1, RIVERTOWN WTP	N																			
WT-00X	RIVERTOWN WTP	RT-03	BLDG 3 / HYPO CHLORITE RIVERTOWN WTP	INJECT-2	HYPO CHLORITE INJECTOR #2, RIVERTOWN WTP	N																			
WT-00X	RIVERTOWN WTP			IS-1	SEWAGE PUMP STATION RIVERTOWN WTP	Y																			
WT-00X	RIVERTOWN WTP	RT-02	BLDG 2 / ELECTRICAL ROOM RIVERTOWN WTP	SWGR-1	MCC SWGR (SWGR-1)	Y																			
WT-00X	RIVERTOWN WTP	RT-02	BLDG 2 / ELECTRICAL ROOM RIVERTOWN WTP	MCC-1	MCC-1 (MCC-1)	Y																			
GRS-XXXXXX	WELL #1, RIVERTOWN WTP			METER-1	WELL PUMP #1 FLOW METER & TRANSMITTER, RIVERTOWN WTP	Y																			
GRS-XXXXXX	WELL #2, RIVERTOWN WTP			METER-2	WELL PUMP #2 FLOW METER & TRANSMITTER, RIVERTOWN WTP	Y																			
GRS-XXXXXX	WELL #3, RIVERTOWN WTP			METER-3	WELL PUMP #3 FLOW METER & TRANSMITTER, RIVERTOWN WTP	Y																			
RT-01	BLDG 1 / PUMP ROOM RIVERTOWN WTP	ASBLY-6	FLOW METER ASSEMBLY, RIVERTOWN WTP	METER-4	EFF. FLOW METER, RIVERTOWN WTP	Y																			
RT-01	BLDG 1 / PUMP ROOM RIVERTOWN WTP			METER-5	EFFLUENT PRESSURE METER AND TRANSMITTER, RIVERTOWN WTP	Y																			
RT-03	BLDG 3 / HYPO CHLORITE RIVERTOWN WTP	TANK-3	HYPO CHLORITE TANK #1, BUILDING 3	METER-6	LEVEL METER AND TRANSMITTER, HYPOCHLORITE TANK #1, RIVERTOWN WTP	Y																			
WT-00X	RIVERTOWN WTP	TANK-1	RESERVOIR 1, RIVERTOWN WTP	METER-7	LEVEL METER AND TRANSMITTER, RESERVOIR #1, RIVERTOWN WTP	Y																			
RT-01	BLDG 1 / PUMP ROOM RIVERTOWN WTP	ASBLY-1	HIGH SERVICE PUMP ASSEMBLY #1	METER-8	PRESSURE METER DOWNSTREAM OF HSP #1, RIVERTOWN WTP	Y																			
RT-01	BLDG 1 / PUMP ROOM RIVERTOWN WTP	ASBLY-2	HIGH SERVICE PUMP ASSEMBLY #2	METER-9	PRESSURE METER DOWNSTREAM OF HSP #2, RIVERTOWN WTP	Y																			
RT-01	BLDG 1 / PUMP ROOM RIVERTOWN WTP	ASBLY-3	HIGH SERVICE PUMP ASSEMBLY #3	METER-10	PRESSURE METER DOWNSTREAM OF HSP #3, RIVERTOWN WTP	Y																			
RT-01	BLDG 1 / PUMP ROOM RIVERTOWN WTP	ASBLY-4	HIGH SERVICE PUMP ASSEMBLY #4	METER-11	PRESSURE METER DOWNSTREAM OF HSP #4, RIVERTOWN WTP	Y																			
RT-01	BLDG 1 / PUMP ROOM RIVERTOWN WTP	ASBLY-5	HIGH SERVICE PUMP ASSEMBLY #5	METER-12	PRESSURE METER DOWNSTREAM OF HSP #5, RIVERTOWN WTP	Y																			
RT-01	BLDG 1 / PUMP ROOM RIVERTOWN WTP	ASBLY-1	HIGH SERVICE PUMP ASSEMBLY #1	METER-13	PRESSURE METER UPSTREAM OF HSP #1, RIVERTOWN WTP	Y																			
RT-01	BLDG 1 / PUMP ROOM RIVERTOWN WTP	ASBLY-2	HIGH SERVICE PUMP ASSEMBLY #2	METER-14	PRESSURE METER UPSTREAM OF HSP #2, RIVERTOWN WTP	Y																			
RT-01	BLDG 1 / PUMP ROOM RIVERTOWN WTP	ASBLY-3	HIGH SERVICE PUMP ASSEMBLY #3	METER-15	PRESSURE METER UPSTREAM OF HSP #3, RIVERTOWN WTP	Y																			
RT-01	BLDG 1 / PUMP ROOM RIVERTOWN WTP	ASBLY-4	HIGH SERVICE PUMP ASSEMBLY #4	METER-16	PRESSURE METER UPSTREAM OF HSP #4, RIVERTOWN WTP	Y																			
RT-01	BLDG 1 / PUMP ROOM RIVERTOWN WTP	ASBLY-5	HIGH SERVICE PUMP ASSEMBLY #5	METER-17	PRESSURE METER UPSTREAM OF HSP #5, RIVERTOWN WTP	Y																			
GRS-XXXXXX	WELL #1, RIVERTOWN WTP			METER-18	WELL PUMP #1 LEVEL SENSOR AND TRANSMITTER, RIVERTOWN WTP	Y																			
GRS-XXXXXX	WELL #2, RIVERTOWN WTP			METER-19	WELL PUMP #2 LEVEL SENSOR AND TRANSMITTER, RIVERTOWN WTP	Y																			
GRS-XXXXXX	WELL #3, RIVERTOWN WTP			METER-20	WELL PUMP #3 LEVEL SENSOR AND TRANSMITTER, RIVERTOWN WTP	Y																			
GRS-XXXXXX	WELL #1, RIVERTOWN WTP	SCADA-2	SCADA ASSEMBLY, WELL PUMP #1	MOD-1	COMMUNICATION MODULE, WELL #1 RIVERTOWN WTP	Y																			
GRS-XXXXXX	WELL #2, RIVERTOWN WTP	SCADA-3	SCADA ASSEMBLY, WELL PUMP #2	MOD-2	COMMUNICATION MODULE, WELL #2 RIVERTOWN WTP	Y																			
GRS-XXXXXX	WELL #2, RIVERTOWN WTP	SCADA-4	SCADA ASSEMBLY, WELL PUMP #3	MOD-3	COMMUNICATION MODULE, WELL #3 RIVERTOWN WTP	Y																			
RT-02	BLDG 2 / ELECTRICAL ROOM RIVERTOWN WTP	SCADA-1	SCADA ASSEMBLY PLANT	MOD-4	COMMUNICATION MODULE, RIVERTOWN WTP	Y																			
RT-02	BLDG 2 / ELECTRICAL ROOM RIVERTOWN WTP	SCADA-1	SCADA ASSEMBLY PLANT	MOD-5	ETHERNET MODULE, RIVERTOWN WTP	N																			
RT-02	BLDG 2 / ELECTRICAL ROOM RIVERTOWN WTP	SCADA-1	SCADA ASSEMBLY PLANT	MOD-6	INTERFACE MODULE #1, RIVERTOWN WTP	N																			
RT-02	BLDG 2 / ELECTRICAL ROOM RIVERTOWN WTP	SCADA-1	SCADA ASSEMBLY PLANT	MOD-7	TELECOM MODULE, RIVERTOWN WTP	Y																			
RT-01	BLDG 1 / PUMP ROOM RIVERTOWN WTP	ASBLY-1	HIGH SERVICE PUMP ASSEMBLY #1	MOTOR-1	MOTOR, SERVICE PUMP #1, RIVERTOWN WTP	≥ 15 HP Only																			
RT-01	BLDG 1 / PUMP ROOM RIVERTOWN WTP	ASBLY-2	HIGH SERVICE PUMP ASSEMBLY #2	MOTOR-2	MOTOR, SERVICE PUMP #2, RIVERTOWN WTP	≥ 15 HP Only																			
RT-01	BLDG 1 / PUMP ROOM RIVERTOWN WTP	ASBLY-3	HIGH SERVICE PUMP ASSEMBLY #3	MOTOR-3	MOTOR, SERVICE PUMP #3, RIVERTOWN WTP	≥ 15 HP Only																			
RT-01	BLDG 1 / PUMP ROOM RIVERTOWN WTP	ASBLY-4	HIGH SERVICE PUMP ASSEMBLY #4	MOTOR-4	MOTOR, SERVICE PUMP #4, RIVERTOWN WTP	≥ 15 HP Only																			
RT-01	BLDG 1 / PUMP ROOM RIVERTOWN WTP	ASBLY-5	HIGH SERVICE PUMP ASSEMBLY #5	MOTOR-5	MOTOR, SERVICE PUMP #5, RIVERTOWN WTP	≥ 15 HP Only																			
GRS-XXXXXX	WELL #1, RIVERTOWN WTP	ASBLY-9	WELL PUMP #1 ASSEMBLY, RIVERTOWN WTP	MOTOR-6	WELL PUMP #1, MOTOR, RIVERTOWN WTP	≥ 15 HP Only																			
GRS-XXXXXX	WELL #2, RIVERTOWN WTP	ASBLY-10	WELL PUMP #2 ASSEMBLY, RIVERTOWN WTP	MOTOR-7	WELL PUMP #2, MOTOR, RIVERTOWN WTP	≥ 15 HP Only																			
GRS-XXXXXX	WELL #2, RIVERTOWN WTP	ASBLY-11	WELL PUMP #2 ASSEMBLY, RIVERTOWN WTP	MOTOR-8	WELL PUMP #3, MOTOR, RIVERTOWN WTP	≥ 15 HP Only																			
WT-00X	RIVERTOWN WTP	RT-01	BLDG 1 / PUMP ROOM RIVERTOWN WTP	MOTOR-9	MOTOR, EXHAUST FAN 1, PUMP ROOM, RIVERTOWN WTP	Y																			
WT-00X	RIVERTOWN WTP	RT-01	BLDG 1 / PUMP ROOM RIVERTOWN WTP	MOTOR-10	MOTOR, EXHAUST FAN 2, PUMP ROOM, RIVERTOWN WTP	Y																			
WT-00X	RIVERTOWN WTP	RT-01	BLDG 1 / PUMP ROOM RIVERTOWN WTP	MOTOR-11	MOTOR, EXHAUST FAN 3, PUMP ROOM, RIVERTOWN WTP	Y																			
WT-00X	RIVERTOWN WTP	RT-03	BLDG 3 / HYPO CHLORITE RIVERTOWN WTP	MOTOR-12	MOTOR, EXHAUST FAN 1, HYPOCHLORITE, RIVERTOWN WTP	Y																			
WT-00X	RIVERTOWN WTP	RT-03	BLDG 3 / HYPO CHLORITE RIVERTOWN WTP	MOTOR-13	MOTOR, EXHAUST FAN 2, HYPOCHLORITE, RIVERTOWN WTP	Y																			
WT-00X	RIVERTOWN WTP	RT-03	BLDG 3 / HYPO CHLORITE RIVERTOWN WTP	MOTOR-14	MOTOR, EXHAUST FAN 3, HYPOCHLORITE, RIVERTOWN WTP	Y																			

Water Treatment Plant Asset List - RIVERTOWN WTP

Asset Information						Attributes required for all equipment				NAME PLATE DATA								Additional Attributes										
Location	Location Description	Parent Asset ID	Asset Description	Parent or Child Asset ID	Asset Description	Capital Asset (Yes / No)	COMMISSION DATE / SUBSTANTIAL COMPLETION DATE	WARRANTY END DATE	PURCHASE COST	FINAL INSTALLED COST	MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	MANUF PART #	PURCHASE COST	VENDOR	DATE MANUFACTURED	DATE PURCHASED	Length	Material	Width							
GRS-XXXXXX	WELL #1, RIVERTOWN WTP			PAD-1	WELL PUMP #1 PAD, RIVERTOWN WTP	≥ 3 CY Only																						
GRS-XXXXXX	WELL #2, RIVERTOWN WTP			PAD-2	WELL PUMP #2 PAD, RIVERTOWN WTP	≥ 3 CY Only																						
GRS-XXXXXX	WELL #3, RIVERTOWN WTP			PAD-3	WELL PUMP #3 PAD, RIVERTOWN WTP	≥ 3 CY Only																						
Location		Parent Asset ID	Asset Description	Parent or Child Asset ID	Asset Description	CAPITAL (Yes/No)	COMMISSION DATE / SUBSTANTIAL COMPLETION DATE	WARRANTY END DATE	PURCHASE COST	FINAL INSTALLED COST	MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	MANUF PART #	PURCHASE COST	VENDOR	DATE MANUFACTURED	DATE PURCHASED	PIPE SIZE	TYPE	LENGTH	PIPE LINED						
RT-01	BLDG 1 / PUMP ROOM RIVERTOWN WTP	ASBLY-1	HIGH SERVICE PUMP ASSEMBLY #1	PIPE-1	10" PIPING, SERVICE PUMP #1, RIVERTOWN WTP	Y																						
RT-01	BLDG 1 / PUMP ROOM RIVERTOWN WTP	ASBLY-2	HIGH SERVICE PUMP ASSEMBLY #2	PIPE-2	10" PIPING, SERVICE PUMP #2, RIVERTOWN WTP	Y																						
RT-01	BLDG 1 / PUMP ROOM RIVERTOWN WTP	ASBLY-3	HIGH SERVICE PUMP ASSEMBLY #3	PIPE-3	10" PIPING, SERVICE PUMP #3, RIVERTOWN WTP	Y																						
RT-01	BLDG 1 / PUMP ROOM RIVERTOWN WTP	ASBLY-4	HIGH SERVICE PUMP ASSEMBLY #4	PIPE-4	10" PIPING, SERVICE PUMP #4, RIVERTOWN WTP	Y																						
WT-00X	RIVERTOWN WTP			PIPE-5	DRAIN PIPE, 10" AT RESERVOIR #1, RIVERTOWN WTP (24"-V135)	Y																						
WT-00X	RIVERTOWN WTP	ASBLY-12	FINISHED WATER PIPING AND VALVES, RIVER TOWN	PIPE-6	FINISHED WATER YARD PIPING, 36", 42", NORTHWEST WTP	Y																						
LS-	SEWAGE PUMP STATION RIVERTOWN WTP	SPA-1	SEWAGE PUMP ASSEMBLY	PIPE-7	FORCE MAIN PIPING AND VALVES, 2" RIVERTOWN WTP	Y																						
RT-01	BLDG 1 / PUMP ROOM RIVERTOWN WTP	ASBLY-5	HIGH SERVICE PUMPS DISCHARGE MANIFOLD PIPING, RIVERTOWN WTP	PIPE-8	HIGH SERVICE PUMPS DISCHARGE MANIFOLD PIPING, 24", RIVERTOWN WTP	Y																						
RT-03	BLDG 3 / HYPO CHLORITE RIVERTOWN WTP			PIPE-9	HYPO PIPING 1" THRU 2", RIVERTOWN WTP	Y																						
WT-00X	RIVERTOWN WTP			PIPE-11	OVERFLOW PIPE, 24" AT RESERVOIR #1, RIVERTOWN WTP (24"-V135)	Y																						
WT-00X	RIVERTOWN WTP	ASBLY-13	RAW WATER PIPING AND VALVES, RIVER TOWN	PIPE-12	RAW WATER YARD PIPING, 24", RIVERTOWN WTP	Y																						
TANK-	RESERVOIR 1, RIVERTOWN WTP	ASBLY-7	SUMP PUMP ASSEMBLY OVERFLOW RESERVOIR #1, RIVERTOWN WTP	PIPE-13	SUMP PUMP PIPE, RIVERTOWN WTP	Y																						
GRS-XXXXXX	WELL #1, RIVERTOWN WTP	ASBLY-9	WELL PUMP #1 ASSEMBLY, RIVERTOWN WTP	PIPE-14	WELL PUMP #1 COLUMN PIPE, RIVERTOWN WTP	Y																						
GRS-XXXXXX	WELL #1, RIVERTOWN WTP	ASBLY-9	WELL PUMP #1 ASSEMBLY, RIVERTOWN WTP	PIPE-15	WELL PUMP #1 SITE PIPING, 12", RIVERTOWN WTP	Y																						
GRS-XXXXXX	WELL #2, RIVERTOWN WTP	ASBLY-10	WELL PUMP #2 ASSEMBLY, RIVERTOWN WTP	PIPE-17	WELL PUMP #2 COLUMN PIPE, RIVERTOWN WTP	Y																						
GRS-XXXXXX	WELL #2, RIVERTOWN WTP	ASBLY-10	WELL PUMP #2 ASSEMBLY, RIVERTOWN WTP	PIPE-18	WELL PUMP #2 SITE PIPING, 12", RIVERTOWN WTP	Y																						
GRS-XXXXXX	WELL #3, RIVERTOWN WTP	ASBLY-11	WELL PUMP #3 ASSEMBLY, RIVERTOWN WTP	PIPE-17	WELL PUMP #3 COLUMN PIPE, RIVERTOWN WTP	Y																						
GRS-XXXXXX	WELL #3, RIVERTOWN WTP	ASBLY-11	WELL PUMP #3 ASSEMBLY, RIVERTOWN WTP	PIPE-18	WELL PUMP #3 SITE PIPING, 12", RIVERTOWN WTP	Y																						
Location		Parent Asset ID	Asset Description	Parent or Child Asset ID	Asset Description	CAPITAL (Yes/No)	COMMISSION DATE / SUBSTANTIAL COMPLETION DATE	WARRANTY END DATE	PURCHASE COST	FINAL INSTALLED COST	MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	MANUF PART #	PURCHASE COST	VENDOR	DATE MANUFACTURED	DATE PURCHASED	PART NUMBER									
GRS-XXXXXX	WELL #1, RIVERTOWN WTP	SCADA-2	SCADA ASSEMBLY, WELL PUMP #1	PLC-1	PLC, WELL #1 NORTHWEST	Y																						
GRS-XXXXXX	WELL #2, RIVERTOWN WTP	SCADA-3	SCADA ASSEMBLY, WELL PUMP #2	PLC-2	PLC, WELL #2 NORTHWEST	Y																						
GRS-XXXXXX	WELL #3, RIVERTOWN WTP	SCADA-4	SCADA ASSEMBLY, WELL PUMP #3	PLC-3	PLC, WELL #3 NORTHWEST	Y																						
RT-02	BLDG 2 / ELECTRICAL ROOM RIVERTOWN WTP	SCADA-1	SCADA ASSEMBLY PLANT	PLC-3	PLC, RIVERTOWN WTP	Y																						
Location		Parent Asset ID	Asset Description	Parent or Child Asset ID	Asset Description	CAPITAL (Yes/No)	COMMISSION DATE / SUBSTANTIAL COMPLETION DATE	WARRANTY END DATE	PURCHASE COST	FINAL INSTALLED COST	MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	MANUF PART #	PURCHASE COST	VENDOR	DATE MANUFACTURED	DATE PURCHASED										
RT-02	BLDG 2 / ELECTRICAL ROOM RIVERTOWN WTP	SWGR-1	MCC SWGR (SWGR-1)	PM-1	POWER MONITOR #1, RIVERTOWN WTP	Y																						
RT-02	BLDG 2 / ELECTRICAL ROOM RIVERTOWN WTP	SWGR-1	MCC SWGR (SWGR-1)	PM-2	POWER MONITOR #2, RIVERTOWN WTP	Y																						
GRS-XXXXXX	WELL #1, RIVERTOWN WTP	SCADA-2	SCADA ASSEMBLY, WELL PUMP #1	PM-3	POWER MONITOR, WELL #1 RIVERTOWN WTP	Y																						
GRS-XXXXXX	WELL #2, RIVERTOWN WTP	SCADA-3	SCADA ASSEMBLY, WELL PUMP #2	PM-4	POWER MONITOR, WELL #2 RIVERTOWN WTP	Y																						
GRS-XXXXXX	WELL #2, RIVERTOWN WTP	SCADA-4	SCADA ASSEMBLY, WELL PUMP #3	PM-5	POWER MONITOR, WELL #3 RIVERTOWN WTP	Y																						
GRS-XXXXXX	WELL #1, RIVERTOWN WTP	SCADA-2	SCADA ASSEMBLY, WELL PUMP #1	PS-1	POWER SUPPLY, WELL #1 RIVERTOWN WTP	N																						
GRS-XXXXXX	WELL #2, RIVERTOWN WTP	SCADA-3	SCADA ASSEMBLY, WELL PUMP #2	PS-2	POWER SUPPLY, WELL #2 RIVERTOWN WTP	N																						
GRS-XXXXXX	WELL #3, RIVERTOWN WTP	SCADA-4	SCADA ASSEMBLY, WELL PUMP #3	PS-3	POWER SUPPLY, WELL #3 RIVERTOWN WTP	N																						
Location		Parent Asset ID	Asset Description	Parent or Child Asset ID	Asset Description	CAPITAL (Yes/No)	COMMISSION DATE / SUBSTANTIAL COMPLETION DATE	WARRANTY END DATE	PURCHASE COST	FINAL INSTALLED COST	MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	MANUF PART #	PURCHASE COST	VENDOR	DATE MANUFACTURED	DATE PURCHASED	TYPE	HP	RPM	IMPELLER	IMPELLER DIAMETER	SUCTION HEAD	SUCTION SIZE	TDH	GPM	DISCHARGE SIZE
RT-03	BLDG 3 / HYPO CHLORITE RIVERTOWN WTP			PUMP-1	HYPO CHLORINATOR PUMP #1, RIVERTOWN WTP	≥ 15 HP Only																						
RT-03	BLDG 3 / HYPO CHLORITE RIVERTOWN WTP			PUMP-2	HYPO CHLORINATOR PUMP #2, RIVERTOWN WTP	≥ 15 HP Only																						
RT-01	BLDG 1 / PUMP ROOM RIVERTOWN WTP	ASBLY-1	HIGH SERVICE PUMP ASSEMBLY #1	PUMP-3	SERVICE PUMP #1, RIVERTOWN WTP	Y																						
RT-01	BLDG 1 / PUMP ROOM RIVERTOWN WTP	ASBLY-2	HIGH SERVICE PUMP ASSEMBLY #2	PUMP-4	SERVICE PUMP #2, RIVERTOWN WTP	Y																						
RT-01	BLDG 1 / PUMP ROOM RIVERTOWN WTP	ASBLY-3	HIGH SERVICE PUMP ASSEMBLY #3	PUMP-5	SERVICE PUMP #3, RIVERTOWN WTP	Y																						
RT-01	BLDG 1 / PUMP ROOM RIVERTOWN WTP	ASBLY-4	HIGH SERVICE PUMP ASSEMBLY #4	PUMP-6	SERVICE PUMP #4, RIVERTOWN WTP	Y																						
RT-01	BLDG 1 / PUMP ROOM RIVERTOWN WTP	ASBLY-5	HIGH SERVICE PUMP ASSEMBLY #4	PUMP-7	SERVICE PUMP #5, RIVERTOWN WTP	Y																						
LS-	SEWAGE PUMP STATION RIVERTOWN WTP	SPA-1	SEWAGE PUMP ASSEMBLY	PUMP-8	SEWAGE PUMP #1, GRINDER, RIVERTOWN WTP	≥ 7.5 HP Only																						
LS-	SEWAGE PUMP STATION RIVERTOWN WTP	SPA-1	SEWAGE PUMP ASSEMBLY	PUMP-9	SEWAGE PUMP #1, GRINDER, RIVERTOWN WTP	≥ 7.5 HP Only																						
GRS-XXXXXX	WELL #1, RIVERTOWN WTP	ASBLY-8	WELL PUMP #1 ASSEMBLY, RIVERTOWN WTP	PUMP-10	WELL PUMP #1, PUMP, RIVERTOWN WTP	Y																						
GRS-XXXXXX	WELL #2, RIVERTOWN WTP	ASBLY-9	WELL PUMP #2 ASSEMBLY, RIVERTOWN WTP	PUMP-11	WELL PUMP #2, PUMP, RIVERTOWN WTP	Y																						
GRS-XXXXXX	WELL #3, RIVERTOWN WTP	ASBLY-10	WELL PUMP #3 ASSEMBLY, RIVERTOWN WTP	PUMP-12	WELL PUMP #3, PUMP, RIVERTOWN WTP	Y																						
RT-03	BLDG 3 / HYPO CHLORITE RIVERTOWN WTP			PUMP-13	SUMP PUMP, HYPOCHLORITE, RIVERTOWN WTP	Y																						
Location	Location Description	Parent Asset ID	Parent Description	Parent or Child Asset ID	Asset Description	CAPITAL (Yes/No)	COMMISSION DATE / SUBSTANTIAL COMPLETION DATE	WARRANTY END DATE	PURCHASE COST	FINAL INSTALLED COST	MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	MANUF PART #	PURCHASE COST	VENDOR	DATE MANUFACTURED	DATE PURCHASED										
WT-00X	RIVERTOWN WTP	RT-01	BLDG 1 / PUMP ROOM RIVERTOWN WTP	SAMPLER-01	EFFLUENT SAMPLER	N																						
Location	Location Description	Parent Asset ID	Asset Description	Parent or Child Asset ID	Asset Description	Capital Asset (Yes / No)	COMMISSION DATE / SUBSTANTIAL COMPLETION DATE	WARRANTY END DATE	PURCHASE COST	FINAL INSTALLED COST	MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	MANUF PART #	PURCHASE COST	VENDOR	DATE MANUFACTURED	DATE PURCHASED	Diameter	Length	Material							
GRS-XXXXXX	WELL #1, RIVERTOWN WTP	ASBLY-8	WELL PUMP #1 ASSEMBLY, RIVERTOWN WTP	SHAFT-1	WELL PUMP #1, LINE SHAFT, RIVERTOWN WTP	N																						
GRS-XXXXXX	WELL #2, RIVERTOWN WTP	ASBLY-9	WELL PUMP #2 ASSEMBLY, RIVERTOWN WTP	SHAFT-2	WELL PUMP #2, LINE SHAFT, RIVERTOWN WTP	N																						
GRS-XXXXXX	WELL #3, RIVERTOWN WTP	ASBLY-10	WELL PUMP #3 ASSEMBLY, RIVERTOWN WTP	SHAFT-3	WELL PUMP #3, LINE SHAFT, RIVERTOWN WTP	N																						
Location		Parent Asset ID	Asset Description	Parent or Child Asset ID	Asset Description	CAPITAL (Yes/No)	COMMISSION DATE / SUBSTANTIAL COMPLETION DATE	WARRANTY END DATE	PURCHASE COST	FINAL INSTALLED COST	MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	MANUF PART #	PURCHASE COST	VENDOR	DATE MANUFACTURED	DATE PURCHASED	VOLTAGE	CONTINUOUS AMP RATING	STARTER SIZE	STARTER TYPE						
RT-02	BLDG 2 / ELECTRICAL ROOM RIVERTOWN WTP	MCC-1	MCC-1 (MCC-1)	STRTR-1	WELL PUMP #1, STARTER, RIVERTOWN WTP	Y																						
RT-02	BLDG 2 / ELECTRICAL ROOM RIVERTOWN WTP	MCC-1																										

Water Treatment Plant Asset List - RIVERTOWN WTP

Asset Information						Attributes required for all equipment				NAME PLATE DATA										Additional Attributes									
Location		Parent Asset ID	Asset Description	Parent or Child Asset ID	Asset Description	CAPITAL (Yes/No)	COMMISSION DATE / SUBSTANTIAL COMPLETION DATE	WARRANTY END DATE	PURCHASE COST	FINAL INSTALLED COST	MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	MANUF PART #	PURCHASE COST	VENDOR	DATE MANUFACTURED	DATE PURCHASED	VOLTAGE	CONTINUOUS AMP RATING	PHASE	TYPE							
RT-04	BLDG 4 / GENERATOR RIVERTOWN WTP	GEN-1	GENERATOR - RIVERTOWN WTP	SWITCH-1	AUTO TRANSFER SWITCH, MAIN GENERATOR, RIVERTOWN WTP	Y																							
Location		Parent Asset ID	Asset Description	Parent or Child Asset ID	Asset Description	CAPITAL (Yes/No)	COMMISSION DATE / SUBSTANTIAL COMPLETION DATE	WARRANTY END DATE	PURCHASE COST	FINAL INSTALLED COST	MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	MANUF PART #	PURCHASE COST	VENDOR	DATE MANUFACTURED	DATE PURCHASED	TANK TYPE	TANK CAPACITY	MATERIAL	PRESSURE RATING							
WT-00X	RIVERTOWN WTP			TANK-1	RESERVOIR 1, RIVERTOWN WTP	Y																							
NW-04	BLDG 4 / GENERATOR RIVERTOWN WTP	GEN-1	GENERATOR, RIVERTOWN WTP	TANK-2	FUEL TANK, MAIN GENERATOR, RIVERTOWN WTP	Y																							
RT-03	BLDG 3 / HYPO CHLORITE RIVERTOWN WTP				HYPO CHLORITE TANK #1, BUILDING 3	Y																							
RT-03	BLDG 3 / HYPO CHLORITE RIVERTOWN WTP			TANK-4	HYPO CHLORITE TANK #2, BUILDING 3	Y																							
Location	Location Description	Parent Asset ID	Asset Description	Parent or Child Asset ID	Asset Description	Capital Asset (Yes / No)	COMMISSION DATE / SUBSTANTIAL COMPLETION DATE	WARRANTY END DATE	PURCHASE COST	FINAL INSTALLED COST	MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	MANUF PART #	PURCHASE COST	VENDOR	DATE MANUFACTURED	DATE PURCHASED	Cooling	HV Compant/ Conservator Oil	Impedance	LTC Manufacturer	LTC Oil	Main Tank Oil	MVA Base	MVA Secondary	MVA Third	Primary OP Voltage	Radiator Oil
RT-02	BLDG 2 / ELECTRICAL ROOM RIVERTOWN WTP			TRANSFORMER-1	MAIN TRANSFORMER, RIVERTOWN WTP	Y																							
GRS-XXXXXX	WELL #1, RIVERTOWN WTP			TRANSFORMER-2	WELL PUMP #1, TRANSFORMER, RIVERTOWN WTP	Y																							
GRS-XXXXXX	WELL #2, RIVERTOWN WTP			TRANSFORMER-3	WELL PUMP #2, TRANSFORMER, RIVERTOWN WTP	Y																							
GRS-XXXXXX	WELL #3, RIVERTOWN WTP			TRANSFORMER-4	WELL PUMP #3, TRANSFORMER, RIVERTOWN WTP	Y																							
Location		Parent Asset ID	Asset Description	Parent or Child Asset ID	Asset Description	CAPITAL (Yes / No)	COMMISSION DATE / SUBSTANTIAL COMPLETION DATE	WARRANTY END DATE	PURCHASE COST	FINAL INSTALLED COST	MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	MANUF PART #	PURCHASE COST	VENDOR	DATE MANUFACTURED	DATE PURCHASED	VALVE SIZE	VALVE TYPE	OPERATOR TYPE	BODY MATERIAL							
RT-01	BLDG 1 / PUMP ROOM RIVERTOWN WTP	ASBLY-1	HIGH SERVICE PUMP ASSEMBLY #1	VALVE-1	CHECK VALVE 10", SERVICE PUMP #1, RIVERTOWN WTP	Y																							
RT-01	BLDG 1 / PUMP ROOM RIVERTOWN WTP	ASBLY-2	HIGH SERVICE PUMP ASSEMBLY #2	VALVE-2	CHECK VALVE 10", SERVICE PUMP #2, RIVERTOWN WTP	Y																							
RT-01	BLDG 1 / PUMP ROOM RIVERTOWN WTP	ASBLY-3	HIGH SERVICE PUMP ASSEMBLY #3	VALVE-3	CHECK VALVE 10", SERVICE PUMP #3, RIVERTOWN WTP (16"-V608)	Y																							
RT-01	BLDG 1 / PUMP ROOM RIVERTOWN WTP	ASBLY-4	HIGH SERVICE PUMP ASSEMBLY #4	VALVE-4	CHECK VALVE 6", SERVICE PUMP #4, RIVERTOWN WTP	Y																							
RT-01	BLDG 1 / PUMP ROOM RIVERTOWN WTP	ASBLY-5	HIGH SERVICE PUMP ASSEMBLY #5	VALVE-5	CHECK VALVE 6", SERVICE PUMP #5, RIVERTOWN WTP	Y																							
RT-01	BLDG 1 / PUMP ROOM RIVERTOWN WTP	ASBLY-1	HIGH SERVICE PUMP ASSEMBLY #1	VALVE-6	DISCHARGE VALVE 12", SERVICE PUMP #1 RIVERTOWN WTP	Y																							
RT-01	BLDG 1 / PUMP ROOM RIVERTOWN WTP	ASBLY-2	HIGH SERVICE PUMP ASSEMBLY #2	VALVE-7	DISCHARGE VALVE 12", SERVICE PUMP #2 RIVERTOWN WTP	Y																							
RT-01	BLDG 1 / PUMP ROOM RIVERTOWN WTP	ASBLY-3	HIGH SERVICE PUMP ASSEMBLY #3	VALVE-8	DISCHARGE VALVE 12", SERVICE PUMP #3 RIVERTOWN WTP	Y																							
RT-01	BLDG 1 / PUMP ROOM RIVERTOWN WTP	ASBLY-4	HIGH SERVICE PUMP ASSEMBLY #4	VALVE-9	DISCHARGE VALVE 12", SERVICE PUMP #4 RIVERTOWN WTP	Y																							
RT-01	BLDG 1 / PUMP ROOM RIVERTOWN WTP	ASBLY-5	HIGH SERVICE PUMP ASSEMBLY #5	VALVE-10	DISCHARGE VALVE 12", SERVICE PUMP #5 RIVERTOWN WTP	Y																							
RT-01	BLDG 1 / PUMP ROOM RIVERTOWN WTP	ASBLY-1	HIGH SERVICE PUMP ASSEMBLY #1	VALVE-11	SUCTION VALVE 10", SERVICE PUMP #1 RIVERTOWN WTP	Y																							
RT-01	BLDG 1 / PUMP ROOM RIVERTOWN WTP	ASBLY-2	HIGH SERVICE PUMP ASSEMBLY #2	VALVE-12	SUCTION VALVE 10", SERVICE PUMP #2 RIVERTOWN WTP	Y																							
RT-01	BLDG 1 / PUMP ROOM RIVERTOWN WTP	ASBLY-3	HIGH SERVICE PUMP ASSEMBLY #3	VALVE-13	SUCTION VALVE 10", SERVICE PUMP #3 RIVERTOWN WTP	Y																							
RT-01	BLDG 1 / PUMP ROOM RIVERTOWN WTP	ASBLY-4	HIGH SERVICE PUMP ASSEMBLY #4	VALVE-14	SUCTION VALVE 10", SERVICE PUMP #4 RIVERTOWN WTP	Y																							
RT-01	BLDG 1 / PUMP ROOM RIVERTOWN WTP	ASBLY-5	HIGH SERVICE PUMP ASSEMBLY #5	VALVE-15	SUCTION VALVE 10", SERVICE PUMP #5 RIVERTOWN WTP	Y																							
GRS-XXXXXX	WELL #1, RIVERTOWN WTP	ASBLY-8	WELL PUMP #1 ASSEMBLY, RIVERTOWN WTP	VALVE-16	CHECK VALVE 12", WELL PUMP #1, RIVERTOWN WTP	Y																							
GRS-XXXXXX	WELL #2, RIVERTOWN WTP	ASBLY-9	WELL PUMP #2 ASSEMBLY, RIVERTOWN WTP	VALVE-17	CHECK VALVE 12", WELL PUMP #2, RIVERTOWN WTP	Y																							
GRS-XXXXXX	WELL #3, RIVERTOWN WTP	ASBLY-10	WELL PUMP #3 ASSEMBLY, RIVERTOWN WTP	VALVE-18	CHECK VALVE 12", WELL PUMP #3, RIVERTOWN WTP	Y																							
GRS-XXXXXX	WELL #1, RIVERTOWN WTP	ASBLY-8	WELL PUMP #1 ASSEMBLY, RIVERTOWN WTP	VALVE-19	BUTTERFLY VALVE 12", DOWNSTREAM OF WELL PUMP #1, METER, RIVERTOWN WTP	Y																							
GRS-XXXXXX	WELL #2, RIVERTOWN WTP	ASBLY-9	WELL PUMP #2 ASSEMBLY, RIVERTOWN WTP	VALVE-20	BUTTERFLY VALVE 12", DOWNSTREAM OF WELL PUMP #2, METER, RIVERTOWN WTP	Y																							
GRS-XXXXXX	WELL #3, RIVERTOWN WTP	ASBLY-10	WELL PUMP #3 ASSEMBLY, RIVERTOWN WTP	VALVE-21	BUTTERFLY VALVE 12", DOWNSTREAM OF WELL PUMP #3, METER, RIVERTOWN WTP	Y																							
GRS-XXXXXX	WELL #1, RIVERTOWN WTP	ASBLY-8	WELL PUMP #1 ASSEMBLY, RIVERTOWN WTP	VALVE-22	BUTTERFLY VALVE 12", UPSTREAM OF WELL PUMP #1, METER, RIVERTOWN WTP	Y																							
GRS-XXXXXX	WELL #2, RIVERTOWN WTP	ASBLY-9	WELL PUMP #2 ASSEMBLY, RIVERTOWN WTP	VALVE-23	BUTTERFLY VALVE 12", UPSTREAM OF WELL PUMP #2, METER, RIVERTOWN WTP	Y																							
GRS-XXXXXX	WELL #3, RIVERTOWN WTP	ASBLY-10	WELL PUMP #3 ASSEMBLY, RIVERTOWN WTP	VALVE-24	BUTTERFLY VALVE 12", UPSTREAM OF WELL PUMP #3, METER, RIVERTOWN WTP	Y																							
GRS-XXXXXX	WELL #1, RIVERTOWN WTP	ASBLY-8	WELL PUMP #1 ASSEMBLY, RIVERTOWN WTP	VALVE-25	GATE VALVE 12", WELL PUMP #1 EFFLUENT VALVE, RIVERTOWN WTP	Y																							
GRS-XXXXXX	WELL #2, RIVERTOWN WTP	ASBLY-9	WELL PUMP #2 ASSEMBLY, RIVERTOWN WTP	VALVE-26	GATE VALVE 12", WELL PUMP #2 EFFLUENT VALVE, RIVERTOWN WTP	Y																							
GRS-XXXXXX	WELL #3, RIVERTOWN WTP	ASBLY-10	WELL PUMP #3 ASSEMBLY, RIVERTOWN WTP	VALVE-27	GATE VALVE 12", WELL PUMP #3 EFFLUENT VALVE, RIVERTOWN WTP	Y																							
WT-00X	RIVERTOWN WTP	ASBLY-13	RAW WATER PIPING AND VALVES, RIVER TOWN	VALVE-28	GATE VALVE 20", PLANT INFLUENT VALVE, RIVERTOWN WTP	Y																							
WT-00X	RIVERTOWN WTP	ASBLY-13	RAW WATER PIPING AND VALVES, RIVER TOWN	VALVE-29	GATE VALVE 20", RESERVOIR BYPASS, RIVERTOWN WTP	Y																							
WT-00X	RIVERTOWN WTP	ASBLY-13	RAW WATER PIPING AND VALVES, RIVER TOWN	VALVE-30	GATE VALVE 20", FOR FUTURE EQUIPMENT, RIVERTOWN WTP	Y																							
WT-00X	RIVERTOWN WTP	ASBLY-13	RAW WATER PIPING AND VALVES, RIVER TOWN	VALVE-31	GATE VALVE 20", FOR FUTURE RESERVOIR #2, RIVERTOWN WTP	Y																							
WT-00X	RIVERTOWN WTP	TANK-1	RESERVOIR 1, RIVERTOWN WTP	VALVE-32	INFLUENT VALVE 20", RESERVOIR #1, RIVERTOWN WTP	Y																							
WT-00X	RIVERTOWN WTP	TANK-1	RESERVOIR 1, RIVERTOWN WTP	VALVE-33	GATE VALVE 24", RESERVOIR #1 TO RESERVOIR #2, RIVERTOWN WTP	Y																							
WT-00X	RIVERTOWN WTP	ASBLY-13	RAW WATER PIPING AND VALVES, RIVER TOWN	VALVE-34	DRAIN VALVE 10", FUTURE RESERVOIR #2, RIVERTOWN WTP	Y																							
WT-00X	RIVERTOWN WTP	TANK-1	RESERVOIR 1, RIVERTOWN WTP	VALVE-35	DRAIN VALVE 10", RESERVOIR #1, RIVERTOWN WTP	Y																							
WT-00X	RIVERTOWN WTP	ASBLY-13	RAW WATER PIPING AND VALVES, RIVER TOWN	VALVE-36	OVERFLOW VALVE 16", FUTURE RESERVOIR #2, RIVERTOWN WTP	Y																							
WT-00X	RIVERTOWN WTP	TANK-1	RESERVOIR 1, RIVERTOWN WTP	VALVE-37	EFFLUENT VALVE 24", RESERVOIR #1, RIVERTOWN WTP	Y																							
WT-00X	RIVERTOWN WTP	ASBLY-13	RAW WATER PIPING AND VALVES, RIVER TOWN	VALVE-38	EFFLUENT VALVE 24", FUTURE RESERVOIR #2, RIVERTOWN WTP	Y																							
WT-00X	RIVERTOWN WTP	ASBLY-13	RAW WATER PIPING AND VALVES, RIVER TOWN	VALVE-39	GATE VALVE 24", RESERVOIR BYPASS, RIVERTOWN WTP	Y																							
WT-00X	RIVERTOWN WTP	ASBLY-13	RAW WATER PIPING AND VALVES, RIVER TOWN	VALVE-40	INFLUENT VALVE 24", SERVICE PUMPS, RIVERTOWN WTP	Y																							
WT-00X	RIVERTOWN WTP	ASBLY-6	FLOW METER ASSEMBLY, RIVERTOWN WTP	VALVE-41	INFLUENT VALVE																								



## SECTION 017825 - ASSET MANAGEMENT DATA

### PART 1 GENERAL

#### 1.01 SCOPE OF WORK

- A. This Section includes procedural requirements for compiling and submitting asset management data required to complete the project. In addition to the requirements specified herein, Contractor asset management data shall be as required in JEA Water and Wastewater Standards – Section 445.

#### 1.02 RELATED REQUIREMENTS

- A. Application for Payment is included in Section 012900.
- B. Standard General Conditions of the Construction Contract are included in the Front-End Documents provided by Owner.

#### 1.03 ENTERPRISE ASSET MANAGEMENT DATA (EAM WORKSHEET)

- A. Equipment Attribute Information:
  - 1. Equipment Attribute Worksheets as presented at the end of this Specification shall be provided for all equipment meeting the asset definition as follows:
    - a. Maintenance is recommended.
    - b. Assets have a value greater than \$1,000.00.
    - c. Assets are complete and usable, and perform a distinct function independently.
  - 2. This asset definition is intended to give a general indication of which equipment must be included in the Equipment Attribute Worksheets. The Engineer will provide the specific list of equipment that the Contractor must provide information for:
    - a. The information requirements are shown in detail in the table at the end of this Specification. The data requirements include nameplate data, manufacturer and supplier information, information specific to the type of equipment, and recommended preventative maintenance activities.
    - b. An electronic copy of the Equipment Attribute Worksheets must be delivered in Excel format and submitted to the Engineer on CD-ROM at closeout. It is not necessary to submit printed copies of the Equipment Attribute Worksheets.

#### 1.04 SCHEDULE OF ASSET VALUES

- A. The asset table is included in this Division. It includes the assets to be accounted for in the Schedule of Asset Values.

- B. For each asset listed, provide a constructed cost which will include an allocation of construction activities including but not limited to, demolition, sitework, specialties, materials, labor, general conditions, and overhead and profit associated with the construction of the asset.
- C. The combined value of the assets will equal the bid price for the project and will require adjustments as necessary due to change orders. The schedule of asset values will be updated on a monthly basis and will be included in the monthly pay request application for approval.
- D. The Owner reserves the right to edit this list prior to the first pay request application and may add up to 10 percent more items than have been identified in the list.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 SUBMITTAL SCHEDULE

- A. The Engineer will review the EAM data and SCHEDULE OF ASSET VALUES data for conformance with the requirements listed on each worksheet.
- B. The EAM worksheet and SCHEDULE OF ASSET VALUES worksheets will be updated on a monthly basis and submitted to the Engineer for review with the monthly payment application.

END OF SECTION 017825

## SECTION 017839 - PROJECT RECORD DOCUMENTS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes administrative and procedural requirements for Project Record Documents, including the following:
  - 1. Record Drawings.
  - 2. Record Product Data.
- B. Related Requirements:
  - 1. Section 012900 "Payment Procedures" for maintaining and exhibiting project record documents as a prerequisite for progress payments.
  - 2. Section 017300 "Execution" for final property survey.
  - 3. Section 017700 "Closeout Procedures" for general closeout procedures.
  - 4. Section 017823 "Operation and Maintenance Data" for operation and maintenance manual requirements.

#### 1.3 CLOSEOUT SUBMITTALS

- A. Record Drawings: Comply with the following:
  - 1. Number of Copies: Submit one set(s) of marked-up record prints.
- B. Record Product Data: Submit annotated PDF electronic files and directories of each submittal.
  - 1. Where record Product Data are required as part of operation and maintenance manuals, submit duplicate marked-up Product Data as a component of manual.

#### 1.4 RECORD DRAWINGS

- A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.
  - 1. Preparation: Mark record prints to show the actual installation, where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.

- a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
    - b. Accurately record information in an acceptable drawing technique.
    - c. Record data as soon as possible after obtaining it.
    - d. Record and check the markup before enclosing concealed installations.
    - e. Cross-reference record prints to corresponding photographic documentation.
  2. Content: Types of items requiring marking include, but are not limited to, the following:
    - a. Dimensional changes to Drawings.
    - b. Revisions to details shown on Drawings.
    - c. Depths of foundations.
    - d. Locations and depths of underground utilities.
    - e. Revisions to routing of piping and conduits.
    - f. Revisions to electrical circuitry.
    - g. Actual equipment locations.
    - h. Duct size and routing.
    - i. Locations of concealed internal utilities.
    - j. Changes made by Change Order.
    - k. Changes made following Engineer's written orders.
    - l. Details not on the original Contract Drawings.
    - m. Field records for variable and concealed conditions.
    - n. Record information on the Work that is shown only schematically.
  3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
  4. Mark record prints with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
  5. Mark important additional information that was either shown schematically or omitted from original Drawings.
  6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
- B. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked-up record prints with Engineer. When authorized, prepare a full set of corrected digital data files of the Contract Drawings, as follows:
1. Format: Annotated PDF electronic file.
  2. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.
  3. Refer instances of uncertainty to Engineer for resolution.
  4. Engineer will furnish Contractor with one set of digital data files of the Contract Drawings for use in recording information.
    - a. See Section 013100 "Project Management and Coordination" for requirements related to use of Engineer's digital data files.
    - b. Engineer will provide data file layer information. Record markups in separate layers.

- C. Format: Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
1. Record Prints: Organize record prints into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
  2. Format: Annotated PDF electronic file.
  3. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.
  4. Identification: As follows:
    - a. Project name.
    - b. Date.
    - c. Designation "PROJECT RECORD DRAWINGS."
    - d. Name of Engineer.
    - e. Name of Contractor.

#### 1.5 RECORD PRODUCT DATA

- A. Recording: Maintain one copy of each submittal during the construction period for Project Record Document purposes. Post changes and revisions to Project Record Documents as they occur; do not wait until end of Project.
- B. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.
1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
  2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
  3. Note related Change Orders and Record Drawings where applicable.
- C. Format: Submit Record Product Data as annotated PDF electronic file.
1. Include Record Product Data directory organized by Specification Section number and title, electronically linked to each item of Record Product Data.

#### 1.6 MAINTENANCE OF RECORD DOCUMENTS

- A. Maintenance of Record Documents: Store Record Documents in the field office apart from the Contract Documents used for construction. Do not use Project Record Documents for construction purposes. Maintain Record Documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to Project Record Documents for Engineer's reference during normal working hours. As a prerequisite for monthly progress payments, exhibit the updated record documents for review by Owner and Engineer for accuracy and completeness.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 017839

## SECTION 017900 - DEMONSTRATION AND TRAINING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:
  - 1. Instruction in operation and maintenance of systems, subsystems, and equipment.
  - 2. Demonstration and training video recordings.
  - 3. The following specified equipment or items are required to comply with this section,
    - a. All major equipment, including, pumps, motors, VFDs, chemical storage and feed equipment, electrical and instrumentation.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Instruction Program: Submit outline of instructional program for demonstration and training, including a list of training modules and a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.
- B. Qualification Data: For instructor.
- C. Attendance Record: For each training module, submit list of participants and length of instruction time.
- D. Evaluations: For each participant and for each training module, submit results and documentation of performance-based test.

#### 1.4 QUALITY ASSURANCE

- A. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Section 014000 "Quality Requirements," experienced in operation and maintenance procedures and training.

#### 1.5 COORDINATION

- A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations and to ensure availability of Owner's personnel.

- B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.
- C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data have been reviewed and approved by Engineer.

## 1.6 INSTRUCTION PROGRAM

- A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.
- B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:
  - 1. Basis of System Design, Operational Requirements, and Criteria: Include the following:
    - a. System, subsystem, and equipment descriptions.
    - b. Performance and design criteria if Contractor is delegated design responsibility.
    - c. Operating standards.
    - d. Regulatory requirements.
    - e. Equipment function.
    - f. Operating characteristics.
    - g. Limiting conditions.
    - h. Performance curves.
  - 2. Documentation: Review the following items in detail:
    - a. Emergency manuals.
    - b. Systems and equipment operation manuals.
    - c. Systems and equipment maintenance manuals.
    - d. Product maintenance manuals.
    - e. Project Record Documents.
    - f. Identification systems.
    - g. Warranties and bonds.
    - h. Maintenance service agreements and similar continuing commitments.
  - 3. Emergencies: Include the following, as applicable:
    - a. Instructions on meaning of warnings, trouble indications, and error messages.
    - b. Instructions on stopping.
    - c. Shutdown instructions for each type of emergency.
    - d. Operating instructions for conditions outside of normal operating limits.
    - e. Sequences for electric or electronic systems.
    - f. Special operating instructions and procedures.



4. Operations: Include the following, as applicable:
  - a. Startup procedures.
  - b. Equipment or system break-in procedures.
  - c. Routine and normal operating instructions.
  - d. Regulation and control procedures.
  - e. Control sequences.
  - f. Safety procedures.
  - g. Instructions on stopping.
  - h. Normal shutdown instructions.
  - i. Operating procedures for emergencies.
  - j. Operating procedures for system, subsystem, or equipment failure.
  - k. Seasonal and weekend operating instructions.
  - l. Required sequences for electric or electronic systems.
  - m. Special operating instructions and procedures.
5. Adjustments: Include the following:
  - a. Alignments.
  - b. Checking adjustments.
  - c. Noise and vibration adjustments.
  - d. Economy and efficiency adjustments.
6. Troubleshooting: Include the following:
  - a. Diagnostic instructions.
  - b. Test and inspection procedures.
7. Maintenance: Include the following:
  - a. Inspection procedures.
  - b. Types of cleaning agents to be used and methods of cleaning.
  - c. List of cleaning agents and methods of cleaning detrimental to product.
  - d. Procedures for routine cleaning.
  - e. Procedures for preventive maintenance.
  - f. Procedures for routine maintenance.
  - g. Instruction on use of special tools.
8. Repairs: Include the following:
  - a. Diagnosis instructions.
  - b. Repair instructions.
  - c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
  - d. Instructions for identifying parts and components.
  - e. Review of spare parts needed for operation and maintenance.

1.7 PREPARATION

- A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Section 017823 "Operation and Maintenance Data."
- B. Set up instructional equipment at instruction location.

1.8 INSTRUCTION

- A. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
  - 1. Engineer will furnish an instructor to describe basis of system design, operational requirements, criteria, and regulatory requirements.
- B. Scheduling: Provide instruction at mutually agreed-on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.
  - 1. Schedule training with Owner, through Engineer, with at least seven days' advance notice.
- C. Training Location and Reference Material: Conduct training on-site in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.
- D. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of a demonstration performance-based test.
- E. Cleanup: Collect used and leftover educational materials and give to Owner. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 017900

## SECTION 018819 - TIGHTNESS TESTING PERFORMANCE REQUIREMENTS

### 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. Tightness testing of cast-in-place reinforced concrete liquid retaining structures.

- B. Related Requirements:

- 1. Section 031500 "Concrete Joints and Accessories" for joints in concrete structures.
  - 2. Section 033000 "Cast-In-Place Concrete" for concrete related construction.
  - 3. Section 400551 "Common Requirements for Process Valves" for valves and valve actuators.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Submit in accordance with Section 013300:

- 1. Action Plan: Submit a detailed plan and schedule for each structure, which shows method of filling, testing and disposal of water.
  - 2. Repair Procedures: Submit for acceptance the proposed repair methods, materials, and modifications needed, if structure does not meet tightness testing.
  - 3. Retain "Test Reports" Paragraph below for test reports that are Contractor's responsibility.
  - 4. Test Reports: Submit a completed Tightness Test Report, Figure A, appended at the end of this Section of each test for each structure.

#### 1.4 FIELD CONDITIONS

- A. Coordinate timing and procedures for obtaining water for testing, structure testing, and water disposal with the Engineer and Owner a minimum of 30 days in advance of actual testing.

- B. Water Source:

- 1. Contractor may use water for testing from Owner's plant water system. Make arrangements with Owner through the Engineer. Obtain water at a time, flow rate, and location approved by Owner.

2. Provide labor, materials, equipment, incidentals, and power required to convey water to the structure.
- C. Water Disposal:
1. Dispose of test water in an approved manner. Do not dispose by discharging onto the ground surface of public or private land.
  2. Provide labor, materials, equipment, incidentals, and power required to convey water from the structure.
- D. Environmental Conditions: Do not schedule test measurements for a period when the weather forecast indicates a substantial change in weather patterns.

## PART 2 - PRODUCTS (NOT USED)

## PART 3 - EXECUTION

### 3.1 GENERAL

- A. Perform tightness testing of cast-in-place reinforced concrete liquid retaining structures conforming to ACI 350.1 and as specified in this Section.
- B. Perform tightness tests prior to waterproofing and damp proofing and prior to placing backfill around structures in order to permit observation and detection of leakage points.
- C. Individually test each cell of multi-cell tanks.
- D. Multi-cell tanks may be tested as a single unit where indicated.

### 3.2 PREPARATION

- A. Remove dirt, mud, and debris from structures prior to initiating tightness tests. Flush floor and sumps with water to provide a clean surface that is ready for testing.
- B. Prior to testing, temporarily seal or bulkhead inlet and outlet pipes not required to be operational for testing procedures.
- C. Confirm that valves are completely closed. Repair and reset seals if necessary. Test valves for leakage in accordance with requirements of respective Sections as part of the preparation for final tightness testing under this Section.
- D. Estimates of valve leakage will not be allowed as adjustments to the measured structure leakage.

### 3.3 EXAMINATION

- A. Examine structures to be tested for potential leakage paths including cracks, voids, honeycombs, and unsealed joints. Repair such paths as directed by the Engineer, without additional compensation.
- B. Proceed with testing only after unsatisfactory conditions have been corrected.

### 3.4 TESTING PROCEDURES

#### A. Testing Conditions:

- 1. Do not begin filling of reinforced concrete structure until concrete elements of the structure have attained specified design strength, but not less than 14 days after placement of all concrete elements.
- 2. Fill reinforced concrete structure not exceeding a rate of 4 feet in 1 hour.
- 3. To minimize water absorption by concrete during testing, fill reinforced concrete structure to maximum operating water surface level and maintain water at that level for at least 3 days, prior to beginning tightness tests. Observe the exterior surfaces of the structure in both the early mornings and late afternoons during 3 days prior to tightness testing. Note any water observed on the structure exterior surfaces.
- 4. Test only a single structure at a time. Concurrent testing of contiguous or adjacent structures will not be allowed.

#### B. Testing Procedures:

- 1. Test Duration: Test period shall be at least the time required to lower the water surface 3/8 inch, assuming a loss of water at the maximum allowable rate. The test period need not be longer than 5 days.
- 2. Measure water surface elevations at 24-hour intervals. The vertical distance to the water surface shall be measured to within 1/16 inch from a fixed point on the structure above the water surface. Measure water surface elevations at the same four locations, 90 degrees apart. Record water temperature 18 inches below water surface when taking the first and last sets of measurements.
  - a. Use methods to determine amount of precipitation or evaporation as approved by the Engineer.
- 3. Compute percentage of water volume loss based on measured change in water surface elevation, area of the horizontal water surface, initial water volume, and correction for precipitation or evaporation where applicable.

#### C. Reports: Prepare and submit as referenced in this Section.

### 3.5 ACCEPTANCE

- A. Following conditions shall be considered as NOT meeting the criteria for acceptance, regardless of actual loss of water volume from the structure:

1. Groundwater seeping or flowing into the structure through floors, walls, or wall-floor joints.
  2. Structures which exhibit seeping or flowing water from joints, cracks, voids, honeycombs, or from beneath the foundation.
  3. Damp spots on concrete surfaces.
  4. Moisture can be deposited on a dry hand held against the exterior surface of the structure.
- B. Tightness of concrete tanks and structures will be considered acceptable when the conditions of previous Paragraph A are not present and when loss of water volume does not exceed 0.05 percent of the starting volume per day.

### 3.6 REPAIRS AND RETESTING

- A. Structures failing the tightness test and not exhibiting visible leakage may be retested after an additional stabilization period of 7 days. Structures failing this second test shall be repaired at no additional cost to the Owner prior to further testing.
- B. Restart test when test measurements become unreliable due to unusual precipitation or other external factors.
- C. Repaired structures shall be retested. Repairs and retesting shall be conducted without additional compensation and shall be continued and repeated until the structure meets all requirements specified herein.

### 3.7 SCHEDULE

- A. Test following structures for tightness:
1. Tank types include:
    - a. Ground Storage Tank No. 1.

END OF SECTION 018819

**FIGURE A**  
**TIGHTNESS TEST REPORT**

PROJECT \_\_\_\_\_ SUBMITTED BY \_\_\_\_\_  
STRUCTURE \* \_\_\_\_\_ TEST DATES \_\_\_\_\_

Allowable loss of water volume \_\_\_\_\_ percent in 24 hours

Measured loss of water volume \_\_\_\_\_ percent in 24 hours

**TEST READINGS**

Water Temperature at Start \_\_\_\_\_ degrees F

Water Temperature at End \_\_\_\_\_ degrees F

Operating Water Surface Level \_\_\_\_\_

			Water Surface Elevation				Initials**
Entry	Date**	Time	Location 1	Location 2	Location 3	Location 4	
0							
1							
2							
3							
4							
5							
Change in level (difference between entry 5 and entry 0)							
Average change in level (sum of change in level / 4)							
Correction for precipitation/evaporation							
Corrected change in level = CL =							
Measured percent water loss in 24 hrs. =			$\frac{(CL) \times (\text{surface area}) \times (100)}{(\text{initial water volume}) (\text{number of test days})}$				

Notes and Field Observations \*\* \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

\* Attach a sketch showing a plan of structure and measurement locations.

\*\* Place date and initials at the beginning of each entry.

END OF TIGHTNESS TEST REPORT FORM

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## SECTION 033000 - 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 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes.
- B. Related Requirements:
  - 1. Section 036000 "Grouting" for grouting.
  - 2. Section 312000 "Earthwork" for drainage fill under slabs-on-grade.
  - 3. Section 050519 "Post-Installed Anchors and Reinforcing Bars"

#### 1.3 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash, slag cement, other pozzolans, and silica fume; materials subject to compliance with requirements.
- B. W/C Ratio: The ratio by weight of water to cementitious materials.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Design Mixtures: For each formulation of concrete proposed for use, submit constituent quantities per cubic yard, water cementitious ratio, air content, concrete slump, type and manufacturer of cement and type and manufacturer of fly ash or ground granulated blast furnace slag. For each concrete mixture, submit alternate design mixtures when characteristics of materials change, source of cement or aggregate change or test results do not meet specification requirements, or other circumstances warrant adjustments.
- C. Steel Reinforcement Shop Drawings: Placing Drawings that detail fabrication, bending, and placement. Include bar sizes, spacing, 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. Reference bars to be the same identification marks shown on the bar bending details.
- D. Construction Joint Layout: As shown on the Drawings.

E. 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. Bonding agents.
7. Adhesives.
8. Vapor retarders.
9. Semirigid joint filler.
10. Joint-filler strips.
11. Repair materials.

F. Material Test Reports: For the following, from a qualified testing agency:

1. Aggregates: Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.
2. Mill Test Reports:
  - a. Cementitious materials.
  - b. Steel Reinforcing.
  - c. Reinforcing Splicing Devices.

## 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For independent testing agency responsible for concrete design mixtures.
- B. Formwork Shop Drawings: Prepared by or under the supervision of a qualified professional engineer, detailing fabrication, assembly, and support of formwork. Formwork shop drawings shall be stamped and sealed by a professional engineer registered in the State of Florida.
  1. Shoring and Reshoring: Indicate proposed schedule and sequence of stripping formwork, shoring removal, and reshoring installation and removal.
- C. Field quality-control reports.
- D. PE Certification form for the design of formwork and shoring.

## 1.6 QUALITY ASSURANCE

- A. 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.
- B. Testing Agency Qualifications: An independent agency, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.
  1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 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.

#### 1.7 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing on concrete mixtures.

#### 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Steel Reinforcement: Provide reinforcement free from mill scale, rust, mud, dirt, grease, oil, ice, or other foreign matter that will reduce or destroy bond. Deliver, store, and handle steel reinforcement to prevent bending and damage. Store reinforcement off the ground, protect from moisture, and keep out of standing water, and free from rust, mud, dirt, grease, oil, ice, or other contaminants and deleterious films that will reduce or destroy bond.

#### 1.9 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 subgrade or on subgrade 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 ACI 305.1, 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 subgrade just before placing concrete. Keep subgrade 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 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. High-density overlay, Class 1 or better.
  3. Overlaid Finnish birch plywood.
- 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. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that produce surfaces with gradual or abrupt irregularities not exceeding specified formwork surface class. Provide units with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.
- D. Pan-Type Forms: Glass-fiber-reinforced plastic or formed steel, stiffened to resist plastic concrete loads without detrimental deformation.
- E. Void Forms: Biodegradable paper surface, treated for moisture resistance, structurally sufficient to support weight of plastic concrete and other superimposed loads.
- F. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.
- G. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.
- H. Form-Release Agent: Commercially formulated form-release agent that does not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces.
  1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
- I. Form Ties: Factory-fabricated, removable or snap-off glass-fiber-reinforced plastic or metal form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
  1. Furnish units that leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.
  2. Furnish ties that, when removed, leave holes no larger than 1 inch in diameter in concrete surface.
  3. Furnish ties with integral water-barrier plates to below grade walls.

## 2.3 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.
- B. Reinforcing bars to be welded or field bent: Low-Alloy-Steel Reinforcing Bars, ASTM A 706/A 706M, deformed.

## 2.4 REINFORCEMENT ACCESSORIES

- A. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60, plain-steel bars, cut true to length with ends square and free of burrs.
- B. 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 precast 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.
- C. Tie wires for reinforcement: 16 gauge or heavier black annealed wire to tie uncoated reinforcing.

## 2.5 CONCRETE MATERIALS

- A. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.
- B. Cementitious Materials:
  - 1. Portland Cement: ASTM C 150/C 150M, Type II, gray.
  - 2. Fly Ash: ASTM C 618, Class F.
  - 3. Slag Cement: ASTM C 989/C 989M, Grade 100 or 120.
  - 4. Silica Fume: ASTM C 1240, amorphous silica.
- C. Normal-Weight Aggregates: ASTM C 33/C 33M, 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: ASTM C33 Size Number 57 nominal.
  - 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- D. Air-Entraining Admixture: ASTM C 260/C 260M.
- E. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and that do 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. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
3. Water-Reducing and Accelerating Admixture: ASTM C 494/C 494M, Type E.
4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.

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

## 2.6 VAPOR RETARDERS

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

## 2.7 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
- 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 and Sealing Compound: ASTM C 1315, Type 1, Class A.

## 2.8 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1752, Type III, cork or self-expanding cork.
- B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 according to ASTM D 2240.
- C. Bonding Agent: ASTM C 1059/C 1059M, Type II, nonredispersible, acrylic emulsion or styrene butadiene.
- D. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:
  1. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.
- E. Reglets: Fabricate reglets of not less than 0.022-inch- thick, galvanized-steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.

- F. Dovetail Anchor Slots: Hot-dip galvanized-steel sheet, not less than 0.034 inch thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.

## 2.9 REPAIR MATERIALS

- A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.
  - 1. Cement Binder: ASTM C 150/C 150M, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
  - 2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
  - 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by underlayment manufacturer.
  - 4. Compressive Strength: Not less than 5000 psi at 28 days when tested according to ASTM C 109/C 109M.
- B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch and that can be filled in over a scarified surface to match adjacent floor elevations.
  - 1. Cement Binder: ASTM C 150/C 150M, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
  - 2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
  - 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
  - 4. Compressive Strength: Not less than 5000 psi at 28 days when tested according to ASTM C 109/C 109M.

## 2.10 CONCRETE MIXTURES, GENERAL

- 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. Combined Fly Ash and Pozzolan: 25 percent.
  - 3. Slag Cement: 45 percent.
  - 4. Combined Fly Ash or Pozzolan and Slag Cement: 50 percent portland cement minimum, with fly ash or pozzolan not exceeding 25 percent.
  - 5. Silica Fume: 10 percent.

6. Combined Fly Ash, Pozzolans, and Silica Fume: 35 percent with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.
  7. Combined Fly Ash or Pozzolans, Slag Cement, and Silica Fume: 50 percent with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.
- C. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.
- D. Admixtures: Use admixtures according to manufacturer's written instructions.
1. Use water-reducing admixture in concrete, for placement and workability.
  2. High-range water-reducing admixture in concrete, may be used, for placement and workability.
  3. Plasticizing admixture in concrete, may be used, for placement and workability.
  4. Water-reducing and -retarding admixture, may be used, when required by high temperatures, low humidity, or other adverse placement conditions.
  5. Use accelerating admixtures in cold weather. Use of admixtures will not relax cold-weather placement requirements.

## 2.11 CONCRETE MIXTURES FOR BUILDING ELEMENTS

A. Beams, Columns, Footings, Slabs and Walls: Normal-weight concrete.

1. Minimum Compressive Strength: 4500 psi at 28 days.
2. Maximum W/C Ratio: 0.42.
3. Minimum Cementitious Materials Content: 580 lb/cu. yd.
4. Coarse Aggregate: 57 (Size number is ASTM C 33).
5. Slump Limit: 4 inches, plus or minus 1 inch.
6. Air Content: 3.5 to 5 percent.

B. Concrete Toppings: Normal-weight concrete.

1. Minimum Compressive Strength: 4000 psi at 28 days.
2. Maximum W/C Ratio: 0.44.
3. Minimum Cementitious Materials Content: 600 lb/cu. yd.
4. Coarse Aggregate: 8 (Size number is ASTM C 33).
5. Slump Limit: 4 inches, plus or minus 1 inch.
6. Air Content: 3.5 to 5 percent

## 2.12 FABRICATING REINFORCEMENT

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

## 2.13 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 FORMWORK INSTALLATION

- A. Design, erect, shore, brace, and maintain formwork, 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 formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
- C. Limit concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:
  1. Class A, 1/8 inch for smooth-formed finished surfaces.
  2. Class B, 1/4 inch for rough-formed finished surfaces.
- D. Construct forms tight to prevent loss of concrete mortar.
- E. Construct forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast-concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
  1. Install reglets, recesses, and the like, for easy removal.
  2. Do not use rust-stained steel form-facing material.
- F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.
- G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.
- H. Chamfer exterior corners and edges of permanently exposed concrete.
- I. Form openings, chases, offsets, sinkages, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.
- J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, ice, snow and other debris just before placing concrete.
- K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

### 3.2 EMBEDDED ITEM INSTALLATION

- 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.
  - 1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC 303.
  - 2. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
  - 3. Install dovetail anchor slots in concrete structures as indicated.

### 3.3 REMOVING AND REUSING FORMS

- A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations, and curing and protection operations need to be maintained.
  - 1. Leave formwork for beam soffits, joists, slabs, and other structural elements that support weight of concrete in place until concrete has achieved at least 70 percent of its 28-day design compressive strength.
  - 2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.
- B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material are not acceptable for exposed surfaces. Apply new form-release agent.
- C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Engineer.

### 3.4 SHORING AND RESHORING INSTALLATION

- A. Comply with ACI 318 and ACI 301 for design, installation, and removal of shoring and reshoring.
  - 1. Do not remove shoring or reshoring until measurement of slab tolerances is complete.
- B. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

### 3.5 VAPOR-RETARDER INSTALLATION

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

### 3.6 STEEL REINFORCEMENT INSTALLATION

- A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
  - 1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.
- B. Clean reinforcement of loose mill scale, rust, mud, dirt, grease, oil, ice, and other foreign materials that reduce or destroy the bond to concrete.
- C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
- D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- E. 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, 1.3 times the development length, or 8 inches, whichever is greater. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.
- F. Splicing:
  - 1. If not indicated on Drawings, locate reinforcement splices at point of minimum stress.
- G. Obtain approval of splice locations from Engineer.

### 3.7 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 Engineer.
  - 1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated.
  - 2. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
  - 3. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.

4. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
  5. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces. Intentionally roughen concrete surface and remove laitance prior to applying epoxy-bonding adhesive.
  6. At construction joints and at concrete joints indicated on Drawings to be "roughened", uniformly roughen the surface of concrete to a full amplitude (distance between high and low points and side to side) of 1/4 inch with chipping tools to expose a fresh face. Thoroughly clean joint surfaces of loose or weakened materials by waterblasting or sandblasting and prepare for bonding.
  7. Do not use keyways in construction joints unless specifically shown on the Drawings or approved by the Engineer.
- C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated.
- D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated.
  2. Terminate full-width joint-filler strips below finished concrete surface where joint sealants, specified in Section 079200 "Joint Sealants," are indicated. Terminate joint filler as required by sealant manufacturer or as indicated.
  3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

### 3.8 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections are completed.
- B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Engineer.
1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
- C. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
1. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid "cold" joints.
  2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
  3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have

begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

- D. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
  - 1. Consolidate concrete during placement operations, so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
  - 2. Maintain reinforcement in position on chairs during concrete placement.
  - 3. Screed slab surfaces with a straightedge and strike off to correct elevations.
  - 4. Slope surfaces uniformly to drains where required.
  - 5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

### 3.9 FINISHING FORMED SURFACES

- A. Finish concrete surfaces according to ACI 301.
- B. 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 view.
- C. 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 view,.
- D. 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.
- E. 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.

### 3.10 FINISHING FLOORS AND SLABS

- A. General: Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, 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 Engineer before application.

### 3.11 MISCELLANEOUS CONCRETE ITEM INSTALLATION

- A. Filling In: Fill in holes and openings left in concrete structures after work of other trades is in place unless otherwise indicated. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.
- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
- C. Equipment Pads:
  - 1. Coordinate sizes and locations of concrete pads with actual equipment provided.
  - 2. Minimum Compressive Strength: 4500 psi at 28 days.
  - 3. Install reinforcing dowels; to connect concrete pad to concrete floor. Unless otherwise indicated.
  - 4. For supported equipment, install anchor bolts that extend through concrete pad and anchor into structural concrete substrate.
  - 5. Prior to pouring concrete, place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 6. Cast anchor-bolt insert into pads. Install anchor bolts to elevations required for proper attachment to supported equipment.

### 3.12 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 305.1 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. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after

loosening forms. If removing forms before end of curing period, continue curing for remainder of curing period.

- D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.
- E. 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 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. Cure for not less than seven days. Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
    - a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
    - b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
    - c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies does not interfere with bonding of floor covering used on Project.
  - 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.
  - 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. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

### 3.13 JOINT FILLING

- A. Prepare, clean, and install joint filler according to manufacturer's written instructions.
  - 1. Defer joint filling until concrete has aged at least one month(s). Do not fill joints until construction traffic has permanently ceased.
- B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joints clean and dry.

- C. Install semi-rigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

### 3.14 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by Engineer. Remove and replace concrete that cannot be repaired and patched to Engineer's approval.
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of 1 part portland cement to 2-1/2 parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.
- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
  - 1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete. Limit sawcut at the perimeter of the area to a depth of 3/4 inch. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
  - 2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar matches surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
  - 3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Engineer.
- D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
  - 1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
  - 2. After concrete has cured at least 14 days, correct high areas by grinding.
  - 3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
  - 4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
  - 5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.



6. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete, except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
  7. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.
- E. Perform structural repairs of concrete, subject to Engineer's approval, using epoxy adhesive and patching mortar.
- F. Repair materials and installation not specified above may be used, subject to Engineer's approval.

### 3.15 FIELD QUALITY CONTROL

- A. Perform inspection and testing according to ACI 318 and Florida Building Code.
- B. Provide unrestricted access to work and cooperate with appointed testing and inspection firm.
- C. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172/C 172M shall be performed according to the following requirements by the testing agency:
1. Testing Frequency: One composite sample for each 100 cu. yd. or fraction thereof of each concrete mixture placed each day.
    - a. When frequency of testing provides 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 mixture. Perform additional tests will be performed when concrete consistency appears to change.
  3. Air Content: ASTM C 231/C 231M, pressure method, for normal-weight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
  4. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F and below or 80 deg F and above, and one test for each composite sample.
  5. Compression Test Specimens: ASTM C 31/C 31M.
    - a. Cast and laboratory cure two sets of two standard cylinder specimens for each composite sample.
    - b. Cast and field cure two sets of two standard cylinder specimens for each composite sample.

6. Compressive-Strength Tests: ASTM C 39/C 39M; test one set of two laboratory-cured specimens at 7 days and one set of two specimens at 28 days.
  - a. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
7. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
8. Test results shall be reported in writing to Engineer, 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.
9. 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 Engineer. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by Engineer.
10. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
11. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

END OF SECTION 033000

## SECTION 034113 - PRECAST CONCRETE HOLLOW CORE PLANKS

### 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. Precast prestressed concrete hollow core planks and structural steel headers for openings.
2. Reinforcing, inserts, weld plates, bearing plates, bolts, anchors, angles, and sleeves which are indicated to be provided with precast concrete hollow core planks.
3. Furnish reinforcing, inserts, weld plates, bearing plates, bolts, anchors, sleeves, and other accessories to be installed in concrete under Section 033000.
4. Furnish reinforcing, inserts, weld plates, bearing plates, bolts, anchors, sleeves, and other accessories to be installed in masonry under Section 042000.
5. Connection plates, brackets, and hangers.
6. Bearing pads.
7. Erection, including all shimming, connections, welding and removal of lifting.
8. Grouting plank joint keys, between precast concrete hollow core planks, and as indicated.
9. Concrete topping

- B. Related Requirements:

1. Section 033000 - Cast-in-Place Concrete: Concrete superstructure building frame, topping, and reinforcement.
2. Section 078443 - Firestopping: Products for closing openings in and penetrations through fire-rated construction to maintain fire- and smoke-resistance ratings.
3. Section 079200 - Joint Protection: Calking of butt joints of precast units at exposed underside of floor members.

#### 1.3 COORDINATION

- A. Coordinate Work of this Section with framing components directly associated with Work of this Section.
- B. Coordinate field cut openings with affected Section.
- C. Coordinate location of hanger tabs and devices for mechanical and electrical Work.

#### 1.4 PREINSTALLATION MEETINGS

- A. Convene minimum one week prior to commencing Work of this Section.
- B. Discuss anchor and weld plate locations, sleeve locations, and cautions regarding cutting or core drilling.

#### 1.5 ACTION SUBMITTALS

- A. Section 013300 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit standard component configuration, design loads, deflections, camber, bearing requirements, and fire ratings.
- C. Shop Drawings: Fabrication and erection drawings. Indicate plank layout, plank locations, fabrication details, unit identification marks, reinforcement, connection details, edge conditions, bearing requirements, support conditions, dimensions, openings, openings intended to be field cut, and relationship to adjacent materials.

#### 1.6 INFORMATIONAL SUBMITTALS

- A. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- B. Welder Certificates: Certify welders and welding procedures employed on Work, verifying AWS qualification with AWS D1.1 or D1.4, as applicable, within previous 12 months.
- C. Delegated Design Submittals: Submit signed and sealed Shop Drawings with design calculations and assumptions for loadings of planks, prestressing, connections, headers, and related system components.
- D. Manufacturer Instructions: Submit special procedures, and perimeter conditions requiring special attention.
- E. Source Quality-Control Submittals: Indicate results of factory tests and inspections.
- F. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.
- G. Qualifications Statements:
  - 1. Submit qualifications for manufacturer, erector, welders, and licensed professional.
    - a. Copy of PCI Plant Certification for manufacturer.
    - b. Copy of PCI Certificate of Compliance for erector.
  - 2. Test reports for tests performed in accordance with PCI MNL-116.
  - 3. Welders: Qualify procedures and personnel according to AWS D1.1/D1.1M, AWS B2.1/2.1M, and AWS D1.4/D1.4M.
- H. Do not fabricate members until shop drawings and calculations are approved.

## 1.7 QUALITY ASSURANCE

- A. Design planks according to following:
  - 1. PCI MNL-120.
  - 2. PCI MNL-126.
  - 3. PCI MNL-124.
  - 4. ACI 318.
  - 5. ACI 301.
- B. Design connections according to PCI MNL-123.
- C. Plank Production:
  - 1. Comply with PCI MNL-116.
  - 2. Maintain plant records and quality-control program during production of precast planks.
  - 3. Make records available upon request of Engineer.
- D. Fire-Rated Roof Construction:
  - 1. Rating: As indicated on Drawings.
  - 2. Tested Rating: Determined according to ASTM E 119.
- E. Surface-Burning Characteristics:
  - 1. Foam Insulation: Maximum 75/450 flame-spread/smoke-developed index when tested according to ASTM E84.
  - 2. Other Insulation: Maximum 25/450 flame-spread/smoke-developed index when tested according to ASTM E84.
- F. Apply label from agency approved by authorities having jurisdiction to identify each foam plastic insulation board.

## 1.8 QUALIFICATIONS

- A. Manufacturer: Company specializing in fabricating products specified in this Section with minimum three years' documented experience. Manufacture all precast concrete hollow core planks at an existing plant certified at the time of bidding by the Precast/Prestressed Concrete Institute Plant Certification Program. Certification is required in the following product groups and categories: C2 Prestressed Hollow-Core and Repetitive Products.
- B. Erector: Company specializing in performing Work of this Section with minimum three years' documented experience and approved by manufacturer. Install all precast concrete hollow core planks by an erector qualified at the time of bidding as evidenced by PCI's Certificate of Compliance to erect Category S1 Simple Structural Systems.
- C. Welders: AWS qualified within previous 12 months for employed weld types.
- D. Licensed Professional: Professional engineer experienced in design of specified Work and licensed in State of Project location.

## 1.9 DELIVERY, STORAGE, AND HANDLING

- A. Section 016000 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- C. Transport, store, and handle precast concrete hollow core planks to protect from cracking, distortion, warping, staining, and other damage and in accordance with the manufacturers' instructions.
- D. Protection:
  - 1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
  - 2. Provide additional protection according to manufacturer instructions.
  - 3. Protect members to prevent staining, chipping, or spalling of concrete.
- E. Handling:
  - 1. Handle precast members in position consistent with their shape and design.
  - 2. Lift and support only from designated support points.
  - 3. Lifting or Handling Devices: Capable of supporting member in positions anticipated during manufacture, storage, transportation, and erection.
  - 4. Mark each member with date of production and final position in structure.
- F. Repair or replace damaged units without additional compensation.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE AND DESIGN CRITERIA

- A. Conform to ACI 318.
- B. Member sizes: as indicated. Provide a minimum of 3/4 inch of clear concrete cover for all primary reinforcing, bar or prestressing strand. Fabricate precast concrete hollow core planks having shear keyways on the sides that are adjacent to other members to permit grouting between adjacent members.
- C. Design precast concrete hollow core planks and connections to support the following loads:
  - 1. Self-weight.
  - 2. Weight of concrete topping at a density of 150 lbs/cu.ft. to indicated thicknesses.
  - 3. Concentrated dead loads (weight of partitions, equipment and other permanent construction supported by precast concrete hollow core planks) as indicated.
  - 4. Uniformly distributed dead loads (weight of ceilings, equipment and other permanent construction supported by precast concrete hollow core planks) as indicated.
  - 5. Live load as indicated.

6. Other loads indicated.
  7. Wind Loads: Refer to Design Drawings.
- D. Design components to withstand dead and live loads in a restrained condition as follows:
1. Dead Loads:
    - a. Roof Assembly: Self-weight.
  2. Live Loads:
    - a. Roof Assembly: Refer to Design Drawings.
  3. Concentrated Loads: As indicated on Drawings.
  4. Horizontal Loads: As indicated on Drawings.
- E. Maximum Allowable Live Load Deflection of Roof Planks: 1/180 of span.
- F. Design members exposed to weather to allow movement of components without damage, failure of joint seals, undue stress on connections and fasteners, or other detrimental effects when subject to seasonal or cyclic day/night temperature ranges.
- G. Design components to accommodate construction tolerances, deflection of other building structural members, and clearances of intended openings.
- H. Grouted Keys: Capable of transmitting horizontal shear force of 2,000 lb./ft..

## 2.2 MANUFACTURERS

- A. Furnish materials according to Performance and Design Standards.

## 2.3 MATERIALS

- A. Obtain all cement, sand and gravel used in precast concrete hollow core planks, including for patching members, from one single source to provide a uniform color and texture.
- B. Cement:
1. Comply with ASTM C 150/C 150M, Type III.
  2. Type: Portland.
  3. Color: Gray.
- C. Aggregate, Sand, Water, Admixtures:
1. Sand and gravel conforming to ASTM C 33. Size of coarse aggregate to meet spacing requirements of prestressing steel and reinforcing steel. Maximum size of coarse aggregate no larger than 1 inch.
  2. Water reducing admixture in accordance with ASTM C 494.
  3. Air entraining admixture in accordance with ASTM C 260.

4. As determined by precast manufacturer.
5. As appropriate to design requirements and PCI MNL-116.

D. Tensioning Steel Tendons:

1. Prestressing Strand: Uncoated seven wire low relaxation strand conforming to ASTM A 416 Grade 250K.
2. Comply with ASTM A 416/A 416M, Grade 250.
3. Diameter: Appropriate to member design.

E. Deformed Reinforcement:

1. Description: Steel bars.
2. Comply with ASTM A 615/A 615M, Grade 60.
3. Deformed Concrete Reinforcing Bars indicated to be Field Bent or Welded: ASTM A 706.

F. Non-Shrink Grout:

1. Type: Nonmetallic.
2. Non-Shrink Cementitious Grout: As specified in Section 036000 and as approved.

G. Cement Grout: Minimum compressive strength of 3,000 psi at 28 days.

## 2.4 CONCRETE MIXES

- A. Provide concrete for all precast concrete hollow core planks having a minimum 28-day compressive strength of 5,000 psi as determined by cylinder tests in accordance with ASTM C 39.
- B. Unless otherwise approved by the Engineer, provide concrete having a minimum compressive strength of 3,500 psi at transfer of prestressing force, as determined by cylinder tests in accordance with ASTM C 39.
- C. Maximum water-cementitious materials ratio, by weight, 0.45. Minimum cementitious content 470 lbs./cu.yd..
- D. Provide concrete mixes having a water reducing admixture and an air entraining admixture, each at a rate in accordance with manufacturers' recommendations.
- E. Do not use admixtures containing chlorides.
- F. Concrete Topping: Concrete as specified in and conforming to requirements of Section 033000 - Cast-In-Place Concrete, except as modified herein.



## 2.5 FABRICATION

- A. Planks:
  - 1. Description: Plant cast, prestressed, hollow core.
  - 2. Comply with PCI MNL-126 and ACI 318.
- B. Dimensions: As indicated on Drawings.
- C. Nominal Dimensions:
  - 1. Thickness: As indicated on Drawings.
  - 2. Width: As indicated on Drawings .
- D. Maintain plant records and quality-control program during production of precast members and make records available upon request of Engineer.
- E. Provide a minimum 1/2 inch chamfer at exposed corners.
- F. Set all reinforcing, inserts, weld plates, hangers, openings, sleeves, bolts, anchors and blockouts required by the various trades or as indicated, located, and detailed on final approved shop drawings. Prevent displacement during concreting. Correct any omission or change in location or details indicated or required by the various trades as a result of the Contractor's actions without additional Compensation.
- G. Fabricate required openings larger than 8 inches.
- H. Welding:
  - 1. Steel Fabrications: Comply with AWS D1.1/D1.1M.
  - 2. Do not tack-weld reinforcing.
- I. Place concrete continuously without joints for each precast concrete hollow core plank.
- J. Coat ends of strands with bituminous or asphaltic dampproofing materials.
- K. Exposed Ends at Stressing Tendons: Fill recess with nonshrink grout and trowel flush.
- L. Plant Finish: Comply with PCI MNL-116, commercial grade.
- M. Provide a raked finish at top surfaces of members to be covered with concrete topping.
- N. Connecting and Supporting Steel Devices: Do not paint surfaces in contact with concrete or surfaces requiring field welding.

## 2.6 ACCESSORIES

- A. Connecting and Supporting Devices:
  - 1. Materials: Type 316 stainless steel, ASTM A 666, unless otherwise noted.
  - 2. Welded plates: Carbon steel, ASTM A 36; prime painted.

- B. Anchorage Devices for Mechanical and Electrical Equipment Hangers: As specified in the appropriate equipment Section.
- C. Bearing Pads:
  - 1. Multi-monomer plastic bearing strips manufactured specifically for bearing purposes and as approved.

## 2.7 SOURCE QUALITY CONTROL

- A. Section 014000 - Quality Requirements: Requirements for testing, inspection, and analysis.
- B. Inspection and Testing:
  - 1. Testing of Concrete and Grout Materials and Mix Designs: As specified in Section 033000 - Cast-in-Place Concrete and Section 036000 - Grouting.
  - 2. Inspect and test stressing tendons before delivery for compliance with indicated standards.
- C. Owner Inspection:
  - 1. Make completed unit available for inspection at manufacturer's factory prior to packaging for shipment.
  - 2. Notify Owner at least seven days before inspection is allowed.
- D. Owner Witnessing:
  - 1. Allow witnessing of factory inspections and test at manufacturer's test facility.
  - 2. Notify Owner at least seven days before inspections and tests are scheduled.
- E. Certificate of Compliance:
  - 1. If manufacturer is approved by authorities having jurisdiction, submit certificate of compliance indicating Work performed at manufacturer's facility conforms to Contract Documents.
  - 2. Specified shop tests are not required for Work performed by approved manufacturer.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Section 017300 - Execution: Requirements for installation examination.
- B. Verify that Site conditions are ready to receive Work.
- C. Verify that field measurements are as indicated on Shop Drawings.
- D. Verify supporting structure is ready to receive Work.

### 3.2 PREPARATION

- A. Section 017300 - Execution: Requirements for installation preparation.
- B. Prepare support equipment for erection procedure, temporary bracing, and induced loads during erection.

### 3.3 ERECTION

- A. Erect members without damage to structural capacity, shape, or finish; replace or repair damaged members.
- B. Align and maintain uniform horizontal and end joints as erection progresses.
- C. Temporary Bracing and Support:
  - 1. Maintain temporary bracing in place until final connections are made.
  - 2. Protect members from staining.
  - 3. Provide temporary lateral support to prevent bowing, twisting, or warping of members.
- D. Install bearing pads at bearing ends of planks as indicated on Drawings. Provide minimum bearing as indicated.
- E. Adjust differential camber between precast members to indicated tolerance before final attachment and grouting.
- F. Adjust differential elevation between precast members to indicated tolerance before final attachment.
- G. Welding:
  - 1. Comply with AWS D1.1/D1.1M and AWS D1.4/D1.4M.
  - 2. Do not tack-weld reinforcing.
- H. Tape-seal underside of plank joints to prevent grout leakage.
- I. Joint keys: Clean out and completely fill longitudinal keys and spaces between precast concrete hollow core planks with approved non-shrink cementitious grout. Remove grout that seeps to soffit before it hardens.
- J. Adjoining Planks:
  - 1. Make plank-to-plank joints smooth using grout, troweled smooth.
  - 2. Transition differential elevation of adjoining planks with grout to maximum slope of 1:12.
- K. Plank ends: Grout plank ends where indicated. Clean out, provide grout stops, and completely fill voids with grout.
- L. Do not cut or drill holes in the field, except as shown on approved shop drawings, without written approval of the Engineer. Do not cut prestressing strands.

- M. Clean top surface of precast concrete hollow core planks before placing concrete topping. Remove debris, dirt, laitance, oil, grease, and other bond inhibiting materials from the surface by dry mechanical means such as sandblasting, chipping, or wire brushing. Clean surface of loose or weakened material and dust by dry mechanical means such as sandblasting, vacuuming and airblasting. Irregular voids or surface stones need not be removed if they are sound, free of laitance, and firmly embedded into parent concrete.
- N. After top surface has been cleaned, saturate with water and maintain saturation for a period of at least 12 hours. Protect area and equipment below from dripping water. Brush on a 1/16 inch layer of cement and water mixed to the consistency of a heavy paste. Place concrete topping immediately after application of cement paste.
- O. Place concrete topping to the limits indicated. Place to the minimum depth as indicated. Consolidate as specified in Section 033000 - Cast-In-Place Concrete.

### 3.4 ATTACHMENT OF ARCHITECTURAL, MECHANICAL AND ELECTRICAL COMPONENTS AND SYSTEMS

- A. Make attachments at embedded weld plates provided by manufacturer of precast concrete hollow core planks.
- B. Make attachments to precast concrete hollow core planks only at the center of the hollow core using drilled bolts (through bolts with nuts and plate washers, adhesive anchors, or toggle bolts). Do not make attachments in the areas between hollow cores.
- C. Do not use powder actuated ('shot') fasteners for attachment to precast concrete hollow core planks.

### 3.5 TOLERANCES

- A. Section 014000 - Quality Requirements: Requirements for tolerances.
- B. Erect members level and plumb within allowable tolerances according to PCI MNL-126.

### 3.6 FIELD QUALITY CONTROL

- A. Section 014000 - Quality Requirements: Requirements for inspecting and testing.
- B. Section 017300 - Execution: Requirements for testing, adjusting, and balancing.
- C. Inspect welds according to AWS D1.1/D1.1M and AWS D1.4/D1.4M.

### 3.7 CLEANING

- A. Section 017300 - Execution: Requirements for cleaning.
- B. Clean weld marks, dirt, or blemishes from surfaces of exposed members.

3.8 PROTECTION

- A. Section 017300 - Execution: Requirements for protecting finished Work.
- B. Protect members from damage caused by field welding or erection operations.
- C. Use noncombustible shields during welding operations to protect adjacent Work.

END OF SECTION 034113

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## SECTION 036000 - GROUTING

### 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. Portland cement grout.
  - 2. Nonshrink cementitious grout.

- B. Related Requirements:

- 1. Section 024119 "Selective Demolition": Demolition and removals.
  - 2. Section 033000 "Cast-in-Place Concrete."
  - 3. Section 042000 "Unit Masonry: Masonry grout."
  - 4. Section 055000 "Metal Fabrications: Grout related to miscellaneous metals."

#### 1.3 ACTION SUBMITTALS

- A. Section 013300 "Submittal Procedures": Requirements for submittals.
- B. Product Data: Submit manufacturer information regarding grout and surface preparation, mixing and installation.
  - 1. Commercially manufactured nonshrink cementitious grout. Include catalog cuts, technical data, storage requirements, product life, working time after mixing, temperature considerations, and conformity to the specified ASTM standards.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- B. Manufacturer Instructions: Submit instructions for mixing, handling, surface preparation, and placing nonshrink grouts.
- C. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.
- D. Qualifications Statement:
  - 1. Submit qualifications for manufacturer.

## 1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum ten years' experience in production and use of provided grouts.
- B. Independent testing laboratory shall meet the requirements of ASTM E329 and ASTM C1077 and be acceptable to the Engineer. Laboratories affiliated with the Contractor or in which the Contractor or officers of the Contractor's organization have beneficial interest are not acceptable.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Section 016000 "Product Requirements": Requirements for transporting, handling, storing, and protecting products.
- B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- C. Store materials according to manufacturer instructions. Limit total storage time from date of manufacture to date of installation to six months or the manufacturer's recommended storage time, whichever is less.
- D. Remove immediately from the site material which becomes damp, contains lumps, or is hardened and replace with acceptable material.
- E. Protection:
  - 1. Protect materials from moisture and dust by storing in clean, dry location.
  - 2. Provide additional protection according to manufacturer instructions.

## 1.7 AMBIENT CONDITIONS

- A. Maximum Conditions: Do not perform grouting if temperatures exceed 90 degrees F.
- B. Minimum Conditions: Do not perform grouting if the minimum temperature of base plates, supporting concrete and grout are less than 40 degrees F. Maintain minimum temperature of 40 degrees F before, during, and after grouting, until grout has set.

## PART 2 - PRODUCTS

### 2.1 PORTLAND CEMENT GROUT

- A. Portland Cement: Comply with ASTM C 150/C 150M, Type I and II.
- B. Water:
  - 1. Potable.



2. No impurities, suspended particles, algae, or dissolved natural salts in quantities capable of causing:
  - a. Corrosion of steel.
  - b. Volume change increasing shrinkage cracking.
  - c. Efflorescence.
  - d. Excess air entraining.

C. Fine Aggregate:

1. Washed natural sand.
2. Gradation:
  - a. Comply with ASTM C 33/C 33M.
  - b. Represented by smooth granulometric curve within required limits.
3. Free from injurious amounts of organic impurities according to ASTM C 40/C 40M.

D. Mix:

1. Portland cement, sand, and water.
2. Do not use ferrous aggregate or staining ingredients in grout mixes.

## 2.2 NONSHRINK CEMENTITIOUS GROUT

A. Products:

1. Sika Grout 212 by Sika Corp.
2. NS Grout by The Euclid Chemical Co.
3. Five Star Grout by Five Star Products, Inc.
4. Or Approved Equal.

B. Description:

1. Pre-mixed and ready-for-use formulation requiring only addition of water.
2. Nonshrink, non-corrosive, nonmetallic, non-gas forming, not containing expansive cement and no chlorides.
3. No shrinkage when tested in conformity with ASTM C 827/C 827M.

C. Performance and Design Criteria:

1. Certified to maintain initial placement volume or expand after set, and to meet following minimum properties when tested according to ASTM C 1107/C 1107M for Grades B, C, D and CRD-C621 nonshrink grout:
  - a. Setting Time:
    - 1) Initial: Approximately two hours.
    - 2) Final: Approximately three hours.
    - 3) Comply with ASTM C 191.

- b. Maximum Expansion: 0.10 to 0.40 percent.
- c. Minimum Compressive Strength:
  - 1) One-Day: 4,000 psi.
  - 2) Seven-Day: 7,000 psi.
  - 3) 28-Day: 10,000 to 10,800 psi.
  - 4) Comply with CRD-C621.

## 2.3 FORMWORK

- A. As specified in this Section and in Section 033000 "Cast-in-Place Concrete".

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Section 017300 "Execution": Requirements for installation examination.
- B. Verify areas to receive grout.

### 3.2 PREPARATION

- A. Section 017300 "Execution": Requirements for installation preparation.
- B. Place grout where indicated or specified over existing concrete and cured concrete which has attained its specified design strength unless otherwise approved by the Engineer.
- C. Remove defective concrete, ice, laitance, dirt, oil, grease, form release agents, paints and other foreign material from concrete surfaces, which may affect the bond or performance of the grout by brushing, hammering, chipping, sand blasting or other similar dry mechanical means until sound and clean concrete surface is achieved. Irregular voids or projecting coarse aggregate need not be removed if they are sound, free of laitance and firmly embedded into the parent concrete.
  - 1. Air compressors used to clean surfaces in contact with grout shall be the oil-less type or equipped with an oil trap in the airline to prevent oil from being blown onto the surface.
- D. Roughen concrete lightly, but not to interfere with placement of grout.
- E. Remove foreign materials from metal surfaces in contact with grout.
- F. Align, level, and maintain final positioning of components to be grouted.
- G. Wash concrete surfaces clean and then keep moist for at least 24 hours prior to the placement of nonshrink cementitious or cement grout. Saturation may be achieved by covering the concrete with saturated burlap bags, use of a soaker hose, or flooding the surface or other method acceptable to the Engineer. Upon completion of the 24 hour period, remove visible water from the surface prior to grouting.

- H. Support equipment during alignment and installation of grout by shims, wedges, blocks or other approved means. Prevent bond of shims, wedges and blocking devices by bond breaking coatings and remove after grouting unless otherwise approved by the Engineer. Grout voids created by the removal of shims, wedges, and blocks.

### 3.3 INSTALLATION - GENERAL

A. Formwork:

1. Construct leakproof forms anchored and shored to withstand grout pressures.
2. Install formwork with clearances to permit proper placement of grout.
3. As specified in Section 033000 "Cast-in-Place Concrete".

B. Mixing - Portland Cement Grout:

1. Use proportions of two parts sand and one part cement, measured by volume.
2. Prepare grout with water to obtain consistency to permit placing and packing.
3. Mix water and grout in two steps:
  - a. Premix using approximately 2/3 of water.
  - b. After partial mixing, add remaining water to bring mix to desired placement consistency and continue mixing two to three minutes.
4. Mix only quantities of grout capable of being placed within 30 minutes after mixing.
5. Do not add additional water after grout has been mixed.
6. Minimum Compressive Strength (ASTM C 579):
  - a. In 48 hours: 2,400 psi.
  - b. In 28 days 7,000 psi.

C. Placing of Grout:

1. Place grout material quickly and continuously.
2. Do not use pneumatic-pressure or dry-packing methods.
3. Apply grout from one side only to avoid entrapping air.
4. Do not vibrate placed grout mixture or permit placement if area is being vibrated by nearby equipment.
5. Thoroughly compact final installation and eliminate air pockets.
6. Do not remove leveling shims for at least 48 hours after grout has been placed.

D. Curing:

1. Prevent rapid loss of water from grout during first 48 hours by use of approved membrane curing compound or by using wet burlap bags, soaker hoses or ponding.
2. Immediately after placement, protect grout from premature drying, excessively hot or cold temperatures, and mechanical injury.
3. After grout has attained its initial set, keep damp for minimum three days.

- E. Reflect all existing underlying expansion joints, partial contraction joints, and construction joints through the grout.

### 3.4 SCHEDULE

A. Use particular types of grout as follows:

1. General Purpose Nonshrink Cementitious Grout (CRD-C621 Grade D): Use at locations where nonshrink grout is indicated, except for base plates greater in area than 3-feet wide by 3-feet long.
2. Flowable (precision) Nonshrink Cementitious Grout (CRD-C621 Grade B or C): Use under base plates greater in area than 3-feet wide by 3-feet long. Use at locations indicated to receive flowable (precision) nonshrink grout. Flowable (precision), nonshrink, cementitious grout may be substituted for general purpose nonshrink cementitious grout.

END OF SECTION 036000

## SECTION 042000 - UNIT MASONRY

### 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. Concrete masonry units.
  - 2. Decorative concrete masonry units.
  - 3. Mortar and grout.
  - 4. Masonry-joint reinforcement.
  - 5. Ties and anchors.
  - 6. Embedded flashing.
  - 7. Miscellaneous masonry accessories.
  - 8. Masonry-cell fill.

#### 1.3 DEFINITIONS

- A. CMU(s): Concrete masonry unit(s).
- B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

#### 1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

#### 1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For the following:
  - 1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.
  - 2. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.
- C. Samples for Initial Selection:
  - 1. Decorative CMUs, in the form of small-scale units.
  - 2. Colored mortar.

3. Weep holes/cavity vents.

## 1.6 INFORMATIONAL SUBMITTALS

- A. List of Materials Used in Constructing Mockups: List generic product names together with manufacturers, manufacturers' product names, model numbers, lot numbers, batch numbers, source of supply, and other information as required to identify materials used. Include mix proportions for mortar and grout and source of aggregates.
  1. Submittal is for information only. Receipt of list does not constitute approval of deviations from the Contract Documents unless such deviations are specifically brought to the attention of Engineer and approved in writing.
- B. Qualification Data: For testing agency.
- C. Material Certificates: For each type and size of the following:
  1. Masonry units.
    - a. Include data on material properties and material test reports substantiating compliance with requirements.
    - b. For masonry units used in structural masonry, include data and calculations establishing average net-area compressive strength of units.
  2. Integral water repellent used in CMUs.
  3. Cementitious materials. Include name of manufacturer, brand name, and type.
  4. Mortar admixtures.
  5. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
  6. Grout mixes. Include description of type and proportions of ingredients.
  7. Joint reinforcement.
  8. Anchors, ties, and metal accessories.
- D. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.
  1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C109/C109M for compressive strength, ASTM C1506 for water retention, and ASTM C91/C91M for air content.
  2. Include test reports, according to ASTM C1019, for grout mixes required to comply with compressive strength requirement.
- E. Statement of Compressive Strength of Masonry: For each combination of masonry unit type and mortar type, provide statement of average net-area compressive strength of masonry units, mortar type, and resulting net-area compressive strength of masonry determined according to TMS 602/ACI 530.1/ASCE 6.
- F. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

## 1.7 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to ASTM C1093 for testing indicated.
- B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
  - 1. Build mockups for typical exterior wall in sizes approximately 72 inches long by 60 inches high by full thickness, including face and backup wythes and accessories.
    - a. Include a sealant-filled joint at least 16 inches long in exterior wall mockup.
    - b. Include lower corner of window opening at upper corner of exterior wall mockup. Make opening approximately 12 inches wide by 16 inches high.
    - c. Include through-wall flashing installed for a 24-inch length in corner of exterior wall mockup approximately 16 inches down from top of mockup, with a 12-inch length of flashing left exposed to view (omit masonry above half of flashing).
    - d. Include metal studs, sheathing, water-resistive barrier air barrier, veneer anchors, flashing, and weep holes in exterior masonry-veneer wall mockup.
  - 2. Clean one-half of exposed faces of mockups with masonry cleaner as indicated.
  - 3. Protect accepted mockups from the elements with weather-resistant membrane.
  - 4. Approval of mockups is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; and aesthetic qualities of workmanship.
    - a. Approval of mockups is also for other material and construction qualities specifically approved by Engineer in writing.
    - b. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Engineer specifically approves such deviations in writing.
  - 5. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

## 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.
- B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- C. Store aggregates where grading and other required characteristics can be maintained, and contamination avoided.
- D. Deliver preblended, dry mortar mix in moisture-resistant containers. Store preblended, dry mortar mix in delivery containers on elevated platforms in a dry location or in covered weatherproof dispensing silos.

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

## 1.9 FIELD CONDITIONS

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



## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.
- B. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.

### 2.2 PERFORMANCE REQUIREMENTS

- A. Provide structural unit masonry that develops indicated net-area compressive strengths at 28 days.
  - 1. Determine net-area compressive strength of masonry from average net-area compressive strengths of masonry units and mortar types (unit-strength method) according to TMS 602/ACI 530.1/ASCE 6.
  - 2. Determine net-area compressive strength of masonry by testing masonry prisms according to ASTM C1314.

### 2.3 UNIT MASONRY, GENERAL

- A. Masonry Standard: Comply with TMS 602/ACI 530.1/ASCE 6, except as modified by requirements in the Contract Documents.
- B. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated. Do not use units where such defects are exposed in the completed Work and will be within 20 feet vertically and horizontally of a walking surface.
- C. Fire-Resistance Ratings: Comply with requirements for fire-resistance-rated assembly designs indicated.
  - 1. Where fire-resistance-rated construction is indicated, units shall be listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction.

### 2.4 CONCRETE MASONRY UNITS

- A. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.
  - 1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
  - 2. Provide square-edged units for outside corners unless otherwise indicated.

B. Integral Water Repellent: Provide units made with integral water repellent for exposed units.

1. Integral Water Repellent: Liquid polymeric, integral water-repellent admixture that does not reduce flexural bond strength. Units made with integral water repellent, when tested according to ASTM E514/E514M as a wall assembly made with mortar containing integral water-repellent manufacturer's mortar additive, with test period extended to 24 hours, shall show no visible water or leaks on the back of test specimen.
  - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - 1) BASF Corporation.
    - 2) Euclid Chemical Company (The); an RPM company.
    - 3) GCP Applied Technologies Inc.

C. CMUs: ASTM C90.

1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2150 psi.
2. Density Classification: Normal weight unless otherwise indicated.
3. Size (Width): Manufactured to dimensions 3/8 inch less than nominal dimensions.
4. Exposed Faces: Provide color and texture matching the range represented by Engineer's sample.

D. Decorative CMUs: ASTM C90.

1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2150 psi.
2. Density Classification: Normal weight.
3. Size (Width): Manufactured to dimensions specified in "CMUs" Paragraph.
4. Pattern and Texture:
  - a. Standard pattern, split-face finish.
5. Colors: As selected by Engineer from manufacturer's full range.
6. Special Aggregate: Provide units made with aggregate matching aggregate in Engineer's sample.

2.5 CONCRETE AND MASONRY LINTELS

A. General: Provide one of the following:

- B. Concrete Lintels: ASTM C1623, matching CMUs in color, texture, and density classification; and with reinforcing bars indicated. Provide lintels with net-area compressive strength not less than that of CMUs.
- C. Concrete Lintels: Precast or formed-in-place concrete lintels complying with requirements in Section 032000 "Concrete Reinforcing," and with reinforcing bars indicated.

- D. Masonry Lintels: Prefabricated or built-in-place masonry lintels made from bond beam CMUs matching adjacent CMUs in color, texture, and density classification, with reinforcing bars placed as indicated and filled with coarse grout. Cure precast lintels before handling and installing. Temporarily support built-in-place lintels until cured.

## 2.6 MORTAR AND GROUT MATERIALS

- A. Portland Cement: ASTM C150/C150M, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.
  - 1. Alkali content shall not be more than 0.1 percent when tested according to ASTM C114.
- B. Hydrated Lime: ASTM C207, Type S.
- C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.
- D. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes and complying with ASTM C979/C979M. Use only pigments with a record of satisfactory performance in masonry mortar.
- E. Colored Cement Products: Packaged blend made from portland cement and hydrated lime and mortar pigments, all complying with specified requirements, and containing no other ingredients.
  - 1. Colored Portland Cement-Lime Mix:
    - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      - 1) Holcim (US) Inc.
      - 2) Lafarge North America Inc.
      - 3) Lehigh Hanson; Heidelberg Cement Group.
  - 2. Formulate blend as required to produce color indicated or, if not indicated, as selected from manufacturer's standard colors.
  - 3. Pigments shall not exceed 10 percent of portland cement by weight.
- F. Aggregate for Mortar: ASTM C144.
  - 1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
  - 2. For joints less than 1/4 inch thick, use aggregate graded with 100 percent passing the No. 16 sieve.
  - 3. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.
- G. Aggregate for Grout: ASTM C404.

- H. Epoxy Pointing Mortar: ASTM C395, epoxy-resin-based material formulated for use as pointing mortar for glazed or pre-faced masonry units (and approved for such use by manufacturer of units); in color indicated or, if not otherwise indicated, as selected by Engineer from manufacturer's colors.
- I. Refractory Mortar Mix: Ground fireclay or nonwater-soluble, calcium aluminate, medium-duty refractory mortar that passes ASTM C199 test; or an equivalent product acceptable to authorities having jurisdiction.
- J. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C494/C494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.
- K. Water-Repellent Admixture: Liquid water-repellent mortar admixture intended for use with CMUs containing integral water repellent from same manufacturer.
- L. Water: Potable.

## 2.7 REINFORCEMENT

- A. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells and to hold reinforcing bars in center of cells. Units are formed from 0.148-inch steel wire, hot-dip galvanized after fabrication. Provide units designed for number of bars indicated.
- B. Masonry-Joint Reinforcement, General: ASTM A951/A951M.
  - 1. Interior Walls: Hot-dip galvanized carbon steel.
  - 2. Exterior Walls: Hot-dip galvanized carbon steel.
  - 3. Wire Size for Side Rods: 0.148-inch diameter.
  - 4. Wire Size for Cross Rods: 0.148-inch diameter.
  - 5. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches o.c.
  - 6. Provide in lengths of not less than 10 feet , with prefabricated corner and tee units.
- C. Masonry-Joint Reinforcement for Single-Wythe Masonry: Ladder or truss type with single pair of side rods.

## 2.8 EMBEDDED FLASHING MATERIALS

- A. Metal Flashing: Provide metal flashing complying with SMACNA's "Architectural Sheet Metal Manual and as follows:
  - 1. Stainless Steel: ASTM A240/A240M or ASTM A666, Type 304, 0.016 inch thick.
  - 2. Fabricate continuous flashings in sections 96 inches long minimum, but not exceeding 12 feet. Provide splice plates at joints of formed, smooth metal flashing.
  - 3. Fabricate through-wall flashing with drip edge unless otherwise indicated. Fabricate by extending flashing 1/2 inch out from wall, with outer edge bent down 30 degrees and hemmed.
  - 4. Fabricate metal drip edges from stainless steel. Extend at least 3 inches into wall and 1/2 inch out from wall, with outer edge bent down 30 degrees and hemmed.

5. Fabricate metal sealant stops from stainless steel. Extend at least 3 inches into wall and out to exterior face of wall. At exterior face of wall, bend metal back on itself for 3/4 inch and down into joint 1/4 inch to form a stop for retaining sealant backer rod.
6. Solder metal items at corners.

B. Flexible Flashing: Use one of the following unless otherwise indicated:

1. Rubberized-Asphalt Flashing: Composite flashing product consisting of a pliable, adhesive rubberized-asphalt compound, bonded to a high-density, cross-laminated polyethylene film to produce an overall thickness of not less than 0.040 inch.
  - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - 1) Carlisle Coatings & Waterproofing Inc.
    - 2) GCP Applied Technologies Inc.
    - 3) Heckmann Building Products, Inc.
    - 4) W.R. Meadows, Inc.
  - b. Accessories: Provide preformed corners, end dams, other special shapes, and seaming materials produced by flashing manufacturer.
2. Butyl Rubber Flashing: Composite, self-adhesive, flashing product consisting of a pliable, butyl rubber compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than 0.040 inch.
  - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - 1) DuPont de Nemours, Inc.
    - 2) GCP Applied Technologies Inc.
    - 3) Wire-Bond.
  - b. Accessories: Provide preformed corners, end dams, other special shapes, and seaming materials produced by flashing manufacturer.
3. Elastomeric Thermoplastic Flashing: Composite flashing product consisting of a polyester-reinforced ethylene interpolymer alloy.
  - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - 1) Hohmann & Barnard, Inc.
    - 2) Mortar Net Solutions.
    - 3) Wire-Bond.
  - b. Monolithic Sheet: Elastomeric thermoplastic flashing, 0.040 inch thick.

- c. Self-Adhesive Sheet: Elastomeric thermoplastic flashing, 0.025 inch thick, with a 0.015-inch- thick coating of adhesive.
  - d. Self-Adhesive Sheet with Drip Edge: Elastomeric thermoplastic flashing, 0.025 inch thick, with a 0.015-inch- thick coating of rubberized-asphalt adhesive. Where flashing extends to face of masonry, rubberized-asphalt coating is held back approximately 1-1/2 inches from edge.
    - 1) Color: Tan/buff.
  - e. Accessories: Provide preformed corners, end dams, other special shapes, and seaming materials produced by flashing manufacturer.
4. EPDM Flashing: Sheet flashing product made from ethylene-propylene-diene terpolymer, complying with ASTM D4637/D4637M, 0.040 inch thick.
- a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - 1) Carlisle Coatings & Waterproofing Inc.
    - 2) Firestone Specialty Products.
    - 3) Heckmann Building Products, Inc.
    - 4) Wire-Bond.
- C. Application: Unless otherwise indicated, use the following:
- 1. Where flashing is indicated to receive counterflashing, use metal flashing.
  - 2. Where flashing is indicated to be turned down at or beyond the wall face, use metal flashing.
  - 3. Where flashing is partly exposed and is indicated to terminate at the wall face, use metal flashing with a drip edge or flexible flashing with a metal drip edge.
  - 4. Where flashing is fully concealed, use or flexible flashing.
- D. Single-Wythe CMU Flashing System: System of CMU cell flashing pans and interlocking CMU web covers made from UV-resistant, high-density polyethylene. Cell flashing pans have integral weep spouts designed to be built into mortar bed joints and that extend into the cell to prevent clogging with mortar.
- 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. Mortar Net Solutions.
- E. Solder and Sealants for Sheet Metal Flashings:
- 1. Solder for Stainless Steel: ASTM B32, Grade Sn60, with acid flux of type recommended by stainless-steel sheet manufacturer.
  - 2. Elastomeric Sealant: ASTM C920, chemically curing urethane sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and remain watertight.

- F. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.
- G. Termination Bars for Flexible Flashing: Stainless-steel sheet 0.019 inch by 1-1/2 inches with a 3/8 inch sealant flange at top.

## 2.9 MISCELLANEOUS MASONRY ACCESSORIES

- A. Compressible Filler: Premolded filler strips complying with ASTM D1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene.
- B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D2000, Designation M2AA-805 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.
- C. Bond-Breaker Strips: Asphalt-saturated felt complying with ASTM D226/D226M, Type I (No. 15 asphalt felt).

## 2.10 MASONRY CLEANERS

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

## 2.11 MORTAR AND GROUT MIXES

- A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.
  - 1. Do not use calcium chloride in mortar or grout.
  - 2. Use portland cement-lime mortar unless otherwise indicated.
- B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.

- C. Mortar for Unit Masonry: Comply with ASTM C270, Proportion Specification. Provide the following types of mortar for applications stated unless another type is indicated or needed to provide required compressive strength of masonry.
1. For masonry below grade or in contact with earth, use Type M.
  2. For reinforced masonry, use Type S.
  3. For exterior, above-grade, load-bearing and nonload-bearing walls and parapet walls; for interior load-bearing walls; for interior nonload-bearing partitions; and for other applications where another type is not indicated, use Type N.
  4. For interior nonload-bearing partitions, Type O may be used instead of Type N.
- D. Pigmented Mortar: Use colored cement product or select and proportion pigments with other ingredients to produce color required. Do not add pigments to colored cement products.
1. Pigments shall not exceed 10 percent of portland cement by weight.
  2. Mix to match Engineer's sample.
  3. Application: Use pigmented mortar for exposed mortar joints with the following units:
    - a. Decorative CMUs.
- E. Colored-Aggregate Mortar: Produce required mortar color by using colored aggregates and natural color or white cement as necessary to produce required mortar color.
1. Mix to match Engineer's sample.
  2. Application: Use colored-aggregate mortar for exposed mortar joints with the following units:
    - a. Decorative CMUs.
- F. Grout for Unit Masonry: Comply with ASTM C476.
1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with TMS 602/ACI 530.1/ASCE 6 for dimensions of grout spaces and pour height.
  2. Proportion grout in accordance with ASTM C476, Table 1 or paragraph 4.2.2 for specified 28-day compressive strength indicated, but not less than 2000 psi.
  3. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C143/C143M.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
  2. Verify that foundations are within tolerances specified.



3. Verify that reinforcing dowels are properly placed.
  4. Verify that substrates are free of substances that impair mortar bond.
- B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION, GENERAL

- A. Thickness: Build cavity and composite walls and other masonry construction to full thickness shown. Build single-wythe walls to actual widths of masonry units, using units of widths indicated.
- B. Build chases and recesses to accommodate items specified in this and other Sections.
- C. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match construction immediately adjacent to opening.
- D. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.
- E. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures. Mix units from several pallets or cubes as they are placed.
- F. Wetting of Brick: Wet brick before laying if initial rate of absorption exceeds 30 g/30 sq. in. per minute when tested according to ASTM C67. Allow units to absorb water so they are damp but not wet at time of laying.

### 3.3 TOLERANCES

- A. Dimensions and Locations of Elements:
1. For dimensions in cross section or elevation, do not vary by more than plus 1/2 inch or minus 1/4 inch.
  2. For location of elements in plan, do not vary from that indicated by more than plus or minus 1/2 inch.
  3. For location of elements in elevation, do not vary from that indicated by more than plus or minus 1/4 inch in a story height or 1/2 inch total.
- B. Lines and Levels:
1. For bed joints and top surfaces of bearing walls, do not vary from level by more than 1/4 inch in 10 feet, or 1/2-inch maximum.
  2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2-inch maximum.
  3. For vertical lines and surfaces, do not vary from plumb by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2-inch maximum.

4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2-inch maximum.
5. For lines and surfaces, do not vary from straight by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2-inch maximum.
6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet or 1/2-inch maximum.
7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch except due to warpage of masonry units within tolerances specified for warpage of units.

C. Joints:

1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch.
2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.
3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch or minus 1/4 inch.
4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch. Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch.
5. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than 1/16 inch from one masonry unit to the next.

### 3.4 LAYING MASONRY WALLS

- A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.
- B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less-than-nominal 4-inch horizontal face dimensions at corners or jambs.
- C. Stopping and Resuming Work: Stop work by stepping back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.
- D. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.
- E. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.
- F. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below, and rod mortar or grout into core.

- G. Fill cores in hollow CMUs with grout 24 inches under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.
- H. Build nonload-bearing interior partitions full height of story to underside of solid floor or roof structure above unless otherwise indicated.
  - 1. Install compressible filler in joint between top of partition and underside of structure above.
  - 2. Fasten partition top anchors to structure above and build into top of partition. Grout cells of CMUs solidly around plastic tubes of anchors and push tubes down into grout to provide 1/2-inch clearance between end of anchor rod and end of tube. Space anchors 48 inches o.c. unless otherwise indicated.
  - 3. At fire-rated partitions, treat joint between top of partition and underside of structure above to comply with Section 078443 "Joint Firestopping."

### 3.5 MORTAR BEDDING AND JOINTING

- A. Lay CMUs as follows:
  - 1. Bed face shells in mortar and make head joints of depth equal to bed joints.
  - 2. Bed webs in mortar in all courses of piers, columns, and pilasters.
  - 3. Bed webs in mortar in grouted masonry, including starting course on footings.
  - 4. Fully bed entire units, including areas under cells, at starting course on footings where cells are not grouted.
  - 5. Fully bed units and fill cells with mortar at anchors and ties as needed to fully embed anchors and ties in mortar.
- B. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.
- C. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.
- D. Cut joints flush where indicated to receive waterproofing unless otherwise indicated.

### 3.6 MASONRY-JOINT REINFORCEMENT

- A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcement a minimum of 6 inches.
  - 1. Space reinforcement not more than 16 inches o.c.
  - 2. Space reinforcement not more than 8 inches o.c. in foundation walls and parapet walls.
  - 3. Provide reinforcement not more than 8 inches above and below wall openings and extending 12 inches beyond openings in addition to continuous reinforcement.
- B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.
- C. Provide continuity at wall intersections by using prefabricated T-shaped units.
- D. Provide continuity at corners by using prefabricated L-shaped units.

- E. Cut and bend reinforcing units as directed by manufacturer for continuity at corners, returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

### 3.7 ANCHORING MASONRY TO STRUCTURAL STEEL AND CONCRETE

- A. Anchor masonry to structural steel and concrete, where masonry abuts or faces structural steel or concrete, to comply with the following:
  - 1. Provide an open space not less than 1/2 inch wide between masonry and structural steel or concrete unless otherwise indicated. Keep open space free of mortar and other rigid materials.
  - 2. Anchor masonry with anchors embedded in masonry joints and attached to structure.
  - 3. Space anchors as indicated, but not more than 24 inches o.c. vertically and 36 inches o.c. horizontally.

### 3.8 CONTROL AND EXPANSION JOINTS

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

### 3.9 LINTELS

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

### 3.10 FLASHING, WEEP HOLES, AND CAVITY VENTS

- A. Install single-wythe CMU flashing system in bed joints of CMU walls where indicated to comply with manufacturer's written instructions. Install CMU cell pans with upturned edges located below face shells and webs of CMUs above and with weep spouts aligned with face of

wall. Install CMU web covers so that they cover upturned edges of CMU cell pans at CMU webs and extend from face shell to face shell.

### 3.11 REINFORCED UNIT MASONRY

- A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.
  - 1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
  - 2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and that of other loads that may be placed on them during construction.
- B. Placing Reinforcement: Comply with requirements in TMS 602/ACI 530.1/ASCE 6.
- C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.
  - 1. Comply with requirements in TMS 602/ACI 530.1/ASCE 6 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
  - 2. Limit height of vertical grout pours to not more than 60 inches.

### 3.12 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Owner will engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas as needed to perform tests and inspections. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.
- B. Inspections: Special inspections according to Level B in TMS 402/ACI 530/ASCE 5.
  - 1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.
  - 2. Place grout only after inspectors have verified compliance of grout spaces and of grades, sizes, and locations of reinforcement.
  - 3. Place grout only after inspectors have verified proportions of site-prepared grout.
- C. Testing Prior to Construction: One set of tests.
- D. Testing Frequency: One set of tests for each 5000 sq. ft. of wall area or portion thereof.
- E. Concrete Masonry Unit Test: For each type of unit provided, according to ASTM C140 for compressive strength.
- F. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, according to ASTM C780.

- G. Mortar Test (Property Specification): For each mix provided, according to ASTM C780. Test mortar for mortar air content and compressive strength.
- H. Grout Test (Compressive Strength): For each mix provided, according to ASTM C1019.
- I. Prism Test: For each type of construction provided, according to ASTM C1314 at 7 days and at 28 days.

### 3.13 REPAIRING, POINTING, AND CLEANING

- A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.
- B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.
- C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.
- D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
  - 1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
  - 2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Engineer's approval of sample cleaning before proceeding with cleaning of masonry.
  - 3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
  - 4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
  - 5. Clean brick by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.
  - 6. Clean concrete masonry by applicable cleaning methods indicated in NCMA TEK 8-4A.
  - 7. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.
  - 8. Clean stone trim to comply with stone supplier's written instructions.
  - 9. Clean limestone units to comply with recommendations in ILI's "Indiana Limestone Handbook."

### 3.14 MASONRY WASTE DISPOSAL

- A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.

- B. Waste Disposal as Fill Material: Dispose of clean masonry waste, including excess or soil-contaminated sand, waste mortar, and broken masonry units, by crushing and mixing with fill material as fill is placed.
  - 1. Crush masonry waste to less than 4 inches in each dimension.
  - 2. Mix masonry waste with at least two parts of specified fill material for each part of masonry waste. Fill material is specified in Section 312000 "Earthwork."
  - 3. Do not dispose of masonry waste as fill within 18 inches of finished grade.
- C. Masonry Waste Recycling: Return broken CMUs not used as fill to manufacturer for recycling.
- D. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above or recycled, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION 042000

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## SECTION 050519 - POST-INSTALLED ANCHORS AND REINFORCING BARS

### 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. Post-installed adhesive and expansion anchors for concrete and concrete masonry unit substrates.
  - 2. Post-installed reinforcing bar dowels using adhesive anchoring system.

- B. Related Requirements:

- 1. Section 033000 "Cast-In-Place Concrete" and related Sections for concrete, reinforcement, and accessories.
  - 2. Section 042000 "Unit Masonry" for concrete masonry units and accessories.
  - 3. Various Sections in Division 05 related to metals.
  - 4. Section 067413 "Fiberglass Reinforced Components".
  - 5. Various Sections in Divisions 21, 22, 23, 25, 26, 27, and 28 related to facility utilities.
  - 6. Various Sections in Divisions 40, 41, 43, 44, and 46 related to process mechanical equipment.

#### 1.3 ACTION SUBMITTALS

- A. Submit in accordance with Section 013300.

- B. Post-Installed Expansion Anchors:

- 1. Design Data: Submit manufacturer's specifications and data including recommended design values and physical characteristics for expansion anchors.
  - 2. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, materials and finishes for post-installed expansion anchors installed into cracked concrete and masonry.
  - 3. Installation Procedures: Submit procedures stating product proposed for use, and complete installation method.

- C. Post-Installed Adhesive Anchoring System:

- 1. Design Data: Submit manufacturer's specifications and data including recommended design values and physical characteristics, including temperature, humidity, and moisture limitations for adhesive anchoring system.

2. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, materials and finishes for post-installed adhesive anchoring system installed into cracked concrete and masonry.
3. Installation Procedures: Submit procedures stating method of drilling, product proposed for use, and complete installation method.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Installation procedure: Submit installation procedure for post-installed adhesive anchoring system; including method of drilling.
- B. Certificates:
  1. Installer Qualifications for Adhesive Anchoring System: Submit installer and testing agency qualifications as stated in following Paragraph of this Article.
  2. Submit current International Code Council (ICC) Evaluation Service Reports (ESR) for expansion anchors and adhesive anchoring system, for installation into cracked concrete or masonry, as applicable, indicating conformance with current ICC Evaluation Service (ICC-ES) Acceptance Criteria.
- C. Qualification Data:
  1. Installer: Indicate manufacturer's training date and a list of personnel trained on installation of adhesive anchoring system.
- D. Evaluation Reports: From ICC-ES for expansion anchors and adhesive anchoring system, for installation of post-installed anchors into cracked concrete or concrete masonry unit, as applicable, indicating conformance with current ICC ES Acceptance Criteria.

#### 1.5 QUALITY ASSURANCE

- A. General: Coordinate with the work of other Sections, field verifying dimensions and work of other trades adjoining items of work before installing items specified in this Section.

#### 1.6 DELIVERY, STORAGE AND HANDLING

- A. Deliver items to be incorporated into the work of other trades in sufficient time to be checked prior to installation.
- B. Handle materials with cranes or derricks. Do not dump material off transportation vehicles or handle in ways that will cause damage.
- C. Store materials elevated above grade and block up so they will not become bent or otherwise damaged.
- D. Repair items that have become damage or corroded to satisfaction of the Engineer prior to incorporating them into the work.

## PART 2 - PRODUCTS

### 2.1 EXPANSION ANCHORS

- A. Fastening to Concrete Substrate: Zinc plated carbon steel wedge type anchors, complete with zinc plated nuts and washers, unless otherwise noted.
- B. Submerged or Weather Exposed Substrates: ASTM A276 Type 316 stainless steel wedge type anchors, complete with Type 316 stainless steel nuts and washers, unless otherwise noted.
- C. Meet ICC ES AC01 or ICC ES AC193.
- D. Length: When length or anchor embedment is not indicated, provide length sufficient to place the wedge and expansion cone portion of the anchor at least 1 inch behind concrete reinforcing steel.
- E. Basis-of-Design:
  - 1. Anchorage designs indicated are based on Hilti, Kwik-Bolt TZ, unless otherwise noted.
  - 2. Acceptable Anchors: Hilti Kwik-Bolt TZ; Simpson Strong-Tie Strong Bolt 2 Wedge Anchor; DeWalt Power-Stud+ SD1 (DeWalt Power-Stud+ SD6 for stainless steel); or equal.

### 2.2 ADHESIVE ANCHORING SYSTEM

- A. Fastening to Concrete Substrate: Manufactured system consisting of post installed threaded rods, nuts, washers, other anchoring hardware, and chemical dispenser for installation in hammer drilled holes.
  - 1. Anchors: Meet ICC ES AC308.
  - 2. Injection Adhesive: Two-component epoxy system consisting of a hardener and a resin, furnished in pre-measured side-by-side cartridges which keep both components separate.
  - 3. Adhesive Cartridge: Side-by-side design to accept a static mixing nozzle which thoroughly blends both components and allows injection directly into a drilled hole.
  - 4. Anchor: or Type 316 stainless steel as indicated consisting of an all-thread anchor rod with nut and washer, of matching material to anchor rod.
    - a. Basis-of-Design:
      - 1) Anchorage designs indicated are based on Hilti HIT-HY 200, unless otherwise noted.
      - 2) Acceptable Manufacturers: Hilti HIT-HY 200; Simpson Strong Tie SET-XP; ITW Ramset Red Head Epcon G5+; or equal.
- 5. Reinforcing Bar Dowels: Reinforcing bar, per Section 033000.
  - a. Basis-of-Design:
    - 1) Anchorage designs indicated are based on Hilti HIT-HY200, unless otherwise noted.

- 2) Acceptable Manufacturers: Hilti HIT-HY 200; Simpson Strong Tie SET-XP; ITW Ramset Red Head Epcon G5+; or equal.
- B. Fastening to Hollow Concrete Block, Brick, or Hollow-Core Precast Concrete Planks: Three-part threaded rod, screen tube, and chemical dispenser anchoring system.
1. Anchors: Meet ICC ES AC58.
  2. Adhesive Cartridges: Contain pre-measured amounts of resin and hardener which are mixed and deposited in a screen tube by a dispenser.
  3. Anchor: or Type 316 stainless steel as indicated consisting of an all-thread anchor rod with nut and washer, of matching material to anchor rod.
  4. Reinforcing Bar Dowel: Reinforcing bar, per Section 033000.
  5. Basis-of-Design:
    - a. Anchorage designs indicated are based on Hilti HIT HY-270 System, unless otherwise noted; or equal.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. General:
1. Install anchoring system in strict compliance with manufacturer's published installation instructions and approved Shop Drawings. Comply with recommended surface preparation, temperature, and moisture of substrate and ambient conditions.
  2. Coordinate installation with Special Inspector.
  3. Use drill bit of correct diameter and drill to required depth using rotary impact type hammer drills with carbide-tipped bits.
  4. Drill holes perpendicular to concrete surface, unless otherwise indicated.
  5. Use oil free compressed air to blast out loose particles and dust from drilled holes.
- B. Expansion anchors:
1. Check expansion anchors for tightness a minimum of 24 hours after initial installation.
- C. Adhesive anchoring system:
1. Inject adhesive and install anchors and reinforcing bar dowels that are clean and free of dirt, oil, grease, ice or other deleterious material which would reduce bond.

END OF SECTION 050519

## SECTION 053100 - STEEL DECKING

### 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. Roof deck.

- B. Related Requirements:

- 1. Section 055000 "Metal Fabrications" for framing deck openings with miscellaneous steel shapes.
  - 2. Various Sections in Division 07 for insulation and roofing systems applied over steel decking.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of deck, accessory, and product indicated.

- B. Shop Drawings:

- 1. Include layout and types of deck panels, anchorage details such as fastener types and sizes, weld types and sizes, and layout patterns, reinforcing channels, pans, cut deck openings, special jointing, closures, valley and ridge plates, cant strips, cover plates accessories, and attachments to other construction.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Manufacturer's load table including design thickness in inches and section properties, gravity load carrying capability at the span used, and diaphragm shear capacity.

- B. Welding certificates.

- C. Product Certificates: For each type of steel deck.

- D. Product Test Reports: For tests performed by a qualified testing agency, indicating that each of the following complies with requirements:

- 1. Power-actuated mechanical fasteners.

- E. Evaluation Reports: For steel deck and fasteners from ICC-ES.
- F. Field quality-control reports.

## 1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.
- B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."
  - 1. Perform by certified welders and in accordance with AISI SG-673 standard.
- C. Electrode manufacturer's data for actual electrodes proposed. Data shall include manufacturer's recommended welding parameters for each electrode to be used.
- D. FM Global Listing:
  - 1. Provide steel roof deck evaluated by FM Global and listed in its "Approval Guide, Building Materials" for Class 1 fire rating and Class 1-90 windstorm ratings.
  - 2. Provide FM Global deck fasteners, by one of the following manufacturers, with a minimum ½ inch integral washer diameter or ¾ inch washer at a maximum spacing of 6 inch:
    - a. Hilti Fasteners, Hilti Inc.
    - b. TEK Screws, ITW Buildex Corp.
- E. Certification from the Steel Deck Institute (SDI) that the steel roof deck is designed in accordance with the SDI.
- F. Conform to requirements of SDI Standard Specifications for steel roof deck.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.
- B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."

- B. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

## 2.2 ROOF DECK

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. New Millennium Building Systems, LLC.
  - 2. Nucor Corp.
  - 3. Valley Joist.
- B. Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 31, AISI, and 'North American Specification for the Design of Cold-Formed Steel Structural Members', and with the following:
  - 1. Galvanized and Shop-Primed Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade 33, G60 zinc coating; cleaned, pretreated, and primed with manufacturer's standard baked-on, rust-inhibitive primer.
    - a. Color: Manufacturer's standard.
  - 2. Deck Profile: As indicated on design drawings.
  - 3. Profile Depth: 1-1/2 inches.
  - 4. Design Uncoated-Steel Thickness: As indicated on design drawings.
  - 5. Span Condition: Simple span.
  - 6. Side Laps: Nestable.

## 2.3 ACCESSORIES

- A. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.
- B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.
- C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 12 minimum diameter.
- D. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.
- E. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi, not less than 0.0359-inch design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.

- F. Closures, Ridge Plates, Valley Plates, Cover Plates and Cant Strips: Steel sheet, of same material, finish, and thickness as deck, unless otherwise indicated.
- G. Weld Washers: Uncoated steel sheet, shaped to fit deck rib, 0.0598 inch thick, with factory-punched hole of 3/8-inch minimum diameter.
- H. Flat Sump Plates: Single-piece steel sheet, 0.0747 inch thick, of same material and finish as deck. For drains, cut holes in the field.
- I. Galvanizing Repair Paint: ASTM A 780/A 780M.
- J. Repair Paint: Manufacturer's standard rust-inhibitive primer of same color as primer.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

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

#### 3.2 INSTALLATION, GENERAL

- A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 31, manufacturer's written instructions, and requirements in this Section.
- B. Install temporary shoring before placing deck panels if required to meet deflection limitations.
- C. Locate deck bundles to prevent overloading of supporting members.
- D. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.
- E. Place deck panels flat and square and fasten to supporting frame without warp or deflection.
- F. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.
- G. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.
- H. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.
- I. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install according to deck manufacturer's written instructions.



### 3.3 ROOF-DECK INSTALLATION

- A. Fasten roof-deck panels to steel supporting members with fasteners indicated on the drawings.
- B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of one-half of the span or 18 inches, and as follows:
  - 1. Mechanically fasten with self-drilling, diameter No. 12 diameter or larger, carbon-steel screws.
- C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 2 inches, with end joints as follows:
  - 1. End Joints: Lapped 2 inches minimum.
- D. Miscellaneous Roof-Deck Accessories: Install ridge and valley plates, finish strips, end closures, cover plates, cant strips and reinforcing channels according to deck manufacturer's written instructions. Weld or mechanically fasten to substrate to provide a complete deck installation.
  - 1. Weld cover plates at changes in direction of roof-deck panels unless otherwise indicated.
- E. Flexible Closure Strips: Install flexible closure strips over partitions, walls, and where indicated. Install with adhesive according to manufacturer's written instructions to ensure complete closure.

### 3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Field welds will be subject to inspection.
- C. Prepare test and inspection reports.

### 3.5 PROTECTION

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A 780/A 780M and manufacturer's written instructions.
- B. Repair Painting: Wire brush and clean rust spots, welds, and abraded areas on both surfaces of prime-painted deck immediately after installation and apply repair paint.
  - 1. Apply repair paint, of same color as adjacent shop-primed deck, to bottom surfaces of deck exposed to view.

END OF SECTION 053100

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## SECTION 054000 - COLD-FORMED METAL FRAMING

### 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. Interior non-load-bearing wall framing exceeding height limitations of standard, nonstructural metal framing.
  - 2. Ceiling joist framing.
  - 3. Soffit framing.

- B. Related Requirements:

- 1. Section 055000 "Metal Fabrications" for miscellaneous steel shapes, masonry shelf angles, and connections used with cold-formed metal framing.
  - 2. Section 092216 "Non-Structural Metal Framing" for standard, interior non-load-bearing, metal-stud framing, with height limitations and ceiling-suspension assemblies.

#### 1.3 ACTION SUBMITTALS

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

- B. Shop Drawings:

- 1. Include layout, spacings, sizes, thicknesses, and types of cold-formed steel framing; fabrication; and fastening and anchorage details, including mechanical fasteners.
  - 2. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.

- C. Delegated-Design Submittal: For cold-formed steel framing.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.

- B. Welding certificates.

- C. Product Certificates: For each type of code-compliance certification for studs and tracks.

- D. Product Test Reports: For each listed product, for tests performed by a qualified testing agency.
  - 1. Steel sheet.
  - 2. Expansion anchors.
  - 3. Power-actuated anchors.
  - 4. Mechanical fasteners.
  - 5. Vertical deflection clips.
  - 6. Horizontal drift deflection clips
  - 7. Miscellaneous structural clips and accessories.
- E. Evaluation Reports: For nonstandard cold-formed steel framing from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.

## 1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.
- B. Product Tests: Mill certificates or data from a qualified independent testing agency indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, and metallic-coating thickness.
- C. Code-Compliance Certification of Studs and Tracks: Provide documentation that framing members are certified according to the product-certification program of the Certified Steel Stud Association the Steel Framing Industry Association or the Steel Stud Manufacturers Association.
- D. Welding Qualifications: Qualify procedures and personnel according to the following:
  - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
  - 2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."
- E. Comply with AISI S230 "Standard for Cold-Formed Steel Framing - Prescriptive Method for One and Two Family Dwellings."

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - 1. ClarkDietrich.
  - 2. MarinoWARE.
  - 3. SCAFCO Steel Stud Company.
  - 4. The Steel Network, Inc.
  - 5. United Metal Products, Inc.

## 2.2 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide cold-formed steel framing capable of withstanding design loads within limits and under conditions indicated.
  - 1. Design Loads: As indicated on Structural Drawings.
  - 2. Deflection Limits: Design framing systems to withstand design loads without deflections greater than the following:
    - a. Interior Non-Load-Bearing Framing: Horizontal deflection of 1/360 of the wall height under a horizontal load of 5 lbf/sq. ft..
    - b. Ceiling Joist Framing: Vertical deflection of 1/360 of the span for live loads and 1/240 for total loads of the span.
  - 3. Design framing systems to provide for movement of framing members located outside the insulated building envelope without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120 deg F.
  - 4. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure as follows:
    - a. Upward and downward movement of 1/2 inch .
  - 5. Design exterior non-load-bearing wall framing to accommodate horizontal deflection without regard for contribution of sheathing materials.
- B. Cold-Formed Steel Framing Standards: Unless more stringent requirements are indicated, framing shall comply with AISI S100, AISI S200, and the following:
  - 1. Floor and Roof Systems: AISI S210.
  - 2. Wall Studs: AISI S211.
  - 3. Headers: AISI S212.
  - 4. Lateral Design: AISI S213.
- C. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency acceptable to authorities having jurisdiction.

## 2.3 COLD-FORMED STEEL FRAMING MATERIALS

- A. Steel Sheet: ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of grade and coating designation as follows:
  - 1. Grade: As required by structural performance.
  - 2. Coating: G60, A60, AZ50, or GF30.

## 2.4 INTERIOR NON-LOAD-BEARING WALL FRAMING

- A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:
  - 1. Minimum Base-Metal Thickness: 0.0538 inch.
  - 2. Flange Width: 1-3/8 inches.
  - 3. Section Properties: Minimum allowable calculated section modulus = 0.839 in<sup>3</sup>, moment of inertia = 2.518 in<sup>4</sup>, and allowable moment = 18.98 (in-k).
- B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:
  - 1. Minimum Base-Metal Thickness: Matching steel studs.
  - 2. Flange Width: 1-1/4 inches.
- C. Vertical Deflection Clips: Manufacturer's standard bypass clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.
  - 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. ClarkDietrich.
    - b. MarinoWARE.
    - c. The Steel Network, Inc.
- D. Single Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track; unpunched, with unstiffened flanges, of web depth to contain studs while allowing free vertical movement, with flanges designed to support horizontal loads and transfer them to the primary structure, and as follows:
  - 1. Minimum Base-Metal Thickness: 0.0538 inch.
  - 2. Flange Width: 1 inch plus the design gap for one-story structures.
- E. Drift Clips: Manufacturer's standard bypass or head clips, capable of isolating wall stud from upward and downward vertical displacement and lateral drift of primary structure through positive mechanical attachment to stud web and structure.

## 2.5 CEILING JOIST FRAMING

- A. Steel Ceiling Joists: Manufacturer's standard C-shaped steel sections, of web depths indicated, punched with standard holes, with stiffened flanges, and as follows:
  - 1. Minimum Base-Metal Thickness: 0.0538 inch.
  - 2. Flange Width: 1-5/8 inches, minimum.

## 2.6 SOFFIT FRAMING

- A. Exterior Soffit Frame: Manufacturer's standard C-shaped steel sections, of web depths indicated, with stiffened flanges, and as follows:
  - 1. Minimum Base-Metal Thickness: 0.0538 inch.
  - 2. Flange Width: 1-5/8 inches, minimum.
  - 3. Section Properties: Minimum allowable calculated section modulus = 0.839 in<sup>3</sup>, moment of inertia = 2.518 in<sup>4</sup>, and allowable moment = 18.98 (in-k).

## 2.7 FRAMING ACCESSORIES

- A. Fabricate steel-framing accessories from ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated steel sheet, of same grade and coating designation used for framing members.
- B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:
  - 1. Supplementary framing.
  - 2. Bracing, bridging, and solid blocking.
  - 3. Web stiffeners.
  - 4. Anchor clips.
  - 5. End clips.
  - 6. Foundation clips.
  - 7. Gusset plates.
  - 8. Stud kickers and knee braces.
  - 9. Joist hangers and end closures.
  - 10. Hole-reinforcing plates.
  - 11. Backer plates.

## 2.8 ANCHORS, CLIPS, AND FASTENERS

- A. Steel Shapes and Clips: ASTM A 36/A 36M, zinc coated by hot-dip process according to ASTM A 123/A 123M.
- B. Anchor Bolts: ASTM F 1554, Grade 36, threaded carbon-steel hex-headed bolts, carbon-steel nuts, and flat, hardened-steel washers; zinc coated by hot-dip process according to ASTM A 153/A 153M, Class C.
- C. Power-Actuated Anchors: Fastener systems with design capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
- D. Mechanical Fasteners: ASTM C 1513, corrosion-resistant-coated, self-drilling, self-tapping, steel drill screws.
  - 1. Head Type: Low-profile head beneath sheathing; manufacturer's standard elsewhere.
- E. Welding Electrodes: Comply with AWS standards.

## 2.9 MISCELLANEOUS MATERIALS

- A. Galvanizing Repair Paint: ASTM A 780/A 780M.
- B. Cement Grout: Portland cement, ASTM C 150/C 150M, Type I; and clean, natural sand, ASTM C 404. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.
- C. Nonmetallic, Nonshrink Grout: Factory-packaged, nonmetallic, noncorrosive, nonstaining grout, complying with ASTM C 1107/C 1107M, and with a fluid consistency and 30-minute working time.
- D. Shims: Load-bearing, high-density, multimonomer, nonleaching plastic; or cold-formed steel of same grade and metallic coating as framing members supported by shims.
- E. Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch thick, selected from manufacturer's standard widths to match width of bottom track or rim track members as required.

## 2.10 FABRICATION

- A. Fabricate cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.
  - 1. Fabricate framing assemblies using jigs or templates.
  - 2. Cut framing members by sawing or shearing; do not torch cut.
  - 3. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, pneumatic pin fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.
    - a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
    - b. Locate mechanical fasteners and install according to Shop Drawings, with screws penetrating joined members by no fewer than three exposed screw threads.
  - 4. Fasten other materials to cold-formed steel framing by welding, bolting, pneumatic pin fastening, or screw fastening, according to Shop Drawings.
- B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies by means that prevent damage or permanent distortion.
- C. Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable variation of 1/8 inch in 10 feet and as follows:
  - 1. Spacing: Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
  - 2. Squareness: Fabricate each cold-formed steel framing assembly to a maximum out-of-square tolerance of 1/8 inch.



## PART 3 - EXECUTION

### 3.1 EXAMINATION

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

### 3.2 PREPARATION

- A. Install load-bearing shims or grout between the underside of load-bearing wall bottom track and the top of foundation wall or slab at locations with a gap larger than 1/4 inch to ensure a uniform bearing surface on supporting concrete or masonry construction.
- B. Install sealer gaskets at the underside of wall bottom track or rim track and at the top of foundation wall or slab at stud or joist locations.

### 3.3 INSTALLATION, GENERAL

- A. Cold-formed steel framing may be shop or field fabricated for installation, or it may be field assembled.
- B. Install cold-formed steel framing according to AISI S200, AISI S202, and manufacturer's written instructions unless more stringent requirements are indicated.
- C. Install shop- or field-fabricated, cold-formed framing and securely anchor to supporting structure.
  - 1. Screw, bolt, or weld wall panels at horizontal and vertical junctures to produce flush, even, true-to-line joints with maximum variation in plane and true position between fabricated panels not exceeding 1/16 inch.
- D. Install cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened.
  - 1. Cut framing members by sawing or shearing; do not torch cut.
  - 2. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.
    - a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
    - b. Locate mechanical fasteners, install according to Shop Drawings, and comply with requirements for spacing, edge distances, and screw penetration.
- E. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.

- F. Install temporary bracing and supports to secure framing and support loads equal to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.
- G. Do not bridge building expansion joints with cold-formed steel framing. Independently frame both sides of joints.
- H. Install insulation, specified in Section 072100 "Thermal Insulation," in framing-assembly members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.
- I. Fasten hole-reinforcing plate over web penetrations that exceed size of manufacturer's approved or standard punched openings.

### 3.4 INTERIOR NON-LOAD-BEARING WALL INSTALLATION

- A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure.
- B. Fasten both flanges of studs to top and bottom track unless otherwise indicated. Space studs as follows:
  - 1. Stud Spacing: As indicated on Drawings.
- C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.
- D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.
  - 1. Install single deep-leg deflection tracks and anchor to building structure.
  - 2. Install double deep-leg deflection tracks and anchor outer track to building structure.
  - 3. Connect vertical deflection clips to studs and anchor to building structure.
  - 4. Connect drift clips to cold-formed steel metal framing and anchor to building structure.
- E. Install horizontal bridging in wall studs, spaced vertically in rows indicated on Shop Drawings but not more than 48 inches apart. Fasten at each stud intersection.
  - 1. Channel Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.
  - 2. Strap Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
  - 3. Bar Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.
- F. Top Bridging for Single Deflection Track: Install row of horizontal bridging within 12 inches of single deflection track. Install a combination of bridging and stud or stud-track solid blocking of width and thickness matching studs, secured to stud webs or flanges.

1. Install solid blocking at centers indicated on Shop Drawings.
- G. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

### 3.5 JOIST INSTALLATION

- A. Install perimeter joist track sized to match joists. Align and securely anchor or fasten track to supporting structure at corners, ends, and spacings indicated on Shop Drawings.
- B. Install joists bearing on supporting frame, level, straight, and plumb; adjust to final position, brace, and reinforce. Fasten joists to both flanges of joist track.
  1. Install joists over supporting frame with a minimum end bearing of 1-1/2 inches.
  2. Reinforce ends and bearing points of joists with web stiffeners, end clips, joist hangers, steel clip angles, or steel-stud sections.
- C. Space joists not more than 2 inches from abutting walls, and as follows:
  1. Joist Spacing: As indicated on Drawings.
- D. Install joist reinforcement at interior supports with single, short length of joist section located directly over interior support, with lapped joists of equal length to joist reinforcement.
  1. Install web stiffeners to transfer axial loads of walls above.
- E. Install bridging at intervals indicated on Shop Drawings. Fasten bridging at each joist intersection as follows:
  1. Joist-Track Solid Bridging: Joist-track solid blocking of width and thickness indicated, secured to joist webs.
  2. Combination Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and joist-track solid blocking of width and thickness indicated. Fasten flat straps to bottom flange of joists and secure solid blocking to joist webs.
- F. Secure joists to load-bearing interior walls to prevent lateral movement of bottom flange.
- G. Install miscellaneous joist framing and connections, including web stiffeners, closure pieces, clip angles, continuous angles, hold-down angles, anchors, and fasteners, to provide a complete and stable joist-framing assembly.

### 3.6 ERECTION TOLERANCES

- A. Install cold-formed steel framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:
  1. Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

### 3.7 FIELD QUALITY CONTROL

- A. Testing: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Field and shop welds will be subject to testing and inspecting.
- C. Testing agency will report test results promptly and in writing to Contractor and Engineer.
- D. Cold-formed steel framing will be considered defective if it does not pass tests and inspections.
- E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

### 3.8 REPAIRS AND PROTECTION

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed steel framing with galvanized repair paint according to ASTM A 780/A 780M and manufacturer's written instructions.
- B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that cold-formed steel framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION 054000

## SECTION 054400 - COLD-FORMED METAL TRUSSES

### 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 cold-formed steel framing in the form of the following:
  - 1. Cold-formed steel trusses for roofs.
- B. Related Requirements:
  - 1. Section 053100 "Steel Deck" for steel roof and floor deck.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings:
  - 1. Include product data including truss component manufacturer's descriptive literature for each item of cold formed metal framing and necessary accessories.
  - 2. Include detailed drawings prepared by Truss Manufacturer under supervision of Truss Design Engineer that are in accordance with AISI references.
  - 3. Include truss placement diagram drawings which identify the location of each individual truss and references the corresponding truss design drawing. Include layout, spacings, sizes, thicknesses, and types of cold-formed steel trusses; fabrication; and dimensions, fastening and anchorage details, including mechanical fasteners.
  - 4. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.
  - 5. Include truss component manufacturer's printed instructions for handling, storage, and installation of each item of cold-formed metal framing and each specified accessory.
- C. Delegated-Design Submittal: For cold-formed steel trusses.
  - 1. Include complete structural design calculations signed and sealed by a professional structural engineer registered in the State of Florida.
  - 2. Include product data including truss component manufacturer's descriptive literature for each item of cold formed metal framing and necessary accessories.

3. Include detailed drawings prepared by Truss Manufacturer under supervision of Truss Design Engineer that are in accordance with AISI references.
4. Include truss placement diagram drawings which identify the location of each individual truss and references the corresponding truss design drawing. Include layout, spacings, sizes, thicknesses, and types of cold-formed steel trusses; fabrication; and fastening and anchorage details, including mechanical fasteners. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.
5. Include truss component manufacturer's printed instructions for handling, storage, and installation of each item of cold-formed metal framing and each specified accessory.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.
- B. Welding certificates.
- C. Product Test Reports: For each listed product, for tests performed by manufacturer and witnessed by a qualified testing agency.
  1. Steel sheet.
  2. Expansion anchors.
  3. Power-actuated anchors.
  4. Mechanical fasteners.
  5. Miscellaneous structural clips and accessories.
- D. Evaluation Reports: For post-installed anchors and power-actuated fasteners, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.
- E. Field quality-control reports.
- F. Manufacturer's printed installation instructions for handling, storage, and installation of each item of cold formed metal trusses, framing, bracing, and specified accessories.

#### 1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.
- B. Product Tests: Mill certificates or data from a qualified independent testing agency indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, and metallic-coating thickness.
- C. Welding Qualifications: Qualify procedures and personnel according to the following:
  1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
  2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

## 1.6 DELIVERY STORAGE AND HANDLING

- A. Deliver materials in fabricator's unopened containers or bundles, fully identified by name, brand, type and grade. Follow recommendations from truss component manufacturer and exercise care to avoid damage during unloading, storing, and erection.
- B. Store trusses on blocking, pallets, platforms or other supports off the ground and in an upright position sufficiently braced to avoid damage from excessive bending and as recommended by the truss component manufacturer.
- C. Protect trusses and accessories from corrosion, deformation, damage, and deterioration when stored at job site. Keep trusses free of dirt and other foreign matter.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Acceptable Truss Manufacturers:
  - 1. TrusSteel Products from Alpine TrusSteel, an ITW Company, Orlando, FL
  - 2. Aegis Metal Framing, LLC, Chesterfield, MO.
  - 3. Or Approved Equal

### 2.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design cold-formed steel trusses.
- B. Structural Performance: Provide cold-formed steel trusses capable of withstanding design loads within limits and under conditions indicated.
  - 1. Design Loads: As indicated on Drawings.
  - 2. Deflection Limits: Design trusses to withstand design loads without deflections greater than the following:
    - a. Roof Trusses: Live load vertical deflection of 1/240 of the span.
  - 3. Design trusses to provide for movement of truss members located outside the insulated building envelope without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120 deg F.

- C. Cold-Formed Steel Truss Standards: Unless more stringent requirements are indicated, trusses shall comply with the following:
  - 1. Floor and Roof Systems: AISI S210.
  - 2. Lateral Design: AISI S213.
  - 3. Roof Trusses: AISI S214.
- D. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Indicate design designations from UL or from the listings of another qualified testing agency acceptable to authorities having jurisdiction.

## 2.3 COLD-FORMED STEEL TRUSS MATERIALS

- A. Steel Sheet: ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of grade and coating designation as follows:
  - 1. Grade: As required by structural performance.
  - 2. Coating: G60.

## 2.4 ROOF TRUSSES

- A. Roof Truss Members: Manufacturer's standard steel sections.
  - 1. Connecting Flange Width: 1-5/8 inches, minimum at top and bottom chords connecting to sheathing or other directly fastened construction.

## 2.5 TRUSS ACCESSORIES

- A. Fabricate steel-truss accessories from steel sheet, ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated steel sheet, of same grade and coating designation used for truss members.
- B. Provide accessories of manufacturer's standard thickness and configuration unless otherwise indicated.

## 2.6 ANCHORS, CLIPS, AND FASTENERS

- A. Steel Shapes and Clips: ASTM A 36/A 36M, zinc coated by hot-dip process according to ASTM A 123/A 123M.
- B. Anchor Bolts: ASTM F 1554, Grade 36, threaded carbon-steel hex-headed bolts, carbon-steel nuts, and flat, hardened-steel washers; zinc coated by hot-dip process according to ASTM A 153/A 153M, Class C.
- C. Post-Installed Anchors: Fastener systems with bolts of same basic metal as fastened metal, if visible, unless otherwise indicated; with design capacity greater than or equal to the design load,



according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC193 or ICC-ES AC308 as appropriate for the substrate.

1. Uses: Securing cold-formed steel trusses to structure.
  2. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, unless otherwise indicated.
  3. Material for Exterior or Interior Locations and Where Stainless Steel Is Indicated: Alloy Group 2 stainless-steel bolts, ASTM F 593, and nuts, ASTM F 594.
- D. Power-Actuated Fasteners: Fastener systems with design capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
- E. Mechanical Fasteners: ASTM C 1513, corrosion-resistant-coated, self-drilling, self-tapping steel drill screws.
1. Head Type: Low-profile head beneath sheathing; manufacturer's standard elsewhere.
- F. Welding Electrodes: Comply with AWS standards.

## 2.7 MISCELLANEOUS MATERIALS

- A. Galvanizing Repair Paint: ASTM A 780/A 780M.
- B. Shims: Load-bearing, high-density multimonomer, nonleaching plastic; or cold-formed steel of same grade and metallic coating as truss members supported by shims.

## 2.8 FABRICATION

- A. Fabricate cold-formed steel trusses and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.
1. Fabricate trusses using jigs or templates.
  2. Cut truss members by sawing or shearing; do not torch cut.
  3. Fasten cold-formed steel truss members by welding, screw fastening, clinch fastening.
    - a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
  4. Fasten other materials to cold-formed steel trusses by welding, bolting, or screw fastening, according to Shop Drawings.
  5. Riveting is not acceptable.
- B. Reinforce, stiffen, and brace trusses to withstand handling, delivery, and erection stresses. Lift fabricated trusses by means that prevent damage or permanent distortion.
- C. Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable variation of 1/8 inch in 10 feet and as follows:

1. Spacing: Space individual truss members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
2. Squareness: Fabricate each cold-formed steel truss to a maximum out-of-square tolerance of 1/8 inch.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

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

### 3.2 PREPARATION

- A. Before sprayed fire-resistive materials are applied, attach continuous angles, supplementary framing, or tracks to structural members indicated to receive sprayed fire-resistive materials.
- B. After applying sprayed fire-resistive materials, remove only as much of these materials as needed to complete installation of cold-formed steel trusses without reducing thickness of fire-resistive materials below that required to obtain fire-resistance ratings indicated. Protect remaining fire-resistive materials from damage.

### 3.3 INSTALLATION

- A. Install bridging and brace cold-formed steel trusses according to AISI S200, AISI S202, AISI S214, and manufacturer's written instructions unless more stringent requirements are indicated.
  1. Anchor trusses securely at all bearing points.
  2. Install continuous bridging and permanently brace trusses as indicated on Shop Drawings and designed according to CFSEI's Technical Note 551e, "Design Guide: Permanent Bracing of Cold-Formed Steel Trusses."
- B. Install cold-formed steel trusses and accessories true to line and location, and with connections securely fastened.
  1. Erect trusses with plane of truss webs plumb and parallel to each other. Align and accurately position trusses at required spacings.
  2. Erect trusses without damaging truss members or connections.
  3. Fasten cold-formed steel trusses by welding or mechanical fasteners.
    - a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
    - b. Locate mechanical fasteners, install according to Shop Drawings, and comply with requirements for spacing, edge distances, and screw penetration.

- C. Install temporary bracing and supports to secure trusses and support loads equal to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to trusses are secured.
- D. Truss Spacing: As indicated on Drawings.
- E. Do not alter, cut, or remove truss members or connections of trusses.
- F. During construction, adequately distribute all loads applied to trusses so as not to exceed carrying capacity of any one truss or other component.

### 3.4 ERECTION TOLERANCES

- A. Install cold-formed steel trusses level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:
  - 1. Space individual trusses no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

### 3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Cold-formed metal trusses will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

### 3.6 REPAIRS AND PROTECTION

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed steel trusses with galvanized repair paint according to ASTM A 780/A 780M and manufacturer's written instructions.
- B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that cold-formed steel trusses are without damage or deterioration at time of Substantial Completion.

END OF SECTION 054400

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## SECTION 055000 - METAL FABRICATIONS

### 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. Steel framing and supports for overhead doors and grilles.
2. Steel framing and supports for mechanical and electrical equipment.
3. Steel framing and supports for applications where framing and supports are not specified in other Sections.
4. Steel angles.
5. Steel support brackets.
6. Steel bridge crane rails.
7. Steel holddown straps and lugs.
8. Miscellaneous items fabricated from steel aluminum or stainless steel.
9. Bridge crane runway rails.
10. Steel pipe pieces for sleeves.
11. Castings.
12. Metal ladders.
13. Fall Prevention Systems.
14. Metal bollards.
15. Loose bearing and leveling plates for applications where they are not specified in other Sections.

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

1. Anchor bolts, steel pipe sleeves, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.
2. Steel weld plates and angles for casting into concrete for applications where they are not specified in other Sections.

- C. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for installing anchor bolts, steel pipe sleeves, wedge-type inserts, and other items cast into concrete.
2. Section 036000 "Grouting" for non-shrink grout.
3. Section 042000 "Unit Masonry" for installing anchor bolts, and other items built into unit masonry.
4. Section 050519 "Post-Installed Anchors and Reinforcing Bars" for anchors in various substrates.

5. Section 067413 "Fiberglass Reinforced Plastic Components".
6. Various Sections in Divisions 40 - 46 for process mechanical work scopes.

### 1.3 COORDINATION

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

### 1.4 ACTION SUBMITTALS

- A. Product Data: For the following:
  1. Metal nosings and treads.
  2. Paint products.
- B. Shop Drawings: Show fabrication and installation details. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items. Provide Shop Drawings for the following:
  1. Steel framing and supports for overhead doors and grilles.
  2. Steel framing and supports for mechanical and electrical equipment.
  3. Steel framing and supports for applications where framing and supports are not specified in other Sections.
  4. Metal ladders.
  5. Fall Prevention System.
  6. Metal bollards.
  7. Miscellaneous steel items.
  8. Miscellaneous aluminum items.
  9. Miscellaneous stainless steel items.

### 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For professional engineer.
- B. Mill Certificates: Signed by aluminum, steel and stainless steel manufacturers, certifying that products furnished comply with requirements.
- C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

## 1.6 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Welding Qualifications: Qualify procedures and personnel according to the following:
  - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
  - 2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
  - 3. AWS D1.6/D1.6M, "Structural Welding Code - Stainless steel."
- C. Evaluation Reports: Post-installed concrete anchors, from ICC-ES for expansion anchors and adhesive anchor system, for installation into cracked concrete or unit masonry, as applicable, indicating conformance with current ICC ES Acceptance Criteria.

## 1.7 FIELD CONDITIONS

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

## PART 2 - PRODUCTS

### 2.1 METALS

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.
- B. Steel Wide Flange Shapes: ASTM A992.
- C. Steel Other Shapes, Plates, Shapes, and Bars: ASTM A 36/A 36M.
- D. Stainless steel Sheet, Strip, and Plate: ASTM A 240/A 240M or ASTM A 666, Type 316, Type 316L for welded components.
- E. Stainless steel Bars and Shapes: ASTM A 276, Type 316, Type 316L for welded components.
- F. Rolled-Steel Floor Plate: ASTM A 786/A 786M, rolled from plate complying with ASTM A 36/A 36M or ASTM A 283/A 283M, Grade C or D.
- G. Rolled-Stainless Steel Floor Plate: ASTM A 793.
- H. Steel Tubing: ASTM A 500/A 500M, Grade B cold-formed steel tubing.
- I. Steel Pipe: ASTM A 53/A 53M, Type S Grade B Standard Weight (Schedule 40) unless otherwise indicated.
- J. Cast Iron: Either gray iron, ASTM A 48/A 48M, or malleable iron, ASTM A 47/A 47M, unless otherwise indicated.

- K. Aluminum Extruded Pipe: ASTM B429, Alloy 6063 T6 and Alloy 6061 T6 as indicated.
- L. Aluminum Plate and Sheet: ASTM B 209, Alloy 6061-T6.
- M. Aluminum Extrusions: ASTM B 221, Alloy 6061 T6.
- N. Aluminum-Alloy Rolled Tread Plate: ASTM B 632/B 632M, Alloy 6061-T6.
- O. Aluminum Castings: ASTM B 26/B 26M, Alloy 443.0-F.
- P. Bronze Extrusions: ASTM B 455, Alloy UNS No. C38500 (extruded architectural bronze).
- Q. Bronze Castings: ASTM B 584, Alloy UNS No. C83600 (lead red brass) or No. C84400 (lead semired brass).
- R. Nickel Silver Extrusions: ASTM B 151/B 151M, Alloy UNS No. C74500.
- S. Nickel Silver Castings: ASTM B 584, Alloy UNS No. C97600 (20 percent lead nickel bronze).
- T. Gray Iron Castings: ASTM A48, Class 35.
- U. Ductile Iron Castings: ASTM A536, Grade 65-45-12.
- V. Stainless steel Bolts: ASTM F593, Type 316.
- W. Stainless steel Nuts: ASTM F594, Type 316.
- X. Carbon Steel Bolts and Studs: ASTM A307, Grade A (hot dip galvanized nuts and washers where noted)
- Y. High Strength Steel Bolts, Nuts and washers: ASTM F3125, Grade A325 (mechanically galvanized per ASTM B695, Class 50, where noted).
  - 1. Elevated Temperature Exposure: Type I.
  - 2. General Application: Type I or Type II.
- Z. Galvanizing: ASTM A123, Zn w/0.05 percent minimum Ni.
- AA. Galvanizing, hardware: ASTM A153, Zn w/0.05 percent minimum Ni.
- BB. Galvanizing, anchor bolts: ASTM F2329, Zn w/0.05 percent minimum Ni.
- CC. Welding electrodes, steel: AWS A5.1 E70xx.

## 2.2 FASTENERS

- A. Unless otherwise noted, provide steel machine bolts for the connection of carbon steel or iron; galvanized steel or stainless-steel machine bolts for the connection of galvanized steel or iron; and stainless steel machine bolts for the connection of aluminum or stainless-steel.



- B. General: Unless otherwise indicated, provide Type 316 stainless steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.
1. Provide stainless steel fasteners for fastening aluminum.
  2. Provide stainless steel fasteners for fastening stainless steel.
  3. Provide stainless steel fasteners for fastening nickel silver.
  4. Provide bronze fasteners for fastening bronze.
- C. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A; with hex nuts, ASTM A 563; and, where indicated, flat washers.
- D. Mechanically Galvanized Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM F 3125, Grade A325, Type 3; with hex nuts, ASTM A 563, Grade C3; and, where indicated, flat washers.
- E. Stainless steel Bolts and Nuts: Regular hexagon-head annealed stainless steel bolts, ASTM F 593; with hex nuts, ASTM F 594; and, where indicated, flat washers; Alloy Group 2.
- F. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, ASTM A 563; and, where indicated, flat washers.
1. Provide standard headed bolts with heavy hex nuts and Grade A washers.
  2. Where galvanized anchor bolts are indicated or specified, provide standard headed bolts with heavy hex nuts and Grade A washers, galvanize in accordance with ASTM F 2329.
- G. Automatic End Welded Headed Anchor Studs and Flux Ended Studs: Cold drawn steel, ASTM A 108, Grades C-1010 through C-1020.
1. Basis-of-Design - Headed Anchor Studs as Manufactured by Nelson or equal: H4L Headed Concrete Anchors.
- H. Machine bolts and nuts conforming to Federal Specification FF-B-575C. Bolts and nuts shall be hexagon type. Bolts, nuts, screws, washers and related appurtenances shall be Type 316 stainless steel.
- I. Toggle Bolts: shall be Hilti, Toggler Bolt or equal.
- J. Anchors, General: Anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.
- K. Cast-in-Place Anchors in Concrete: Either threaded type or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A 47 malleable iron or ASTM A 27 cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F 2329.

## 2.3 MISCELLANEOUS ALUMINUM

- A. Miscellaneous Aluminum: Formed true to detail, with clean, straight, sharply defined profiles and smooth surfaces of uniform color and texture and free from defects impairing strength or durability. Drill or punch holes. Smooth edges without burrs. Fabricate supplementary pieces necessary to complete each item though such pieces are not definitely shown or specified.
- B. Connections and Accessories: Sufficient strength to safely withstand the stresses and strains to which they will be subjected. Close fitting exposed joints and jointed where least conspicuous. Conceal threads on threaded connections where practical. Provide continuous welds or intermittent welds on welded connections as specified or shown. Dress face of welds flush and smooth. Weld on unexposed side as much as possible in order to prevent pitting or discoloration of the aluminum exposed surface. Provide holes for temporary field connections and for attachment of the work of other trades.
- C. Miscellaneous Aluminum Items: Beams, angles, closure angles, grates, floor plates, stop plates, stair nosings, and other miscellaneous aluminum indicated and not otherwise specified.
- D. Angle Frames for Beams, Grates, and Similar Items: Complete with welded strap anchors attached.
- E. Stair Treads for Aluminum Stairs: As specified for grating and having cast abrasive non-slip nosing as approved.
- F. Aluminum Nosing at Concrete Stairs: Furnish with wing type anchors and flat head stainless steel machine screws, 12 inches on center. Single piece nosing for each step extending to within 3 inches at each side of stair. Set nosing flush with stair tread finish at concrete stairs. Furnish treads with heavy duty protective tape cover.
  - 1. Basis-of-Design: Wooster Products, Inc.; Alumogrit Treads, Type 116; similar by Barry Pattern and Foundry Co.; Andco or equal.
- G. Aluminum Finishes:
  - 1. Anodized Finish: Give an anodic oxide treatment in accordance with AA M31C22A41 for the following items: .
  - 2. Mill Finish: Have a cleaned and degreased mill finish on other aluminum items.

## 2.4 MISCELLANEOUS STEEL

- A. Miscellaneous Steel Work: Formed true to detail, with clean, straight, sharply defined profiles and smooth surfaces of uniform color and texture and free from defects impairing strength or durability. Drill or punch holes. Smooth edges without burrs. Fabricate supplementary pieces necessary to complete each item though such pieces are not definitely shown or specified.
- B. Connections and Accessories: Sufficient strength to safely withstand the stresses and strains to which they will be subjected. Close fitting exposed joints and jointed where least conspicuous. Conceal thread on threaded connections where practical. Provide continuous welds or intermittent welds on welded connections as specified or shown. Dress face of welds flush and

smooth. Provide holes for temporary field connections and for attachment of the work of other trades.

- C. Miscellaneous Steel Items: Beams, angles, detailed on the Drawings, support brackets, base plates for other than structural steel or equipment, closure angles, bridge crane rails, hold-down straps and lugs, door frames, splice plates, subframing at roof openings and any other miscellaneous steel indicated and not otherwise specified.
- D. Bridge crane runway rails: 30 lb ASCE or as required per bridge crane manufacturer. Installation and anchoring shall be per the manufacturer's recommendations.
- E. Runway Beam
  - 1. Maximum Span: As shown on the Contract Drawings.
  - 2. Runway beam shall meet the requirements of AISC 360. Beam shall be sized for maximum loads as shown on the Contract Drawings with deflection not to exceed  $L/600$  of the span.
- F. Steel pipe pieces for sleeves, lifting attachments and other functions: Schedule 40 pipe unless otherwise indicated. Wall and floor sleeves, of steel pipe: Provide welded circumferential steel waterstops at mid-length.
- G. Steel Finish Work: Thoroughly cleaned, by effective means, of loose mill scale, rust and foreign matter. Provide one shop coat of primer compatible with finish coat after fabrication but before shipment. Omit paint within 3 inches of proposed field welds. Apply paint to dry surfaces and be thoroughly and evenly spread and well worked into joints and other open spaces.
- H. Galvanizing, where required: Use hot-dip zinc process after fabrication, coating not less than 2 oz/sq. ft. of surface.

## 2.5 MISCELLANEOUS STAINLESS-STEEL

- A. Miscellaneous Stainless-Steel Work: Formed true to detail, with clean, straight, sharply defined profiles and smooth surfaces of uniform color and texture and free from defects impairing strength or durability. Drill or punch holes. Smooth edges without burrs. Fabricate supplementary pieces necessary to complete each item though such pieces are not definitely shown or specified.
- B. Connections and accessories: Sufficient strength to safely withstand the stresses and strains to which they will be subjected. Close fitting exposed joints, jointed where least conspicuous. Conceal threads on threaded connections where practical. Provide continuous welds or intermittent welds on welded connections as specified or shown. Dress face of welds flush and smooth. Provide holes for temporary field connections and for attachment of the work of other trades.
- C. Beams, angles, and other miscellaneous stainless steel.

## 2.6 MISCELLANEOUS MATERIALS

- A. Shop Primers: Provide primers that comply with Section 099010 "Shop Priming."
- B. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
  - 1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.
- C. Water-Based Primer: Emulsion type, anticorrosive primer for mildly corrosive environments that is resistant to flash rusting when applied to cleaned steel, complying with MPI#107 and compatible with topcoat.
- D. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.
- E. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish paint systems indicated.
- F. Galvanizing Repair Paint: High-zinc-dust-content paint complying with ASTM A 780 and compatible with paints specified to be used over it.
- G. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

## 2.7 CASTINGS:

- A. General: Good quality, strong, tough, even-grained, smooth, free from scale, lumps, blisters, sand holes, and other defects. Thoroughly clean castings to remove foreign matter, and deleterious films. Castings will be subjected to a hammer inspection in the field by the Engineer. Damaged castings may be rejected and replaced at no cost to the Owner.
- B. Matching Surfaces: Machine to a true plane surface allowing contact surfaces to seat without rocking. Provide allowances in patterns so specified thickness is not reduced to obtain finished surfaces. Castings will not be acceptable if actual weight is less than 95 percent of theoretical weight computed from dimensions. Provide facilities for weighing castings in the presence of the Engineer.

## 2.8 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- D. Form exposed work with accurate angles and surfaces and straight edges.

- E. Weld corners and seams continuously to comply with the following:
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove welding flux immediately.
  - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.
- G. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.
- I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.
- J. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/4 by 1 inch, with a minimum 6 inch embedment and 1 1/2-inch hook, not less than 8 inches from ends and corners of units and 24 inches o.c., unless otherwise indicated.

## 2.9 MISCELLANEOUS FRAMING AND SUPPORTS

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

## 2.10 METAL LADDERS

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

B. Aluminum Ladders:

1. Space siderails minimum 18 inches apart, unless otherwise indicated.
2. Siderails: Continuous aluminum bars 1/2-by-2-1/2-inch.
3. Rungs: Solid extruded-aluminum tubes, 3/4 inch diameter.
4. Fit rungs in centerline of siderails; fasten as indicated.
5. Wall Support Brackets: Aluminum 6061-T6 spaced 4 feet on center with Type 316 stainless steel fasteners. Fasten side rails to floor with 1/2 inch diameter Type 316 stainless steel expansion anchors.
6. Support each ladder as indicated with welded or bolted aluminum brackets.
7. Provide minimum 72-inch- high, hinged security door with padlock hasp at foot of ladder to prevent unauthorized ladder use.

2.11 LADDER SAFETY SYSTEM

A. Provide a ladder safety system at each ladder more than 20 feet high and as indicated.

1. Provide an aluminum or stainless steel vertical rigid rail, rail brackets for continuous travel, rail extension, stainless steel mounting hardware and fasteners, two non-corrosive metal sliding fall prevention devices, two full body harnesses with "D" rings, accessories and other materials required for complete installation and operation of ladder safety system in accordance with manufacturer's recommendations.
2. Provide 36 inch minimum height permanent aluminum or stainless steel rail extension compatible with sliding fall prevention device to ensure worker is attached to ladder safety system while mounting and dismounting from a platform or landing. Provide removable ladder extensions at manholes, hatches, and roof scuttles. Provide stainless steel hardware and fasteners, accessories, and other materials required for complete installation to ladders in accordance with manufacturer's recommendations.
3. Provide alignment between successive pieces of rail. Provide allowance for expansion and contraction on long runs.
4. In addition to "D" ring used for attachment to sliding fall prevention device, provide harnesses with at least two "D" rings for attachment of safety straps and lanyards.
5. Attach ladder safety system to installed ladders. Provide sliding fall prevention device allowing worker to climb up and down using both hands and move freely up and down the rail with worker in normal climbing position. Do not allow connection between sliding fall prevention device and harness attachment point to exceed 9 inches. Fabricate ladder safety system to stop the fall of a worker independently from offset ladders, platforms, or safety cages.
6. Conform to OSHA Regulation 1910.21 for ladder safety system. Rope or cable systems will not be allowed.
7. Basis-of-Design - Ladder Safety System: Saf-T-Climb by Honeywell International Inc.; Railok 90 by 3M Fall Protection; GlideLoc System by Honeywell International Inc.; or equal.
8. Provide ladder safety post extensions on fixed ladders 20 feet or less in height located below hatches and roof scuttles and as indicated. Locking aluminum telescoping safety post extension in its vertical position and extend a minimum of 36-in above opening and be secured to ladder rungs with stainless steel fasteners and brackets.
  - a. Basis-of-Design: Ladder UP Safety Post, Model LU-4 by Bilco Co.; Series L1E Safety Extension by Halliday Products; or equal.

9. Ladder Shields: Mount 7 feet above finish grade
  - a. Basis-of-Design: Lad-Saf Ladder Gate by 3M Fall Protection; or equal.

## 2.12 METAL BOLLARDS

- A. Fabricate metal bollards from Schedule 40 steel pipe.
  1. Cap bollards with round off top.
  2. Where bollards are indicated to receive controls for door operators, provide cutouts for controls and holes for wire.
  3. Where bollards are indicated to receive light fixtures, provide cutouts for fixtures and holes for wire.
- B. Fabricate bollards with 3/8-inch- thick steel baseplates for bolting to concrete slab. Drill baseplates at all four corners for 3/4-inch anchor bolts.
  1. Provide 1-inch minimum of nonshrink grout beneath bollard base plate to allow for plumb alignment of bollards.
- C. Fabricate sleeves for bollard anchorage from steel pipe with 1/4-inch- thick steel plate welded to bottom of sleeve. Make sleeves not less than 8 inches deep and 3/4 inch larger than OD of bollard.
- D. Fabricate internal sleeves for removable bollards from Schedule 40 steel pipe or 1/4-inch wall-thickness steel tubing with an OD approximately 1/16 inch less than ID of bollards. Match drill sleeve and bollard for 3/4-inch steel machine bolt.
- E. Prime bollards with zinc-rich primer. primer specified in Section 099600 "High-Performance Coatings."

## 2.13 LOOSE BEARING AND LEVELING PLATES

- A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.
- B. Galvanize plates.

## 2.14 STEEL WELD PLATES AND ANGLES

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

## 2.15 FINISHES, GENERAL

- A. Finish metal fabrications after assembly.

- B. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

## 2.16 STEEL AND IRON FINISHES

- A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products. Limit maximum nickel (Ni) content of galvanizing zinc to 0.05%.
  - 1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
- B. Preparation for Shop Priming Galvanized Items: After galvanizing, thoroughly clean of grease, dirt, oil, flux, and other foreign matter, and treat with metallic phosphate process.
- C. Shop prime iron and steel items unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.
  - 1. Shop prime with primers specified in Section 099010 "Shop Priming" indicated.
- D. Preparation for Shop Priming: Prepare surfaces to comply with requirements indicated below:
  - 1. Exterior Items: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
  - 2. Items Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
  - 3. Items Indicated to Receive Primers Specified in Section 099600 "High-Performance Coatings": SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
  - 4. Other Items: SSPC-SP 3, "Power Tool Cleaning."
- E. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.
  - 1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

## 2.17 ALUMINUM FINISHES

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

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. Install all items except those to be embedded in concrete or other masonry which shall be installed under Division 03 and Division 04 respectively. Install items to be attached to concrete or masonry after such work is completed in accordance with the details shown. Fastening to wood plugs in masonry will not be permitted.



- B. Touch up abrasions in the shop primer immediately after erection. Paint areas left unprimed for welding after welding.
- C. Clean and repair, after installation, zinc coating which has been burned by welding, abraded, or otherwise damaged. Thoroughly clean damaged area and remove all traces of welding flux and loose or cracked zinc coating prior to painting. Paint the cleaned area per the requirements of ASTM A780.
- D. Install specialty products in accordance with the manufacturer's recommendations.
- E. Weld headed anchor studs in accordance with manufacturer's recommendations.
- F. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- G. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- H. Field Welding: Comply with the following requirements:
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove welding flux immediately.
  - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- I. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.
- J. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
- K. Corrosion Protection: Coat concealed surfaces of aluminum and steel that come into contact with grout, concrete, masonry, wood, or dissimilar metals with the following:
  - 1. Aluminum Contacting a Dissimilar Metal: Apply a heavy brush coat of zinc-chromate primer followed by two coats of aluminum metal and masonry paint to the dissimilar metal.
  - 2. Aluminum Contacting Masonry or Concrete: Apply a heavy coat of approved alkali resistant paint to the masonry or concrete.
  - 3. Aluminum Contacting Wood: Apply two coats of aluminum metal and masonry paint to the wood.

4. Steel Contacting Exposed Concrete or Masonry: Apply heavy bitumastic troweling mastic.
5. Between aluminum stair treads, and steel supports, insert 1/4 inch thick neoprene isolator pads, 85 plus or minus 5 Shore A durometer, sized for full width and length of bracket or support.

### 3.2 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.
- B. Anchor supports for overhead doors and overhead grilles securely to, and rigidly brace from, building structure.
- C. Support steel girders on solid grouted masonry, concrete, or steel pipe columns. Secure girders with anchor bolts embedded in grouted masonry or concrete or with bolts through top plates of pipe columns.
  1. Where grout space under bearing plates is indicated for girders supported on concrete or masonry, install as specified in "Installing Bearing and Leveling Plates" Article.
- D. Install pipe columns on concrete footings with grouted baseplates. Position and grout column baseplates as specified in "Installing Bearing and Leveling Plates" Article.
  1. Grout baseplates of columns supporting steel girders after girders are installed and leveled.

### 3.3 INSTALLING METAL BOLLARDS

- A. Fill metal-capped bollards solidly with concrete and allow concrete to cure seven days before installing.
  1. Do not fill removable bollards with concrete.
- B. Anchor bollards to existing construction with expansion anchors. Provide four 7/8-inch bolts at each bollard unless otherwise indicated.
  1. Embed anchor bolts at least 4 inches in concrete.
- C. Anchor bollards in concrete with pipe sleeves preset and anchored into concrete. Fill annular space around bollard solidly with nonshrink grout; mixed and placed to comply with grout manufacturer's written instructions. Slope grout up approximately 1/8 inch toward bollard.
- D. Anchor bollards in place with concrete footings. Center and align bollards in holes 3 inches above bottom of excavation. Place concrete and vibrate or tamp for consolidation. Support and brace bollards in position until concrete has cured.
- E. Fill bollards solidly with concrete, mounding top surface to shed water.
  1. Do not fill removable bollards with concrete.

### 3.4 INSTALLING NOSINGS, TREADS, AND THRESHOLDS

- A. Center nosings on tread widths unless otherwise indicated.
- B. For nosings embedded in concrete steps or curbs, align nosings flush with riser faces and level with tread surfaces.
- C. Seal thresholds exposed to exterior with elastomeric sealant complying with Section 079200 "Joint Sealants" to provide a watertight installation.

### 3.5 INSTALLING BEARING AND LEVELING PLATES

- A. Clean concrete and masonry bearing surfaces of bond-reducing materials and roughen to improve bond to surfaces. Clean bottom surface of plates.
- B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with nonshrink grout. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

### 3.6 ADJUSTING AND CLEANING

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
  - 1. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.
- B. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 099100 "Painting."
- C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780/A 780M.

END OF SECTION 055000

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## SECTION 055200 - METAL RAILINGS

### 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. Aluminum pipe guardrails, railings, balusters, and fittings.
  - 2. Handrails.

- B. Related Requirements:

- 1. Section 050519 "Post-Installed Anchors and Reinforcing Bars": Execution requirements for placement of anchors as specified in this Section, in concrete
  - 2. Section 434163 "Wire and Strand Wrapped Prestressed Concrete Tank"

#### 1.3 ACTION SUBMITTALS

- A. Section 013300 "Submittal Procedures": Requirements for submittals.
- B. Shop Drawings: Indicate profiles, sizes, connection attachments, anchorage, size and type of fasteners, and accessories.
- C. Design Data: Submit calculations or test data demonstrating that the railings will resist the loads specified in the Florida Building Code at the post spacing provided. Calculations shall be signed and sealed by a professional engineer registered in the State of Florida.
- D. Samples: Submit railing samples when requested by engineer..

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- B. Test Reports: Certified copy of mill test reports on each aluminum proposed for use showing physical properties and chemical analysis.
- C. Certificates: Certify that welders have been qualified under AWS within previous 12 months to perform required welds.
- D. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

E. Qualifications Statements:

1. Submit qualifications for fabricator and erector.
2. Submit manufacturer's approval of fabricator and erector.

1.5 QUALITY ASSURANCE

- A. Perform Work for structural aluminum according to AA ADM 1.
- B. Finish welded joints according to NOMMA Guideline 1, Finish #1.
- C. Perform Work according to OSHA and Florida Building Code standards.
- D. Welding Qualifications: Qualify procedures and personnel according to the following:
  1. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."

1.6 QUALIFICATIONS

- A. Fabricator: Company specializing in fabricating products specified in this Section and approved by manufacturer.
- B. Erector: Company specializing in performing Work of this Section and approved by manufacturer.

1.7 DELIVERY, STORAGE, AND HANDLING

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

1.8 EXISTING CONDITIONS

- A. Field Measurements: Verify field measurements prior to fabrication. Indicate field measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Provide two rail mechanically fastened or welded pipe railing systems as indicated, fabricated with 1-1/2 inch nominal diameter pipe. Provide Schedule 80 pipe posts, minimum and rails and handrail of Schedule 40 pipe, minimum. Provide continuous posts and top rails. Spacing of posts not to exceed 5 feet 0 inches on center and shall be uniformly spaced except as otherwise indicated. Install railing posts in vertical position.

1. Welding: Provide circumferential welds ground smooth and even to produce a railing that is neat in appearance and structurally sound. Weld in conformity with AWS standards for materials being joined. Cope and fasten rail to post connections with continuous welds. Provide handrail system free of burrs, sharp edges or protrusions on welds. Clean and hand buff welds after fabrication so welds and surrounding area blend with the adjacent finish.
    - a. For welding aluminum, use a weld filler alloy that is compatible with alloys to be joined, that will not discolor the pieces to be joined, and that will not be discolored by anodizing.
  2. Mechanical Fasteners: Locate unobtrusively in countersunk holes with the top, flush with rail surface.
  3. Bending: Form bends in railings as indicated. No distortion of circular railing shape will be allowed. Make bends and terminal sections without use of fittings. Provide corner bends with a 3 inch centerline radius.
- B. Assemble railing in sections as long as practical, but not greater than 24 feet in length. Provide field splice when an assembled section is to be attached to another section. Provide field splices in railing panels that cross over structure expansion joints.
1. Field Splices: Use internal splice sleeves located within 8 inches of railing posts. Weld sleeves to rails on one side and fasten with set screws to rails on other side. Detail field splice to take differential expansion between railing system and the supporting structure.
  2. When field splice occurs in a railing panel crossing a structure expansion joint, weld sleeves to rails on one side and be free to slide in the rails on other side. Detail field splice to take same movement as structure expansion joint.
- C. Provide bases or supports for railing posts and handrail as indicated on drawings.
1. Where guardrail and handrail is to be fastened to walls, provide screwed wall flanges fastened to walls with three 3/8 inch stainless-steel expansion anchors. The horizontal projection of handrail support off the wall shall provide 2-1/4 inch minimum clearance around the handrail.
- D. For railing openings, fabricate safety gates of matching pipe and rail material and configuration. Provide self-closing gates with approved stop, latch, and stainless-steel closure spring and hinges.
- E. Provide toe boards on railings adjacent to a drop elevation of 4 feet or more. Toeboards are not required on inclined portion of stairway railings or where concrete or steel curbs exist at 4 inches or more in height. Provide toeboards fabricated of 4 inch high channels of same material as railing, having a minimum thickness of 1/8 inch and flanges of not less than 3/4 inch or more than 1-1/2 inch in width. Position toeboards with a maximum clearance of 1/4 inch from floor and fasten to railing posts with 1/4 inch stainless-steel U-bolts, with J-bolts at corner posts, and with clip angles and two 1/4 inch stainless-steel expansion bolts at walls. Or provide proprietary toeboard with fastening system.
- F. Protect railings by paper, an approved coating, or both against scratching, splashes of mortar, paint, or other defacements during transportation, erection, and until adjacent work is complete. Remove protective materials and make surfaces clean and free from stains, marks, or defects.

## 2.2 MATERIALS

- A. Aluminum Railing System: provide a welded or mechanically fastened, seamless, extruded aluminum pipe system.
  - 1. Rails: ASTM B 429 Alloy 6063-T6.
  - 2. Posts: ASTM B 429 Alloy 6061-T6.
  - 3. Splice and reinforcing sleeves, brackets, end caps, toeboards, and similar components: ASTM B 221 or ASTM B 209, Alloy 6063-T6 or 6061-T6.
  - 4. Cast Fittings: ASTM B 26/B 26M, Alloy No. 214.
  - 5. Railing System Fastening Hardware: ASTM A 276, Type 316 stainless-steel.
  - 6. Finishes: Clear anodized finish after welding, AAMA 611, Class I, AA M12C22A41.

## 2.3 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. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.

## 2.4 FABRICATION

- A. Fit and shop-assemble components in largest practical sizes for delivery to Site, but not to exceed 24ft in length.
- B. Fabricate components with joints tightly fitted and secured. Furnish sleeves to accommodate site assembly and installation.
- C. Form simple and compound curves by bending pipe in jigs to produce uniform curvature for each repetitive configuration required. Maintain cylindrical cross section of pipe throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces.
- D. Exposed Mechanical Fastenings: Flush countersunk screws or bolts, unobtrusively located, and consistent with design of component, except where otherwise noted.
- E. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where otherwise noted.
- F. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.
- G. Accurately form components to each other, and to building structure.
- H. Accommodate expansion and contraction of members and building movement without damage to connections or members.



## PART 3 - EXECUTION

### 3.1 EXAMINATION

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

### 3.2 PREPARATION

- A. Supply items required to be cast into concrete with setting templates to appropriate Sections in other Divisions.

### 3.3 INSTALLATION

- A. Install items, except those to be embedded in concrete under Division 03. Install items to be attached to concrete after such work is completed in accordance with indicated details.
- B. Install components plumb, level, and square, accurately fitted, and free from distortion or defects.
- C. Anchor railings to structure with anchors and cast aluminum bases.
- D. Conceal bolts and screws whenever possible. Where not concealed, use flush countersunk fastenings.
- E. Assemble with sleeves to accommodate tight joints and secure installation.
- F. Protect steel surfaces that come into contact with exposed concrete or masonry with a protective coating of an approved heavy bituminous troweling mastic applied in accordance with manufacturer's instructions prior to installation.
- G. Where aluminum contacts a dissimilar metal, apply a heavy brush coat of zinc-chromate primer followed by two coats of aluminum metal and masonry paint to the dissimilar metal.
- H. Where aluminum contacts masonry or concrete, apply a heavy coat of approved alkali resistant paint to masonry or concrete. Coat, with a heavy coat of bituminous paint, concealed surfaces of aluminum that are in contact with grout, concrete, masonry, wood, or dissimilar metals.
- I. Where aluminum contacts wood, apply two coats of aluminum metal and masonry paint to the wood.
- J. Between aluminum gratings, aluminum stair treads, or aluminum handrail brackets and steel supports, insert 1/4 inch thick neoprene isolator pads, 85 plus or minus 5 Shore A durometer, sized for full width and length of bracket or support.

### 3.4 CLEANING AND PROTECTION

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

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

END OF SECTION 055200

## SECTION 061000 - ROUGH CARPENTRY

### 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. Wood blocking, cants, and nailers.
  - 2. Plywood backing panels.

#### 1.3 DEFINITIONS

- A. Boards or Strips: Lumber of less than 2 inches nominal size in least dimension.
- B. Dimension Lumber: Lumber of 2 inches nominal size or greater but less than 5 inches nominal size in least dimension.
- C. Timber: Lumber of 5 inches nominal size or greater in least dimension.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
  - 1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
  - 2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.
  - 3. For fire-retardant treatments, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D5664.
  - 4. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
- B. Fastener Patterns: Full-size templates for fasteners in exposed framing.

## 1.5 INFORMATIONAL SUBMITTALS

- A. Material Certificates: For dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the ALSC Board of Review.
- B. Evaluation Reports: For the following, from ICC-ES:
  - 1. Wood-preservative-treated wood.
  - 2. Fire-retardant-treated wood.

## 1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Stack wood products flat with spacers beneath and between each bundle to provide air circulation. Protect wood products from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

# PART 2 - PRODUCTS

## 2.1 WOOD PRODUCTS, GENERAL

- A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Grade lumber by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
  - 1. Factory mark each piece of lumber with grade stamp of grading agency.
  - 2. Dress lumber, S4S, unless otherwise indicated.
- B. Maximum Moisture Content of Lumber: 19 percent unless otherwise indicated.

## 2.2 WOOD-PRESERVATIVE-TREATED LUMBER

- A. Preservative Treatment by Pressure Process: AWP A U1; Use Category UC2 for interior construction not in contact with ground, Use Category UC3b for exterior construction not in contact with ground, and Use Category UC4a for items in contact with ground.
  - 1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.

2. For exposed items indicated to receive a stained or natural finish, chemical formulations shall not require incising, contain colorants, bleed through, or otherwise adversely affect finishes.
- B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or that does not comply with requirements for untreated material.
- C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.
- D. Application: Treat all rough carpentry unless otherwise indicated.
  1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.

### 2.3 FIRE-RETARDANT-TREATED MATERIALS

- A. General: Where fire-retardant-treated materials are indicated, materials shall comply with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.
- B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet beyond the centerline of the burners at any time during the test.
  1. Treatment shall not promote corrosion of metal fasteners.
  2. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated lumber and plywood by pressure process after being subjected to accelerated weathering according to ASTM D2898. Use for exterior locations and where indicated.
  3. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D3201 at 92 percent relative humidity. Use where exterior type is not indicated.
  4. Design Value Adjustment Factors: Treated lumber shall be tested according to ASTM D5664 and design value adjustment factors shall be calculated according to ASTM D6841.
- C. Kiln-dry lumber after treatment to maximum moisture content of 19 percent.
- D. Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency.
- E. Application: Treat all rough carpentry unless otherwise indicated.

## 2.4 MISCELLANEOUS LUMBER

- A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
  - 1. Blocking.
  - 2. Nailers.
  - 3. Cants.
- B. Dimension Lumber Items: Construction or No. 2 grade lumber of any species.
- C. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.
- D. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.

## 2.5 PLYWOOD BACKING PANELS

- A. Equipment Backing Panels: Plywood, DOC PS 1, fire-retardant treated, in thickness indicated or, if not indicated, not less than 1/2-inch nominal thickness.

## 2.6 FASTENERS

- A. General: Fasteners shall be of size and type indicated and shall comply with requirements specified in this article for material and manufacture.
  - 1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A153/A153M.
  - 2. For pressure-preservative-treated wood, use stainless-steel fasteners.
- B. Nails, Brads, and Staples: ASTM F1667.
- C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
- D. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01, ICC-ES AC58, ICC-ES AC193 or ICC-ES AC308 as appropriate for the substrate.
  - 1. Material: Carbon-steel components, zinc plated to comply with ASTM B633, Class Fe/Zn 5.
  - 2. Material: Stainless steel with bolts and nuts complying with ASTM F 593 and ASTM F594, Alloy Group 1 or 2.

## 2.7 MISCELLANEOUS MATERIALS

- A. Flexible Flashing: Composite, self-adhesive, flashing product consisting of a pliable, butyl rubber or rubberized-asphalt compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than 0.025 inch.
- B. Water-Repellent Preservative: NWWDA-tested and -accepted formulation containing 3-iodo-2-propynyl butyl carbamate, combined with an insecticide containing chlorpyrifos as its active ingredient.

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry accurately to other construction. Locate nailers, blocking, and similar supports to comply with requirements for attaching other construction.
- B. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels. Install fire-retardant-treated plywood backing panels with classification marking of testing agency exposed to view.
- C. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.
  - 1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches o.c.
- D. Provide fire blocking in furred spaces, stud spaces, and other concealed cavities as indicated and as follows:
  - 1. Fire block furred spaces of walls, at each floor level, at ceiling, and at not more than 96 inches o.c. with solid wood blocking or noncombustible materials accurately fitted to close furred spaces.
- E. Sort and select lumber so that natural characteristics do not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
- F. Comply with AWPAC M4 for applying field treatment to cut surfaces of preservative-treated lumber.
  - 1. Use inorganic boron for items that are continuously protected from liquid water.
  - 2. Use copper naphthenate for items not continuously protected from liquid water.
- G. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.

- H. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
  - 1. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code (IBC).
  - 2. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's International Residential Code for One- and Two-Family Dwellings.
  - 3. ICC-ES evaluation report for fastener.
- I. Use steel common nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless otherwise indicated.

### 3.2 WOOD BLOCKING, AND NAILER INSTALLATION

- A. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.
- B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.
- C. Provide permanent grounds of dressed, pressure-preservative-treated, key-beveled lumber not less than 1-1/2 inches wide and of thickness required to bring face of ground to exact thickness of finish material. Remove temporary grounds when no longer required.

### 3.3 PROTECTION

- A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.
- B. Protect rough carpentry from weather. If, despite protection, rough carpentry becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 061000



## SECTION 066400 - PLASTIC PANELING

### 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. Plastic sheet paneling.
- B. Related Requirements:
  - 1. Section 061000 "Rough Carpentry" for wood furring for installing plastic paneling.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For plastic paneling and trim accessories, in manufacturer's standard sizes.

#### 1.4 QUALITY ASSURANCE

- A. Testing Agency: FM Approvals.

#### 1.5 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install plastic paneling until spaces are enclosed and weathertight and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Source Limitations: Obtain plastic paneling and trim accessories from single manufacturer.

## 2.2 PLASTIC SHEET PANELING

- A. Glass-Fiber-Reinforced Plastic Paneling: Gelcoat-finished, glass-fiber-reinforced plastic panels complying with ASTM D 5319.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Crane Composites, Inc.
    - b. Glasteel.
    - c. Marlite.
    - d. Parkland Plastics, Inc.
  2. Surface-Burning Characteristics: As follows when tested by a qualified testing agency according to ASTM E 84. Identify products with appropriate markings of applicable testing agency.
    - a. Flame-Spread Index: 25 or less.
    - b. Smoke-Developed Index: 450 or less.
  3. Nominal Thickness: Not less than 0.12 inch.
  4. Surface Finish: Molded pebble texture.
  5. Color: As selected by Engineer from manufacturer's full range.

## 2.3 ACCESSORIES

- A. Trim Accessories: Manufacturer's standard one-piece vinyl extrusions designed to retain and cover edges of panels. Provide division bars, inside corners, and caps as needed to conceal edges.
1. Color: Match panels.
- B. Exposed Fasteners: Nylon drive rivets recommended by panel manufacturer.
- C. Concealed Mounting Splines: Continuous, H-shaped aluminum extrusions designed to fit into grooves routed in edges of factory-laminated panels and to be fastened to substrate.
- D. Adhesive: As recommended by plastic paneling manufacturer.
- E. Sealant: Mildew-resistant, single-component, neutral-curing silicone sealant recommended by plastic paneling manufacturer and complying with requirements in Section 079200 "Joint Sealants."

## PART 3 - EXECUTION

### 3.1 EXAMINATION

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

### 3.2 PREPARATION

- A. Prepare substrate by sanding high spots and filling low spots as needed to provide flat, even surface for panel installation.
- B. Clean substrates of substances that could impair adhesive bond, including oil, grease, dirt, and dust.
- C. Condition panels by unpacking and placing in installation space before installation according to manufacturer's written recommendations.
- D. Lay out paneling before installing. Locate panel joints so that trimmed panels at corners are not less than 12 inches wide.
  - 1. Mark plumb lines on substrate at panel joint locations for accurate installation.
  - 2. Locate trim accessories to allow clearance at panel edges according to manufacturer's written instructions.

### 3.3 INSTALLATION

- A. Install plastic paneling according to manufacturer's written instructions.
- B. Install panels in a full spread of adhesive.
- C. Install trim accessories with adhesive.
- D. Fill grooves in trim accessories with sealant before installing panels, and bed inside corner trim in a bead of sealant.
- E. Maintain uniform space between panels and wall fixtures. Fill space with sealant.
- F. Maintain uniform space between adjacent panels and between panels and floors, ceilings, and fixtures. Fill space with sealant.
- G. Remove excess sealant and smears as paneling is installed. Clean with solvent recommended by sealant manufacturer and then wipe with clean dry cloths until no residue remains.

END OF SECTION 066400

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## SECTION 067413 - FIBERGLASS REINFORCED PLASTIC COMPONENTS

### 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 FRP gratings, frames, and supports for gratings and plates.
- B. Related Requirements:

#### 1.3 DEFINITIONS

- A. FRP: Refers to fiberglass reinforced plastic or glass fiber reinforced plastics.

#### 1.4 COORDINATION

- A. Coordinate installation of anchorages for gratings, grating frames, plates and supports.
- B. 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 as specified in Division 03 or masonry as specified in Division 04. Deliver such items to Project site in time for installation.

#### 1.5 ACTION SUBMITTALS

- A. Test Data: Certified data based on tests of actual production samples which demonstrate that products conform to specified stress and deflection requirements.
- B. Shop Drawings: Include plans, sections, details, and attachments to other work.
- C. Samples for Verification: Submit samples when requested by engineer.
- D. For FRP components, including manufacturer's published load tables.
- E. Delegated-Design Submittal: Submit drawings and calculations for the FRP floor system, signed and sealed by a registered professional engineer in the State of Florida and meeting all applicable loads in this specification.

## 1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For professional engineer confirming registration in State where project site exists.

## 1.7 QUALITY ASSURANCE

- A. Manufacturer Qualifications: The manufacturers of fiberglass reinforced plastic components shall be experienced in the manufacture of the items specified. Present proof as required demonstrating successful installations of the specified items under conditions similar to those of this project.
- B. Coordinate the work of this Section with the work of other Sections. Verify at the site both the dimensions and work of other trades adjoining items of work in this Section before fabrication and installation of items herein specified.
- C. Furnish to the pertinent trades all items included under this Section that are to be built into the work of other sections.

## 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Transport, lift, and handle units with care, avoiding excessive stress and preventing damage; use appropriate equipment.
- B. Store in a clean dry area off the ground and protected from weather, moisture and damage; do not stack unless permitted by manufacturer.
- C. Handle products to prevent damage from abrasion, cracking, chipping, twisting, deformations, and other types of damage.

## 1.9 FIELD CONDITIONS

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

# PART 2 - PRODUCTS

## 2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design FRP components.
- B. Resin for FRP components: Vinyl ester, integrally resistant without applied coatings to: ultra-violet radiation; high concentrations of hydrogen sulfide gas, its solutions and associated compounds; and to the wastewater occurring at the project site.

1. Provide compatible and equally resistant resin as acceptable for shop and field sealing of cut edges.
- C. Colors: Integral colors acceptable to the Engineer selected from standard resin colors.
- D. Pultruded fiberglass reinforcement shall be a combination of continuous roving, continuous strand mat, and surfacing veil in sufficient quantities as needed by the application and/or physical properties required.
- E. Minimum physical properties for pultruded structural FRP shapes and plates:
  1. Tensile Strength: According to ASTM D 638.
    - a. Coupon: 30,000 psi.
    - b. Full Section in Bending: 19,986 psi at 75 degrees F.
  2. Modulus of Elasticity: According to ASTM D 790.
    - a.  $32.3 \times 10^6$  psi at 75 degrees F.
    - b.  $1.8 \times 10^6$  psi at 125 degrees F.
  3. Barcol Hardness: 50.
  4. Water Absorption: 0.75 percent (by weight), according to ASTM D 349.
  5. Specific Gravity: 1.66, according to ASTM D 792.
- F. Provide pultruded shapes conforming to the visual quality of ASTM D 4385.
- G. Protect pultruded and molded FRP from ultraviolet (UV) degradation with:
  1. Integral UV inhibitors in the resin.
  2. A synthetic surfacing veil to produce a resin rich surface.
- H. Structural Performance: Withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated.
  1. Walkways and Elevated Platforms: Uniform load of 100 lb/sq. ft. on the maximum span or 300 lb point load applied at the mid-point of the maximum span.
  2. Limit live load deflection to  $L/360$  or 1/4 inch, whichever is less.

## 2.2 GRATING COMPONENTS

- A. Molded FRP Gratings: Bar gratings made by placing glass-fiber strands that have been saturated with thermosetting plastic resin in molds in alternating directions to form interlocking bars without voids and with a high resin content.
  1. Configuration: As required to comply with structural performance requirements.
  2. Resin: Polyester.
    - a. Flame-Spread Index: 25 or less when tested according to ASTM E 84.
    - b. USDA Acceptance: Accepted for food-processing applications.

3. Color: Manufacturer's standard.
  4. Traffic Surface: As indicated.
- B. Pultruded FRP Gratings: Bar gratings assembled from components made by simultaneously pulling glass fibers and extruding thermosetting plastic resin through a heated die under pressure to produce a product without voids and with a high glass-fiber content.
1. Configuration: As required to comply with structural performance requirements.
  2. Resin Type: Polyester.
    - a. Flame-Spread Index: 25 or less when tested according to ASTM E 84.
    - b. USDA Acceptance: Accepted for food-processing applications.
  3. Color: Manufacturer's standard.
  4. Traffic Surface: As indicated.
- C. Protect grating from ultraviolet (UV) degradation with:
1. Integral UV inhibitors in the resin
  2. A synthetic surfacing veil to produce a resin rich surface
- D. Securely attach FRP grating to supporting members and angles using either stainless steel or FRP with stainless steel fasteners. Attach each grating panel to supporting members at a minimum of four locations, two at each edge. Provide materials and incidentals required for attaching grating to angle frame and supports under this Section.
- E. Coordinate grating panel layouts with work of other Sections to provide openings for approved mechanical equipment, operators, gates, and other items which require penetrations or openings in the grating. Further subdivide grating panels and support to provide maximum panel weight of 110 lbs.

## 2.3 MISCELLANEOUS COMPONENTS

- A. Provide structural FRP angle frames, structural support shapes, and grit impregnated plate where required and appurtenances as indicated.
- B. Provide angle frames continuous around the opening in order to present an even and flat support for the grating except as otherwise indicated.
- C. Provide all finished surfaces of FRP items and fabrications smooth, resin rich, free of voids and without dry spots, cracks, crazes or unreinforced areas. Provide glass fibers well covered with resin to protect against exposure due to wear or weathering.
- D. Provide all exposed surfaces smooth and true to form, consistent with ASTM D 4385.

## 2.4 FASTENERS

- A. General: Unless otherwise indicated, provide Type 316 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.



- B. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, nuts, and, where indicated, flat washers; ASTM F 593 for bolts and ASTM F 594 for nuts, Alloy Group 2.
- C. Post-Installed Anchors: Refer to Section 050519 "Post Installed Anchors."

## 2.5 FABRICATION

- A. Shop Assembly: Shop fabricate grating sections to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- B. Cut, drill, and punch material cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch, unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- C. Form FRP components from materials of size, thickness, and shapes indicated, but not less than that needed to support indicated loads.
- D. Fit exposed connections accurately together to form hairline joints.
- E. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space the anchoring devices to secure gratings, frames, and supports rigidly in place and to support indicated loads.
- F. Fabricate cutouts in grating sections for penetrations indicated. Arrange cutouts to permit grating removal without disturbing items penetrating gratings.

## 2.6 FRP FRAMES AND SUPPORTS

- A. Frames and Supports for FRP Gratings and Plates: Fabricate from FRP shapes of sizes, shapes, and profiles indicated and as necessary to receive gratings. Miter connections for perimeter angle frames. Cut, drill, and tap units to receive hardware and similar items.
  - 1. Unless otherwise indicated, use shapes made from same resin as gratings.
  - 2. Equip units indicated to be cast into concrete or built into masonry with integral anchors.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Coordinate locations and elevations of required supports. Verify that members are properly installed to support components specified in this Section.
- B. Coordinate and furnish anchorages, setting drawings, diagrams, templates, instructions and directions for installation of anchorages, including concrete inserts, sleeves, anchor bolts and miscellaneous items having integral anchors that are to be embedded in concrete or masonry construction.

- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION, GENERAL

- A. Install assemblies in accordance with manufacturer's installations instructions. Install products plumb, level, and square, unless otherwise required by the design.
- B. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing gratings to in-place construction. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.
- C. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing FRP components. Set units accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.
- D. Provide temporary bracing or anchors in formwork for items that are to be built into concrete or masonry. Provide additional supports at penetrations through grating in order to meet design criteria.
- E. Fit exposed connections accurately together to form hairline joints.

### 3.3 INSTALLING FRP COMPONENTS

- A. Comply with manufacturer's written instructions for installing components. Use manufacturer's standard stainless-steel anchor clips and hold-down devices for grating anchorage.

END OF SECTION 067413

## SECTION 071113 - BITUMINOUS DAMPPROOFING

### 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. Cold-applied, emulsified-asphalt dampproofing.
- B. Related Requirements:
  - 1. Section 033000 "Cast-in-Place Concrete" for bituminous vapor retarders under slabs-on-grade.

#### 1.3 ACTION SUBMITTALS

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

#### 1.4 FIELD CONDITIONS

- A. Weather Limitations: Proceed with application only when existing and forecasted weather conditions permit dampproofing to be performed according to manufacturers' written instructions.
- B. Ventilation: Provide adequate ventilation during application of dampproofing in enclosed spaces. Maintain ventilation until dampproofing has cured.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Source Limitations: Obtain primary dampproofing materials and primers from single source from single manufacturer. Provide protection course,] drainage panels and auxiliary materials recommended in writing by manufacturer of primary materials.

## 2.2 PERFORMANCE REQUIREMENTS

- A. VOC Content: Products shall comply with VOC content limits of authorities having jurisdiction unless otherwise indicated.

## 2.3 COLD-APPLIED, EMULSIFIED-ASPHALT DAMPPROOFING

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. BASF Corporation.
  - 2. ChemMasters, Inc.
  - 3. Euclid Chemical Company (The); an RPM company.
  - 4. W.R. Meadows, Inc.
- B. Trowel Coats: ASTM D 1227, Type II, Class 1.
- C. Fibered Brush and Spray Coats: ASTM D 1227, Type II, Class 1.
- D. Brush and Spray Coats: ASTM D 1227, Type III, Class 1.

## 2.4 AUXILIARY MATERIALS

- A. Furnish auxiliary materials recommended in writing by dampproofing manufacturer for intended use and compatible with bituminous dampproofing.
- B. Emulsified-Asphalt Primer: ASTM D 1227, Type III, Class 1, except diluted with water as recommended in writing by manufacturer.
- C. Asphalt-Coated Glass Fabric: ASTM D 1668/D 1668M, Type I.
- D. Patching Compound: Epoxy or latex-modified repair mortar of type recommended in writing by dampproofing manufacturer.
- E. Protection Course: ASTM D 6506, semirigid sheets of fiberglass or mineral-reinforced-asphaltic core, pressure laminated between two asphalt-saturated fibrous liners.
  - 1. Thickness: Nominal 1/8 inch.
  - 2. Adhesive: Rubber-based solvent type recommended in writing by waterproofing manufacturer for protection course type.

## 2.5 INSULATION DRAINAGE PANELS

- A. Insulation Drainage Panels: Comply with Section 072100 "Thermal Insulation" for insulation drainage panels.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements for surface smoothness, maximum surface moisture content, and other conditions affecting performance of the Work.
- B. Proceed with application only after substrate construction and penetrating work have been completed and unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Clean, prepare, and treat substrates according to manufacturer's written instructions. Provide clean, dust-free, and dry substrates for dampproofing application.
- B. Mask or otherwise protect adjoining exposed surfaces from being stained, spotted, or coated with dampproofing. Prevent dampproofing materials from entering and clogging weep holes and drains.
- C. Clean substrates of projections and substances detrimental to dampproofing work; fill voids, seal joints, and remove bond breakers if any.
- D. Apply patching compound to patch and fill tie holes, honeycombs, reveals, and other imperfections; cover with asphalt-coated glass fabric.

### 3.3 APPLICATION, GENERAL

- A. Comply with manufacturer's written instructions for dampproofing application, cure time between coats, and drying time before backfilling unless otherwise indicated.
  - 1. Apply dampproofing to provide continuous plane of protection.
  - 2. Apply additional coats if recommended in writing by manufacturer or to achieve a smooth surface and uninterrupted coverage.
- B. Where dampproofing footings and foundation walls, apply from finished-grade line to top of footing; extend over top of footing and down a minimum of 6 inches over outside face of footing.
  - 1. Extend dampproofing 12 inches onto intersecting walls and footings, but do not extend onto surfaces exposed to view when Project is completed.
  - 2. Install flashings and corner protection stripping at internal and external corners, changes in plane, construction joints, cracks, and where indicated as "reinforced," by embedding an 8-inch- wide strip of asphalt-coated glass fabric in a heavy coat of dampproofing. Dampproofing coat for embedding fabric is in addition to other coats required.
- C. Where dampproofing interior face of above-grade, exterior single-wythe masonry walls, continue dampproofing through intersecting walls by keeping vertical mortar joints at intersection temporarily open or by dampproofing wall before constructing intersecting walls.

### 3.4 COLD-APPLIED, EMULSIFIED-ASPHALT DAMPPROOFING

- A. Concrete Foundations: Apply two brush or spray coats at not less than 1.5 gal./100 sq. ft. for first coat and 1 gal./100 sq. ft. for second coat or one trowel coat at not less than 4 gal./100 sq. ft..
- B. Unexposed Face of Concrete Retaining Walls: Apply one brush or spray coat at not less than 1.25 gal./100 sq. ft..
- C. Interior Face of Single-Wythe Exterior Masonry Walls: Where above grade and indicated to be furred and finished, apply primer and one brush or spray coat at not less than 1 gal./100 sq. ft..

### 3.5 PROTECTION COURSE INSTALLATION

- A. Install protection course over completed-and-cured dampproofing. Comply with dampproofing-material and protection-course manufacturers' written instructions for attaching protection course.
  - 1. Support protection course over cured coating with spot application of adhesive type recommended in writing by protection-board manufacturer.
  - 2. Install protection course on same day of dampproofing installation (while coating is tacky) to ensure adhesion.

### 3.6 DRAINAGE PANEL INSTALLATION

- A. Insulation Drainage Panels: Install panels over dampproofed surfaces. Use adhesive or another method that does not penetrate dampproofing. Cut and fit panels to within 3/4 inch of projections and penetrations.
  - 1. Ensure that drainage channels are aligned and free of obstructions.

### 3.7 PROTECTION

- A. Protect installed insulation drainage panels from damage due to UV light, harmful weather exposures, physical abuse, and other causes. Provide temporary coverings where panels are subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.
- B. Correct dampproofing that does not comply with requirements; repair substrates, and reapply dampproofing.

END OF SECTION 071113

## SECTION 072100 - THERMAL 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. Extruded polystyrene foam-plastic board.
  - 2. Polyisocyanurate foam-plastic board.

- B. Related Requirements:

- 1. Section 042000 "Unit Masonry" for insulation installed in masonry cells.
  - 2. Section 072119 "Foamed-in-Place Insulation" for spray-applied polyurethane foam insulation.
  - 3. Section 075216 "Styrene-Butadiene-Styrene (SBS) Modified Bituminous Membrane Roofing" for insulation specified as part of roofing construction.
  - 4. Section 092900 "Gypsum Board" for sound attenuation blanket used as acoustic insulation.

#### 1.3 ACTION SUBMITTALS

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

#### 1.4 INFORMATIONAL SUBMITTALS

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

#### 1.5 DELIVERY, STORAGE, AND HANDLING

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

1. Do not expose to sunlight except to necessary extent for period of installation and concealment.
2. Protect against ignition at all times. Do not deliver foam-plastic board materials to Project site until just before installation time.
3. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.

## PART 2 - PRODUCTS

### 2.1 EXTRUDED POLYSTYRENE FOAM-PLASTIC BOARD

- A. Extruded Polystyrene Board, Type VI: ASTM C578, Type VI, 40-psi minimum compressive strength; maximum flame-spread and smoke-developed indexes of 25 and 450, respectively, per ASTM E84.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Dow Chemical Company (The).
    - b. Kingspan Insulation Limited.
    - c. Owens Corning.

### 2.2 POLYISOCYANURATE FOAM-PLASTIC BOARD

- A. Polyisocyanurate Board, Glass-Fiber-Mat Faced: ASTM C1289, glass-fiber-mat faced, Type II, Class 2.
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. Atlas Roofing Corporation - Polyiso.
    - b. Carlisle Coatings & Waterproofing Inc.
    - c. Firestone Building Products.
  2. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.

### 2.3 INSULATION FASTENERS

- A. Adhesively Attached, Spindle-Type Anchors: Plate welded to projecting spindle; capable of holding insulation of specified thickness securely in position with self-locking washer in place.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:



- a. AGM Industries, Inc.
  - b. Gemco.
2. Plate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
  3. Spindle: Copper-coated, low-carbon steel; fully annealed; 0.105 inch in diameter; length to suit depth of insulation.

## 2.4 ACCESSORIES

- A. Insulation for Miscellaneous Voids:
  1. Glass-Fiber Insulation: ASTM C764, Type II, loose fill; with maximum flame-spread and smoke-developed indexes of 5, per ASTM E84.
  2. Spray Polyurethane Foam Insulation: ASTM C1029, Type II, closed cell, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E84.
- B. Adhesive for Bonding Insulation: Product compatible with insulation and air and water barrier materials, and with demonstrated capability to bond insulation securely to substrates without damaging insulation and substrates.

## PART 3 - EXECUTION

### 3.1 PREPARATION

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

### 3.2 INSTALLATION, GENERAL

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

### 3.3 INSTALLATION OF SLAB INSULATION

- A. On vertical slab edge and foundation surfaces, set insulation units using manufacturer's recommended adhesive according to manufacturer's written instructions.

1. If not otherwise indicated, extend insulation a minimum of 24 inches below exterior grade line.
- B. On horizontal surfaces, loosely lay insulation units according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.
  1. If not otherwise indicated, extend insulation a minimum of 24 inches in from exterior walls.

### 3.4 INSTALLATION OF FOUNDATION WALL INSULATION

- A. Butt panels together for tight fit.
- B. Anchor Installation: Install board insulation on concrete substrates by adhesively attached, spindle-type insulation anchors as follows:
  1. Fasten insulation anchors to concrete substrates with insulation anchor adhesive according to anchor manufacturer's written instructions. Space anchors according to insulation manufacturer's written instructions for insulation type, thickness, and application.
  2. Apply insulation standoffs to each spindle to create cavity width indicated on Drawings between concrete substrate and insulation.
  3. After adhesive has dried, install board insulation by pressing insulation into position over spindles and securing it tightly in place with insulation-retaining washers, taking care not to compress insulation.
  4. Where insulation will not be covered by other building materials, apply capped washers to tips of spindles.
- C. Adhesive Installation: Install with adhesive or press into tacky waterproofing or dampproofing according to manufacturer's written instructions.

### 3.5 PROTECTION

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

END OF SECTION 072100

## SECTION 072119 - FOAMED-IN-PLACE 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. Closed-cell spray polyurethane foam.
- B. Related Requirements:
  - 1. Section 072100 "Thermal Insulation" for foam-plastic board insulation.

#### 1.3 ACTION SUBMITTALS

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

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Test Reports: For each product, for tests performed by a qualified testing agency.
- C. Evaluation Reports: For spray-applied polyurethane foam-plastic insulation, from ICC-ES.

#### 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

### PART 2 - PRODUCTS

#### 2.1 CLOSED-CELL SPRAY POLYURETHANE FOAM

- A. Closed-Cell Spray Polyurethane Foam: ASTM C 1029, Type II, minimum density of 1.5 lb/cu. ft. and minimum aged R-value at 1-inch thickness of 6.2 deg F x h x sq. ft./Btu at 75 deg F.

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.
  - b. Carlisle Spray Foam Insulation.
  - c. Johns Manville; a Berkshire Hathaway company.
2. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - a. Flame-Spread Index: 25 or less.
  - b. Smoke-Developed Index: 450 or less.
3. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.

## 2.2 THERMAL BARRIER

- A. Thermal Barrier: Intumescent type fire protection coating material of water-based formulation, single component, factory-mixed formulation meeting NFPA 286, UL 1715, ASTM E 84, and bearing fire-resistant label or equivalent third-party quality assurance program. Include manufacturer's primer if recommended for specific sprayed polyurethane foam (SPF) system being installed.
  1. Meet following performance requirements:
    - a. Maximum Flame Spread and Smoke Developed: 25 and 150 per ASTM E 84.
    - b. Pull-Off Strength from SPF: 50 psi per ASTM D 4541.
    - c. Pull-Off Strength from Concrete: 220 psi per ASTM D 4541.
    - d. Tape Adhesion: 5B per ASTM D 4541.
    - e. Volume Nonvolatile Matter in Clear or Pigmented Coatings: 0.50 percent maximum per ASTM D 2697.
  2. Basis-of-Design: Use the following or equal.
    - a. Paint to Protect DC315 as manufactured by International Fireproof Technology Inc.

## 2.3 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by insulation manufacturer where required for adhesion of insulation to substrates.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Verify that substrates are clean, dry, and free of substances that are harmful to insulation.
- B. Priming: Prime substrates where recommended by insulation manufacturer. Apply primer to comply with insulation manufacturer's written instructions. Confine primers to areas to be insulated; do not allow spillage or migration onto adjoining surfaces.

### 3.2 INSTALLATION

- A. Comply with insulation manufacturer's written instructions applicable to products and applications.
- B. Spray insulation to envelop entire area to be insulated and fill voids.
- C. Apply in multiple passes to not exceed maximum thicknesses recommended by manufacturer. Do not spray into rising foam.
- D. Framed Construction: Install into cavities formed by framing members to achieve thickness indicated on Drawings.
- E. Miscellaneous Voids: Apply according to manufacturer's written instructions.

### 3.3 PROTECTION

- A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes.

END OF SECTION 072119

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## SECTION 072173 - CONTINUOUS INSULATION SUPPORT SYSTEM

### PART 1 GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:

- 1. Composite fiberglass support and connection members for interior application.

- B. Related Requirements:

- 1. Section 042000 "Unit Masonry" for masonry wall components.
  - 2. Section 072100 "Thermal Insulation" for board insulation.
  - 3. Section 079200 "Joint Sealants".

#### 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated; include construction details, material descriptions, dimensions of individual components and profiles, and accessory as necessary for complete fully furnished system assembly.

- B. Shop Drawings: Submit fabrication and installation layouts of continuous insulation support system and exterior cladding system; including details of edge conditions, joints, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.

- 1. Provide distinction between factory-assembled, shop-assembled, and field-assembled work.
  - 2. Provide details of following items at full scale.

- a. Manufacturer's standard sheet metal trims.
    - b. Components of wall panel construction, anchorage methods, and hardware.

#### 1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing of specified products specified with at least three years of documented experience.

- B. Installer: Company specializing in performing work of this Section with at least three years of documented experience that is factory trained and approved by continuous insulation (CI) support system manufacturer.

- C. Source Limitations: Obtain CI support system and continuous insulation from single source and single manufacturer.

- D. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
- E. Mockups: Provide mockups to verify selections, to demonstrate aesthetic effects, and to establish quality standards for fabrication and installation.
  - 1. Build mockup of typical continuous insulation assembly, including corners, supports, attachments, and accessories.
    - a. Include at least four exterior insulation panels to represent a four-way panel joint and showing full thickness.
  - 2. Subject to compliance with requirements, approved mockups may become part of completed Work if undisturbed upon date of Substantial Completion

#### 1.5 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to site in manufacturer's original unopened containers and packaging with labels clearly identifying product name and manufacturer.
  - 1. Deliver components and other manufactured items or accessories without damage or deformation.
- B. Storage and Handling: Store materials in clean, dry, interior area in accordance with manufacturer's instructions.
- C. Protect components during transportation, handling, and installation from weather, excessive temperatures and construction operations.
- D. Handle components in strict compliance with manufacturer's written instructions and recommendations, and in a manner to prevent bending, warping, twisting, and surface damage.

#### 1.6 SITE CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of this Work to be performed according to manufacturer's installation instructions and warranty requirements.
- B. Field Measurements: Verify locations of structural members and wall opening dimensions by field measurements before CI support system fabrication and indicate measurements on Shop Drawings.

#### 1.7 WARRANTY

- A. Special Warranty: Submit jointly standard written warranty by manufacturer and installer agreeing to correct defects in manufacturing and installation as part of Closeout Submittals.
- B. Warranty Period: Five years from date of Substantial Completion.



## PART 2 PRODUCTS

### 2.1 MANUFACTURER

- A. Basis-of-Design: Design is based on SMARTci and Greengirt composite framing system as manufactured by Advanced Architectural Products. Subject to compliance with requirements, provide specified products or comparable product by an equal.

### 2.2 SYSTEM DESCRIPTION

- A. Thermally improved composite framing support (CFS) members anchored to concrete masonry units (CMU).

### 2.3 PERFORMANCE REQUIREMENTS

- A. Air Infiltration Test: Maximum of 0.06 cfm/sq. ft. of wall area in accordance with ASTM E 283 or ASTM C 2357 at an air pressure differential of 6.27 lbf/sq. ft. across assembly.
- B. Water Penetration Test:
  - 1. Static: No uncontrolled water penetration at a static pressure of 2.86 lbf/sq. ft. in accordance with ASTM E 331.
- C. Structural: Provide system tested in accordance with ASTM E 330 and certified to be without permanent deformation or failure of structural members in accordance with design wind velocities for project geographic location and probability of occurrence based on data from wind velocity maps as provided in ASCE 7 and as approved by authorities having jurisdiction.
  - 1. Measure performance using test loads equal to 1-1/2 times design wind loads and with 10 second duration of maximum pressure.
  - 2. Composite Framing Supports (CFS): Structurally engineered to provide in excess of 3 times structural safety factor for lengthwise, longitudinal, and crosswise loading.
- D. Temperature: Comply with structural loading requirements within temperature range of minus 55 degrees F to 180 degrees F.
- E. Fire-Test-Response Characteristics: Provide CI support system with the following fire-test-response characteristics determined by the indicated test standard as applied by UL or other testing and inspection agency acceptable to authorities having jurisdiction.
  - 1. Surface Burning Characteristics: Not greater than the following, per ASTM E 84 or UL 723, for foam insulation, FRP, and interior surface:
    - a. Flame spread index: 25 or less.
    - b. Smoke developed index: 450 or less.
  - 2. Intermediate Scale Multistory Fire Test: Comply with NFPA 285 and IBC acceptance criteria for wall height above grade and fire separation distances.

## 2.4 MATERIALS - COMPOSITE FRAMING SUPPORT

- A. Composite Framing Support (CFS): Polyester and vinyl ester bio-resin matrix with recycled materials, ultra-violet inhibitor, fire retardant additives, and reinforced with glass strand rovings used internally for longitudinal (lengthwise) strength and continuous strand glass mats or stitched reinforcements used internally for transverse (crosswise) strength.
1. Comply with following performance requirements:
    - a. Flame Spread: 25 or less, when tested in accordance with ASTM E 84.
    - b. Smoke Development: 450 or less, when tested in accordance with ASTM E 84.
    - c. Self-Extinguishing: ASTM D 635.
    - d. Modulus of Elasticity: Engineered to meet the performance loading criteria and specified safety factors.
    - e. Barcol Hardness: 45, in accordance with ASTM D 2583.
    - f. Water Absorption: Less than 0.46 percent by weight, within 24 hours, in accordance with ASTM D 570.
    - g. Density: Within range of 0.062 to 0.070 lbs/cu in, in accordance with ASTM D 792.
    - h. Lengthwise Coefficient of Thermal Expansion:  $7.0 \times 10^{-6}$  inch/inch/degrees F, in accordance with ASTM D 696.
    - i. Notched Izod Impact, Lengthwise: 24 ft lbs/in, in accordance with ASTM D 256 within temperature range indicated.
    - j. Notched Izod Impact, Crosswise: 4 ft lbs/in, in accordance with ASTM D 256 within temperature range indicated.
  2. Comply with following physical requirements:
    - a. Height: 3 inches.
    - b. On Center Spacing: 24 inch, unless otherwise indicated on Drawings.
    - c. Include integral compression seal in CFS sections to ensure insulation panel will not dislodge and will stop air movement throughout system.
    - d. Include integral anti-siphon grooves on exterior flanges.
    - e. Include force distribution zones integrally designed into profile.
    - f. Include spline seals for adjacent insulation units.

## 2.5 ACCESSORIES

- A. Provide accessories necessary for a complete CI support system including metal closure trim, transition angle, strapping, tie-in brackets, and similar items.
- B. Fasteners: Corrosion-resistant, self-tapping, and self-drilling screws, bolts, nuts, and other fasteners as recommended by CI support system manufacturer for project application.
1. Composite Framing Support to CMU: Use Tapcon® brand anchors.
- C. Tape: Of width and type as recommended by insulation support system manufacturer.
- D. Sealants: Provide sealants as recommended for openings within wall panels and perimeter conditions.
1. Refer to Section 079200 for additional requirements.

## 2.6 FABRICATION

- A. Fabricate continuous insulation support system using manufacturer's standard procedures and processes identical to tested units and as necessary to comply with performance requirements indicated.
- B. Form support system in a continuous process with no glues or adhesives between dissimilar materials.
- C. Fabricate CFS extrusions of longest standard lengths to minimize number of joints. Factory install metal inserts in outer and inner flanges of CFS extrusions.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas of this work, and project conditions with installer present for compliance with requirements for installation tolerances, substrates, CI support conditions, and other conditions affecting performance for Work of this Section.
- B. Examine structural wall framing to ensure that angles, channels, CMU, and other structural support members have been installed within alignment tolerances required by continuous insulation support system manufacturer.
- C. Examine rough-in for components and systems penetrating CI support system to coordinate actual locations of penetrations relative to exterior joint locations prior to installation.
- D. Verify that mechanical and electrical services for exterior walls have been installed and tested and, if appropriate, verify that adjacent materials and finishes are dry and ready to receive insulation.
- E. Proceed with installation only after walls have been properly prepared and unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using methods recommended by manufacturer for achieving best result for substrate.
- C. Prepare sub-girt, base angles, sills, furring, and other CI support members and provide anchorage in accordance substrate types and panel manufacturer's installation instructions.

### 3.3 INSTALLATION

- A. Comply with manufacturer's written installation instructions. Install materials plumb, square, level, and true, unless otherwise indicated.
- B. Install assembly materials to fill-in spaces without gaps or voids. Do not compress panel insulation.

- C. Install CI support system in compliance with insulation panel orientation, sizes, and indicated locations.
- D. Provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths.
- E. Apply joint sealant material to composite framing members around perimeter of insulation panels. Tightly butt insulation panels and apply tape at exposed seams and at interface of insulation of composite framing.

#### 3.4 TOLERANCES

- A. Shim and align wall panel units with installed tolerances of 1/4 inch in 20 feet, non-cumulative.

#### 3.5 FIELD QUALITY CONTROL

- A. Manufacturer's Representative: Contractor shall have manufacturer's representative review installed assembly, noting areas that require corrective action.
- B. Perform corrective action and have any inspections by authorities having jurisdiction prior to covering CI support system by subsequent construction.

#### 3.6 PROTECTION

- A. Protect installed products from damage until date of Substantial Completion.

END OF SECTION 072173

## SECTION 074113.16 - STANDING-SEAM METAL ROOF PANELS

### 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. Standing seam metal roof panels.
- B. Related Sections:
  - 1. Section 074293 "Soffit Panels" for metal panels used in horizontal soffit applications.

#### 1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
  - 1. Meet with Owner, Engineer, Owner's insurer if applicable, metal panel Installer, metal panel manufacturer's representative, structural-support Installer, and installers whose work interfaces with or affects metal panels, including installers of roof accessories and roof-mounted equipment.
  - 2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
  - 3. Review methods and procedures related to metal panel installation, including manufacturer's written instructions.
  - 4. Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.
  - 5. Review structural loading limitations of deck during and after roofing.
  - 6. Review flashings, special details, drainage, penetrations, equipment curbs, and condition of other construction that affect metal panels.
  - 7. Review governing regulations and requirements for insurance, certificates, and tests and inspections if applicable.
  - 8. Review temporary protection requirements for metal panel systems during and after installation.
  - 9. Review procedures for repair of metal panels damaged after installation.
  - 10. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.
- B. Shop Drawings:
  - 1. Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.
  - 2. Accessories: Include details of the flashing, trim, and anchorage systems, at a scale of not less than 1-1/2 inches per 12 inches.
- C. Samples for Initial Selection: For each type of metal panel indicated with factory-applied color finishes.
  - 1. Include similar Samples of trim and accessories involving color selection.
- D. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below.
  - 1. Metal Panels: 12 inches long by actual panel width. Include clips, fasteners, closures, and other metal panel accessories.
- E. Regulatory Approvals: Provide copy of current, valid statewide product approval for product, material or system as shown on the drawings and as specified in this Section, in accordance with Rule 9N-3. Product approval shall be for the specific manufacturer, product type, model or style, and the State Approval Number.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Test Reports: For each product, for tests performed by a qualified testing agency.
- C. Field quality-control reports.
- D. Sample Warranties: For special warranties.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For metal panels to include in maintenance manuals.

#### 1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

- B. UL-Certified, Portable Roll-Forming Equipment: UL-certified, portable roll-forming equipment capable of producing metal panels warranted by manufacturer to be the same as factory-formed products. Maintain UL certification of portable roll-forming equipment for duration of work.
- C. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
  - 1. Build mockup of typical roof area and eave, including fascia, and soffit as shown on Drawings; approximately 12 feet square by full thickness, including attachments, underlayment, and accessories.
  - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Engineer specifically approves such deviations in writing.
  - 3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

#### 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver components, metal panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.
- B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.
- C. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.
- D. Retain strippable protective covering on metal panels during installation.

#### 1.9 FIELD CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal panels to be performed according to manufacturers' written instructions and warranty requirements.

#### 1.10 COORDINATION

- A. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.
- B. Coordinate metal panel installation with rain drainage work, flashing, trim, construction of soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

## 1.11 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Structural failures including rupturing, cracking, or puncturing.
    - b. Deterioration of metals and other materials beyond normal weathering.
  - 2. Warranty Period: Two years from date of Substantial Completion.
- B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
  - 1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
    - a. Color fading more than 5 Delta E units when tested according to ASTM D2244.
    - b. Chalking in excess of a No. 8 rating when tested according to ASTM D4214.
    - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
  - 2. Finish Warranty Period: 10 years from date of Substantial Completion.
- C. Special Weathertightness Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace standing-seam metal roof panel assemblies that fail to remain weathertight, including leaks, within specified warranty period.
  - 1. Warranty Period: 20 years from date of Substantial Completion.

## 1.12 REGULATORY REQUIREMENTS

- A. The products, materials and assemblies, including anchorage, proposed for the work of this Section shall comply with project specific calculated design pressures and the Florida Building Code (Code), including wind-borne debris region requirements, and shall be designed by the Manufacturer and installed by the Contractor to meet these requirements. Refer to project design pressures in the components and cladding table on the structural drawings. Where a conflict occurs between the requirements of this Specification and the Code, the more stringent requirement shall apply.
- B. It shall be the responsibility of the contractor to provide evidence of code compliance for the products, materials and assemblies, including anchorage specified in this Section. Evidence of code compliance shall be demonstrated by compliance with the Florida Building Code, using one of the methods outlined in Chapter 9N-3 of the Florida Administrative Code, Department of Community Affairs, Florida Building Commission, Product Approval.



## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Energy Performance: Provide roof panels that are listed on the EPA/DOE's ENERGY STAR "Roof Product List" for low-slope roof products.
- B. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM D1592:
  - 1. Wind Loads: As indicated on Structural Drawings.
  - 2. Other Design Loads: As indicated on Structural Drawings.
  - 3. Deflection Limits: For wind loads, no greater than 1/180 of the span.
- C. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. when tested according to ASTM E1680 or ASTM D283 at the following test-pressure difference:
  - 1. Test-Pressure Difference: 6.24 lbf/sq. ft..
- D. Water Penetration under Static Pressure: No water penetration when tested according to ASTM D1646 or ASTM E331 at the following test-pressure difference:
  - 1. Test-Pressure Difference: 6.24 lbf/sq. ft..
- E. Hydrostatic-Head Resistance: No water penetration when tested according to ASTM E2140.
- F. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for wind-uplift-resistance class indicated.
  - 1. Uplift Rating: UL 90.
- G. FM Global Listing: Provide metal roof panels and component materials that comply with requirements in FM Global 4471 as part of a panel roofing system and that are listed in FM Global's "Approval Guide" for Class 1 or noncombustible construction, as applicable. Identify materials with FM Global markings.
  - 1. Fire/Windstorm Classification: Class 1A- 120.
- H. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
  - 1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

### 2.2 STANDING-SEAM METAL ROOF PANELS

- A. Provide factory-formed metal roof panels designed to be installed by lapping and interconnecting raised side edges of adjacent panels with joint type indicated and mechanically

attaching panels to supports using concealed clips in side laps. Include clips, cleats, pressure plates, and accessories required for weathertight installation.

1. Aluminum Panel Systems: Unless more stringent requirements are indicated, comply with ASTM D1637.
- B. Vertical-Rib, Seamed-Joint, Standing-Seam Metal Roof Panels: Formed with vertical ribs at panel edges and a flat pan between ribs; designed for sequential installation by mechanically attaching panels to supports using concealed clips located under one side of panels, engaging opposite edge of adjacent panels, and mechanically seaming panels together.
  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. Berridge Manufacturing Company.
    - b. Englert, Inc.
    - c. Firestone Building Products.
    - d. Merchant and Evans.
    - e. PAC-CLAD; Petersen Aluminum Corporation; a Carlisle company.
  2. Aluminum Sheet: Coil-coated sheet, ASTM B209, alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.
    - a. Thickness: 0.032 inch.
    - b. Surface: Smooth, flat finish.
    - c. Exterior Finish: Two-coat fluoropolymer.
    - d. Color: As selected by Engineer from manufacturer's full range.
  3. Clips: Two-piece floating to accommodate thermal movement.
    - a. Material: 0.064-inch- nominal thickness, zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet.
  4. Joint Type: As standard with manufacturer.
  5. Panel Coverage: 18 inches.
  6. Panel Height: 2.0 inches.

## 2.3 UNDERLAYMENT MATERIALS

- A. Self-Adhering, High-Temperature Underlayment: Provide self-adhering, cold-applied, sheet underlayment, a minimum of 30 mils thick, consisting of slip-resistant, polyethylene-film top surface laminated to a layer of butyl or SBS-modified asphalt adhesive, with release-paper backing. Provide primer when recommended by underlayment manufacturer.
  1. Thermal Stability: Stable after testing at 240 deg F; ASTM D1970.
  2. Low-Temperature Flexibility: Passes after testing at minus 20 deg F; ASTM D1970.
  3. 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. Carlisle WIP Products; a brand of Carlisle Construction Materials.
  - b. Drexel Metals.
  - c. Owens Corning.
- B. Felt Underlayment: ASTM D226/D226M, Type II (No. 30), asphalt-saturated organic felts.
- C. Slip Sheet: Manufacturer's recommended slip sheet, of type required for application.

## 2.4 MISCELLANEOUS MATERIALS

- A. Miscellaneous Metal Subframing and Furring: ASTM C 645; cold-formed, metallic-coated steel sheet, ASTM A653/A653M, G90 coating designation or ASTM A792A/A792M, Class AZ50 coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal panel system.
- B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.
- 1. Closures: Provide closures at eaves and ridges, fabricated of same metal as metal panels.
  - 2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
  - 3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch- thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
- C. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers. Finish flashing and trim with same finish system as adjacent metal panels.
- D. Gutters: Formed from same material as roof panels, complete with end pieces, outlet tubes, and other special pieces as required. Fabricate in minimum 96-inch- long sections, of size and metal thickness according to SMACNA's "Architectural Sheet Metal Manual." Furnish gutter supports spaced a maximum of 36 inches o.c., fabricated from same metal as gutters. Provide wire ball strainers of compatible metal at outlets. Finish gutters to match metal roof panels and roof fascia and rake trim.
- E. Downspouts: Formed from same material as roof panels. Fabricate in 10-foot- long sections, complete with formed elbows and offsets, of size and metal thickness according to SMACNA's "Architectural Sheet Metal Manual." Finish downspouts to match gutters.
- F. Panel Fasteners: Self-tapping screws designed to withstand design loads.
- G. Panel Sealants: Provide sealant type recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.

1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.
2. Joint Sealant: ASTM C920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended in writing by metal panel manufacturer.
3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C1311.

## 2.5 FABRICATION

- A. Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
- B. On-Site Fabrication: Subject to compliance with requirements of this Section, metal panels may be fabricated on-site using UL-certified, portable roll-forming equipment if panels are of same profile and warranted by manufacturer to be equal to factory-formed panels. Fabricate according to equipment manufacturer's written instructions and to comply with details shown.
- C. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.
- D. Fabricate metal panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.
- E. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.
  1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
  2. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
  3. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.
  4. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
  5. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.
    - a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal panel manufacturer for application, but not less than thickness of metal being secured.

## 2.6 FINISHES

- A. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. 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 same piece are unacceptable. 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.
- C. Aluminum Panels and Accessories:
  - 1. Two-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions for seacoast and severe environments.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal panel supports, and other conditions affecting performance of the Work.
  - 1. Examine primary and secondary roof framing to verify that rafters, purlins, angles, channels, and other structural panel support members and anchorages have been installed within alignment tolerances required by metal roof panel manufacturer.
  - 2. Examine solid roof sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal roof panel manufacturer.
    - a. Verify that air- or water-resistive barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.
- B. Examine roughing-in for components and systems penetrating metal panels to verify actual locations of penetrations relative to seam locations of metal panels before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C 754 and metal panel manufacturer's written recommendations.

### 3.3 INSTALLATION OF UNDERLAYMENT

- A. Self-Adhering Sheet Underlayment: Apply primer if required by manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation. Apply at locations indicated below, wrinkle free, in shingle fashion to shed water, and with end laps of not less than 6 inches staggered 24 inches between courses. Overlap side edges not less than 3-1/2 inches. Roll laps with roller. Cover underlayment within 14 days.
  - 1. Apply over the entire roof surface.
- B. Slip Sheet: Apply slip sheet over underlayment before installing metal roof panels.

### 3.4 INSTALLATION OF STANDING SEAM METAL ROOF PANELS

- A. Install metal panels according to manufacturer's written instructions in orientation, sizes, and locations indicated. Install panels perpendicular to supports unless otherwise indicated. Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.
  - 1. Shim or otherwise plumb substrates receiving metal panels.
  - 2. Flash and seal metal panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by metal panels are installed.
  - 3. Install screw fasteners in predrilled holes.
  - 4. Locate and space fastenings in uniform vertical and horizontal alignment.
  - 5. Install flashing and trim as metal panel work proceeds.
  - 6. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
  - 7. Align bottoms of metal panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
  - 8. Provide weathertight escutcheons for pipe- and conduit-penetrating panels.
- B. Fasteners:
  - 1. Aluminum Panels: Use aluminum or stainless steel fasteners for surfaces exposed to the exterior; use aluminum or galvanized-steel fasteners for surfaces exposed to the interior.
- C. Anchor Clips: Anchor metal roof panels and other components of the Work securely in place, using manufacturer's approved fasteners according to manufacturers' written instructions.
- D. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal panel manufacturer.
- E. Standing-Seam Metal Roof Panel Installation: Fasten metal roof panels to supports with concealed clips at each standing-seam joint at location, spacing, and with fasteners recommended in writing by manufacturer.
  - 1. Install clips to supports with self-tapping fasteners.
  - 2. Install pressure plates at locations indicated in manufacturer's written installation instructions.

3. Seamed Joint: Crimp standing seams with manufacturer-approved, motorized seamer tool so clip, metal roof panel, and factory-applied sealant are completely engaged.
  4. Watertight Installation:
    - a. Apply a continuous ribbon of sealant or tape to seal joints of metal panels, using sealant or tape as recommend in writing by manufacturer as needed to make panels watertight.
    - b. Provide sealant or tape between panels and protruding equipment, vents, and accessories.
    - c. At panel splices, nest panels with minimum 6-inch end lap, sealed with sealant and fastened together by interlocking clamping plates.
- F. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
1. Install components required for a complete metal panel system including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal roof panel manufacturers; or, if not indicated, types recommended by metal roof panel manufacturer.
- G. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.
1. Install exposed flashing and trim that is without buckling and tool marks, and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and achieve waterproof and weather-resistant performance.
  2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).
- H. Gutters: Join sections with riveted and soldered or lapped and sealed joints. Attach gutters to eave with gutter hangers spaced not more than 36 inches o.c. using manufacturer's standard fasteners. Provide end closures and seal watertight with sealant. Provide for thermal expansion.
- I. Downspouts: Join sections with telescoping joints. Provide fasteners designed to hold downspouts securely 1 inch away from walls; locate fasteners at top and bottom and at approximately 60 inches o.c. in between.
1. Provide elbows at base of downspouts to direct water away from building.
- J. Pipe Flashing: Form flashing around pipe penetration and metal roof panels. Fasten and seal to metal roof panels as recommended by manufacturer.

### 3.5 ERECTION TOLERANCES

- A. Installation Tolerances: Shim and align metal panel units within installed tolerance of 1/4 inch in 20 feet on slope and location lines as indicated and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

### 3.6 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect metal roof panel installation, including accessories. Report results in writing.
- B. Remove and replace applications of metal roof panels where tests and inspections indicate that they do not comply with specified requirements.
- C. Additional tests and inspections, at Contractor's expense, are performed to determine compliance of replaced or additional work with specified requirements.
- D. Prepare test and inspection reports.

### 3.7 CLEANING AND PROTECTION

- A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.
- B. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 074113.16





# CHECKLIST FOR ROOFING SYSTEM

FM Global Clients: submit completed form and completed RoofNav Contractor Package to local FM Global field office for review.

## CONTACT INFORMATION:

## FM GLOBAL INDEX NUMBER:

ROOFING CONTRACTOR (NAME, ADDRESS, PROJECT NO.)	TELEPHONE NO.:	CONTACT:
	E-MAIL ADDRESS:	FAX:
CLIENT SITE (NAME & ADDRESS)	TELEPHONE NO.:	CONTACT:
	E-MAIL ADDRESS:	FAX:

## OVERVIEW OF WORK: (Submit 1 form per roof area)

Building Name & Number (provide building diagram as appropriate):			
Type of Work: <input type="checkbox"/> New Construction <input type="checkbox"/> Recover (New roof over existing Roofing System) <input type="checkbox"/> Reroof (New cover/remove existing roofing system to deck) <input type="checkbox"/> Other (describe)			
Building Dimensions: Length:	ft/m;	Width:	ft/m.; Height ft/m.
Roof Slope: in. per ft. / degrees			
Parapet Height ,max (in./m):		Parapet Height ,min (in./m): (put "0" if not always present)	
Roof Zone Width/Dimension*: Zone 1': Zone 1: Zone 2: Zone 3:			
FM Approved RoofNav Assembly Numbers (provide Assembly Number for individual roof zones as appropriate):			

\*Refer to FM Global Property Loss Prevention Data Sheet 1-28, *Wind Design* or RoofNav for determination of various zone dimensions.

## ROOF SURFACING:

<input type="checkbox"/> None			
<input type="checkbox"/> Coating (Trade Name/Application Rate)			
<input type="checkbox"/> Granules (Application Rate)			
<input type="checkbox"/> Gravel/Slag (Application Rate)			
<input type="checkbox"/> Ballast:	<input type="checkbox"/> Stone Size	<input type="checkbox"/> Pavers	(Beveled, strapped or square edge); <input type="checkbox"/> Other:
Ballast Weight (psf): Zone 1': Zone 1: Zone 2: Zone 3:			
Additional Detail:			

## ROOF COVER / MEMBRANE:

(Provide ALL applicable details including trade name, type, number of plies, thickness, reinforced, adhesive, etc.)

Roof Cover: Trade Name:	
Hail Rating Provided:	
<input type="checkbox"/> Single Ply:	<input type="checkbox"/> Adhered <input type="checkbox"/> Fastened <input type="checkbox"/> Ballasted
<input type="checkbox"/> Multi-Ply	Built Up Roofing (BUR) <input type="checkbox"/> Modified Bitumen
Number of Plies:	
<input type="checkbox"/> Lap Width in/mm	<input type="checkbox"/> Lap Adhesion Type
<input type="checkbox"/> Panel:	<input type="checkbox"/> Through Fastened Metal <input type="checkbox"/> Standing Seam metal <input type="checkbox"/> Fiber Reinforced Plastic (FRP) <input type="checkbox"/> Other:
<input type="checkbox"/> Spray Applied	<input type="checkbox"/> Other:
Additional Detail:	

# CHECKLIST FOR ROOFING SYSTEM

## ROOF COVER / MEMBRANE SECUREMENT:

Roof Cover Fasteners: Trade Name:	Length:	Diameter/No.:
Stress Plate/Batten: Trade Name:	Size:	
Row Spacing: Zone 1':	Zone 1:	Zone 2: Zone 3:
Fastener Spacing: Zone 1':	Zone 1:	Zone 2: Zone 3:
Bonding Adhesive: Trade Name:		
Adhesive Ribbon Width (in.):		
Adhesive Ribbon Spacing (in.): Zone 1':	Zone 1:	Zone 2: Zone 3:
Adhesive Application Rate (gal./sq.):		
Additional Detail:		

## INSULATION / COVER BOARD:

Layer	Insulation / Cover Board Trade Name	Board Dimensions (ft. x. ft.)	Thickness (in.)	Fastened	Adhered	Tapered
1. Top		X		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Next		X		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Next		X		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Next		X		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Thermal Barrier		X		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/> Glass Fiber/Mineral Wool/Batt <input type="checkbox"/> Facer Type/Vapor Barrier						
<input type="checkbox"/> Other:						
<input type="checkbox"/> None						
Additional Detail:						

## INSULATION / COVER BOARD SECUREMENT:

Insulation / Cover Board Fasteners: Trade Name:	Type:	Size:
Stress Plate: Trade Name:	Size:	
Fastener Spacing: Zone 1':	Zone 1:	Zone 2: Zone 3:
Bonding Adhesive: Trade Name:		
Adhesive Ribbon Width (in.):		
Adhesive Ribbon Spacing (in.): Zone 1':	Zone 1:	Zone 2: Zone 3:
Adhesive Application Rate (gal./sq.):		
Additional Detail:		

## BASE SHEET: (Include Trade Name, Type, and Width)

<input type="checkbox"/> None	
Trade Name:	Width: <input type="checkbox"/> 36 in. <input type="checkbox"/> 1 meter (39 in.)
<input type="checkbox"/> Fastened	<input type="checkbox"/> Adhered
<input type="checkbox"/> Lap Width in/mm	<input type="checkbox"/> Lap Adhesion Type
<input type="checkbox"/> Air Retarder	<input type="checkbox"/> Vapor Retarder
Additional Detail:	

## BASE SHEET SECUREMENT:

Base Sheet Adhesive Name:	Adhesive Application Rate:
Base Sheet Fastener Trade Name:	Type:
Head Diameter:	Length:
Spacing: (Attached Sketches as necessary)	
Spacing Along Laps: Zone 1':	Zone 1: Zone 2: Zone 3:
No. Intermediate Rows: Zone 1':	Zone 1: Zone 2: Zone 3:
Spacing Along Intermediate Rows: Zone 1':	Zone 1: Zone 2: Zone 3:
Additional Detail:	

# CHECKLIST FOR ROOFING SYSTEM

## DECK:

<input type="checkbox"/> Steel:	Manufacturer:	Type (e.g. wide rib):	Thickness / Gauge:	Yield Strength:
<input type="checkbox"/> LWIC (Form Deck):	<input type="checkbox"/> Cementitious Wood Fiber ( <i>Pullout Test Required</i> ):			
<input type="checkbox"/> Concrete: <input type="checkbox"/> Pre-cast panels or <input type="checkbox"/> Cast in Place				
<input type="checkbox"/> Wood ( <i>Pullout Test Required</i> ):				
<input type="checkbox"/> Fiber Reinforced Cement:		<input type="checkbox"/> Fiber Reinforced Plastic		
<input type="checkbox"/> Gypsum ( <i>Pullout Test Required</i> ): <input type="checkbox"/> Plank or <input type="checkbox"/> Poured				
<input type="checkbox"/> Other:				
Additional Detail:				

## DECK or ROOF PANEL SECUREMENT:

Deck Or Roof Panel Fasteners:		Type:		
Trade Name:		Size Washer:		
Length:		Washer:		
If Weld: Size:	Weld:	Washer:		
Fastener / Weld Spacing:	Zone 1':	Zone 1:	Zone 2:	Zone 3:
Deck Side Lap Fastener Spacing:	Zone 1':	Zone 1:	Zone 2:	Zone 3:
Additional Detail:				

## ROOF STRUCTURE (Include Size, Gage, Etc.):

<input type="checkbox"/> Purlins	<input type="checkbox"/> "C" or <input type="checkbox"/> "Z"	Thickness:		
Purlin:	Zone 1':	Zone 1:	Zone 2:	Zone 3:
<input type="checkbox"/> Joists	<input type="checkbox"/> Wood or <input type="checkbox"/> Steel			
Joist Spacing:	Zone 1':	Zone 1:	Zone 2:	Zone 3:
<input type="checkbox"/> Beams	<input type="checkbox"/> Wood or <input type="checkbox"/> Steel			
Beam Spacing:	Zone 1':	Zone 1:	Zone 2:	Zone 3:
<input type="checkbox"/> Other:				
Additional Detail:				

## PERIMETER FLASHING: (*Attach a detailed sketch of metal fascia, gravel stop, nailer, blocking, coping, etc.*)

<input type="checkbox"/> FM Approved Flashing				
<input type="checkbox"/> Other ( <i>applicable only when FM Approved system is not available</i> ):				
Manufacturer/Trade Name:				
Flashing Max Wind Rating:				
Fascia / Coping Detail: Face Height:		Thickness:		
Hook Strip Detail: Height:		Thickness:		Fastener spacing:
Nailer / Blocking Details Per FM Global Data Sheet 1-49? <input type="checkbox"/> Yes <input type="checkbox"/> No ( <i>Attach Details</i> )				
Nailer Securement: Diameter:		Spacing:		Embedment:
Additional Detail:				

## DRAINAGE:

For new construction: Has roof drainage been designed by a Qualified Engineer per FM Global Loss Prevention Data Sheet 1-54 and the local building code? <input type="checkbox"/> Yes <input type="checkbox"/> No ( <i>Attach details</i> )	
For re-roofing and recovering: will the roof drainage be changed from the original design (i.e. drains inserted/covered/removed, new expansion joints, blocked or reduced scupper size)? <input type="checkbox"/> Yes <input type="checkbox"/> No	
If yes, were the changes reviewed by a Qualified Engineer? <input type="checkbox"/> Yes <input type="checkbox"/> No ( <i>Attach details</i> )	
Is secondary (emergency) roof drainage provided per FM Global Data Sheet 1-54? <input type="checkbox"/> Yes <input type="checkbox"/> No ( <i>Attach details</i> )	
Additional Detail:	

## ROOF MOUNTED EQUIPMENT: (*Attach drawings, calculations and any supporting detail.*)

Roof mounted equipment secured per FM Global Loss Prevention Data Sheet 1-28 and the local building code? <input type="checkbox"/> Yes <input type="checkbox"/> No
Additional Detail:

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## SECTION 074293 - SOFFIT PANELS

### 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. Metal soffit panels.

- B. Related Sections:

- 1. Section 074113.16 "Standing-Seam Metal Roof Panels" for metal roof panels.

#### 1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

#### 1.4 ACTION SUBMITTALS

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

- 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.

- B. Shop Drawings:

- 1. Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.
  - 2. Accessories: Include details of flashing, trim, and anchorage systems, at a scale of not less than 1-1/2 inches per 12 inches.

- C. Samples for Initial Selection: For each type of metal panel indicated with factory-applied color finishes.

- 1. Include similar Samples of trim and accessories involving color selection.

- D. Regulatory Approvals: Provide copy of current, valid statewide product approval for product, material or system as shown on the drawings and as specified in this Section, in accordance

with Rule 9N-3. Product approval shall be for the specific manufacturer, product type, model or style, and the State Approval Number.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Test Reports: For each product, tests performed by a qualified testing agency.
- C. Sample Warranties: For special warranties.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For metal panels to include in maintenance manuals.

#### 1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
- B. UL-Certified, Portable Roll-Forming Equipment: UL-certified, portable roll-forming equipment capable of producing metal panels warranted by manufacturer to be the same as factory-formed products. Maintain UL certification of portable roll-forming equipment for duration of work.
- C. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
  - 1. Build mockup of typical roof eave, including fascia, and soffit as shown on Drawings; approximately four panels wide by full eave width, including attachments and accessories.
  - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Engineer specifically approves such deviations in writing.
  - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

#### 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver components, metal panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.
- B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.
- C. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.

- D. Retain strippable protective covering on metal panels during installation.

#### 1.9 FIELD CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal panels to be performed according to manufacturers' written instructions and warranty requirements.

#### 1.10 COORDINATION

- A. Coordinate metal panel installation with rain drainage work, flashing, trim, construction of walls, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

#### 1.11 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.

- 1. Failures include, but are not limited to, the following:

- a. Structural failures including rupturing, cracking, or puncturing.
    - b. Deterioration of metals and other materials beyond normal weathering.

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

- B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.

- 1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:

- a. Color fading more than 5 Delta E units when tested according to ASTM D2244.
    - b. Chalking in excess of a No. 8 rating when tested according to ASTM D4214.
    - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

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

#### 1.12 REGULATORY REQUIREMENTS

- A. The products, materials and assemblies, including anchorage, proposed for the work of this Section shall comply with project specific calculated design pressures and the Florida Building Code (Code), including wind-borne debris region requirements, and shall be designed by the Manufacturer and installed by the Contractor to meet these requirements. Refer to project design pressures in the components and cladding table on the structural drawings. Where a conflict occurs between the requirements of this Specification and the Code, the more stringent requirement shall apply.

- B. It shall be the responsibility of the contractor to provide evidence of code compliance for the products, materials and assemblies, including anchorage specified in this Section. Evidence of code compliance shall be demonstrated by compliance with the Florida Building Code, using one of the methods outlined in Chapter 9N-3 of the Florida Administrative Code, Department of Community Affairs, Florida Building Commission, Product Approval.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E1592:
  - 1. Wind Loads: As indicated on Structural Drawings.
  - 2. Other Design Loads: As indicated on Structural Drawings.
  - 3. Deflection Limits: For wind loads, no greater than 1/180 of the span.
  - 4. .
- B. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. when tested according to ASTM E283 at the following test-pressure difference:
  - 1. Test-Pressure Difference: 6.24 lbf/sq. ft..
- C. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E331 at the following test-pressure difference:
  - 1. Test-Pressure Difference: 6.24 lbf/sq. ft..
- D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
  - 1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

### 2.2 METAL SOFFIT PANELS

- A. Provide metal soffit panels designed to be installed by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners in side laps. Include accessories required for weathertight installation.
- B. V-Groove-Profile Metal Soffit Panels: Solid panels formed with vertical panel edges and a flat pan between panel edges; with a V-groove joint between panels.
  - 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. Berridge Manufacturing Company.
  - b. Englert, Inc.
  - c. Firestone Building Products
  - d. PAC-CLAD; Petersen Aluminum Corporation; a Carlisle company.
2. Material: Same material, finish, and color as metal roof panels.
  3. Panel Coverage: 12 inches.
  4. Panel Height: 0.50 inch.

## 2.3 MISCELLANEOUS MATERIALS

- A. Miscellaneous Metal Subframing and Furring: ASTM C645, cold-formed, metallic-coated steel sheet, ASTM A653/A653M, G90 coating designation or ASTM A792/A792M, Class AZ50 aluminum-zinc-alloy coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal panel system.
- B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.
  1. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch- thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
- C. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Finish flashing and trim with same finish system as adjacent metal panels.
- D. Panel Fasteners: Self-tapping screws designed to withstand design loads. Provide exposed fasteners with heads matching color of metal panels by means of plastic caps or factory-applied coating. Provide EPDM or PVC sealing washers for exposed fasteners.
- E. Panel Sealants: Provide sealant types recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.
  1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.
  2. Joint Sealant: ASTM C920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended in writing by metal panel manufacturer.
  3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C1311.

## 2.4 FABRICATION

- A. Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements

demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.

- B. On-Site Fabrication: Subject to compliance with requirements of this Section, metal panels may be fabricated on-site using UL-certified, portable roll-forming equipment if panels are of same profile and warranted by manufacturer to be equal to factory-formed panels. Fabricate according to equipment manufacturer's written instructions and to comply with details shown.
- C. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.
- D. Fabricate metal panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.
- E. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.
  - 1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
  - 2. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
  - 3. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
  - 4. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.
  - 5. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
  - 6. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.
    - a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal soffit panel manufacturer for application but not less than thickness of metal being secured.

## 2.5 FINISHES

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

C. Aluminum Panels and Accessories:

1. Two-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions for seacoast and severe environments.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal panel supports, and other conditions affecting performance of the Work.
  1. Examine framing to verify that girts, angles, channels, studs, and other structural panel support members and anchorage have been installed within alignment tolerances required by metal panel manufacturer.
  2. Examine sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal panel manufacturer.
    - a. Verify that air- or water-resistive barriers been installed over sheathing or backing substrate to prevent air infiltration or water penetration.
- B. Examine roughing-in for components and systems penetrating metal panels to verify actual locations of penetrations relative to seam locations of metal panels before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C754 and metal panel manufacturer's written recommendations.
  1. Soffit Framing: Wire tie or clip furring channels to supports, as required to comply with requirements for assemblies indicated.

3.3 INSTALLATION

- A. Install metal panels according to manufacturer's written instructions in orientation, sizes, and locations indicated. Install panels perpendicular to supports unless otherwise indicated. Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.
  1. Shim or otherwise plumb substrates receiving metal panels.

2. Flash and seal metal panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by metal panels are installed.
  3. Install screw fasteners in predrilled holes.
  4. Locate and space fastenings in uniform vertical and horizontal alignment.
  5. Install flashing and trim as metal panel work proceeds.
  6. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
  7. Provide weathertight escutcheons for pipe- and conduit-penetrating panels.
- B. Fasteners:
1. Aluminum Panels: Use aluminum or stainless steel fasteners for surfaces exposed to the exterior; use aluminum or galvanized-steel fasteners for surfaces exposed to the interior.
- C. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal panel manufacturer.
- D. Lap-Seam Metal Panels: Fasten metal panels to supports with fasteners at each lapped joint at location and spacing recommended by manufacturer.
1. Apply panels and associated items true to line for neat and weathertight enclosure.
  2. Provide metal-backed washers under heads of exposed fasteners bearing on weather side of metal panels.
  3. Locate and space exposed fasteners in uniform vertical and horizontal alignment. Use proper tools to obtain controlled uniform compression for positive seal without rupture of washer.
  4. Install screw fasteners with power tools having controlled torque adjusted to compress washer tightly without damage to washer, screw threads, or panels. Install screws in predrilled holes.
- E. Watertight Installation:
1. Apply a continuous ribbon of sealant or tape to seal lapped joints of metal panels, using sealant or tape as recommend by manufacturer on side laps of nesting-type panels and elsewhere as needed to make panels watertight.
  2. Provide sealant or tape between panels and protruding equipment, vents, and accessories.
  3. At panel splices, nest panels with minimum 6-inch end lap, sealed with sealant and fastened together by interlocking clamping plates.
- F. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
1. Install components required for a complete metal panel system including trim, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal panel manufacturer; or, if not indicated, provide types recommended by metal panel manufacturer.
- G. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners

where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that are permanently watertight.

1. Install exposed flashing and trim that is without buckling, and tool marks, and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to achieve waterproof performance.
2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

### 3.4 CLEANING AND PROTECTION

- A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.
- B. After metal panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.
- C. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 074293

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## SECTION 075216 - STYRENE-BUTADIENE-STYRENE (SBS) MODIFIED BITUMINOUS MEMBRANE ROOFING

### 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. Styrene-butadiene-styrene (SBS)-modified bituminous membrane roofing.
  - 2. Vapor retarder.
  - 3. Roof insulation.
- B. Related Requirements:
  - 1. Section 072100 "Thermal Insulation" for insulation beneath the roof deck.
  - 2. Section 077100 "Roof Specialties" for coping and roof edge components.
  - 3. Section 079200 "Joint Sealants" for joint sealants, joint fillers, and joint preparation.

#### 1.3 DEFINITIONS

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

#### 1.4 PREINSTALLATION MEETINGS

- A. Preliminary Roofing Conference: Before starting roof deck construction, conduct conference at Project site.
  - 1. Meet with Owner, Engineer, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck Installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
  - 2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
  - 3. Review and finalize construction schedule, and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
  - 4. Review deck substrate requirements for conditions and finishes, including flatness and fastening.
  - 5. Review structural loading limitations of roof deck during and after roofing.

6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that affects roofing system.
7. Review governing regulations and requirements for insurance and certificates if applicable.
8. Review temporary protection requirements for roofing system during and after installation.
9. Review roof observation and repair procedures after roofing installation.

B. Preinstallation Roofing Conference: Conduct conference at Project site.

1. Meet with Owner, Engineer, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck Installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
3. Review and finalize construction schedule, and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
4. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.
5. Review structural loading limitations of roof deck during and after roofing.
6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that affects roofing system.
7. Review governing regulations and requirements for insurance and certificates if applicable.
8. Review temporary protection requirements for roofing system during and after installation.
9. Review roof observation and repair procedures after roofing installation.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For roofing system. Include plans, elevations, sections, details, and attachments to other work, including:

1. Base flashings and membrane terminations.
2. Tapered insulation, including slopes.
3. Crickets, saddles, and tapered edge strips, including slopes.
4. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.

C. Samples for Verification: For the following products:

1. Cap sheet, of color required.
2. Flashing sheet, of color required.
3. Aggregate surfacing material in gradation and color required.
4. Walkway pads or rolls, of color required.

D. Regulatory Approvals: Provide copy of current, valid statewide product approval for product, material or system as shown on the drawings and as specified in this Section, in accordance



with Rule 9N-3. Product approval shall be for the specific manufacturer, product type, model or style, and the State Approval Number.

#### 1.6 INFORMATIONAL SUBMITTALS

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

#### 1.7 CLOSEOUT SUBMITTALS

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

#### 1.8 QUALITY ASSURANCE

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

#### 1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing and mixing with other components.
- B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.
  - 1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.

- C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.
- D. Handle and store roofing materials, and place equipment in a manner to avoid permanent deflection of deck.

#### 1.10 FIELD CONDITIONS

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

#### 1.11 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of roofing system that fail in materials or workmanship within specified warranty period.
  - 1. Special warranty includes membrane roofing, base flashings, roof insulation, fasteners, cover boards, roofing accessories, and other components of roofing system.
  - 2. Warranty Period: 10 years from date of Substantial Completion.
- B. Special Project Warranty: Submit roofing Installer's warranty, on warranty form at end of this Section, signed by Installer, covering the Work of this Section, including all components of roofing system such as membrane roofing, base flashing, roof insulation, fasteners, cover boards, substrate boards, vapor retarders, and walkway products, for the following warranty period:
  - 1. Warranty Period: Two years from date of Substantial Completion.

#### 1.12 REGULATORY REQUIREMENTS

- A. The products, materials and assemblies, including anchorage, proposed for the work of this Section shall comply with project specific calculated design pressures and the Florida Building Code (Code), including wind-borne debris region requirements, and shall be designed by the Manufacturer and installed by the Contractor to meet these requirements. Refer to project design pressures in the components and cladding table on the structural drawings. Where a conflict occurs between the requirements of this Specification and the Code, the more stringent requirement shall apply.
- B. It shall be the responsibility of the contractor to provide evidence of code compliance for the products, materials and assemblies, including anchorage specified in this Section. Evidence of code compliance shall be demonstrated by compliance with the Florida Building Code, using one of the methods outlined in Chapter 9N-3 of the Florida Administrative Code, Department of Community Affairs, Florida Building Commission, Product Approval.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Johns Manville; a Berkshire Hathaway company.
  2. Siplast.
  3. Soprema, Inc.
  4. Or equal manufacturers not accepted for this item.
- B. Source Limitations: Obtain components including roof insulation, fasteners, coverboards, roofing accessories for roofing system from manufacturer approved by membrane roofing manufacturer.

### 2.2 PERFORMANCE REQUIREMENTS

- A. General Performance: Installed roofing and base flashings shall withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Roofing and base flashings shall remain watertight.
1. Accelerated Weathering: Roofing system shall withstand 2000 hours of exposure when tested according to ASTM G 152, ASTM G 154, or ASTM G 155.
  2. Impact Resistance: Roofing system shall resist impact damage when tested according to ASTM D 3746 or ASTM D 4272.
- B. Material Compatibility: Roofing materials shall be compatible with one another and adjacent materials under conditions of service and application required, as demonstrated by roofing manufacturer based on testing and field experience.
- C. Roofing System Design: Tested by a qualified testing agency to resist the following uplift pressures:
1. Corner Uplift Pressure: As indicated on Structural Drawings.
  2. Perimeter Uplift Pressure: As indicated on Structural Drawings.
  3. Field-of-Roof Uplift Pressure: As indicated on Structural Drawings.
- D. FM Global Listing: Roofing, base flashings, and component materials shall comply with requirements in FM Global 4450 or FM Global 4470 as part of a roofing system, and shall be listed in FM Global's "RoofNav" for Class 1 or noncombustible construction, as applicable. Identify materials with FM Global markings.
1. Fire/Windstorm Classification: Class 1A-120.
- E. Energy Performance: Roofing system shall have an initial solar reflectance of not less than 0.70 and an emissivity of not less than 0.75 when tested according to CRRC-1.

- F. Exterior Fire-Test Exposure: ASTM E 108 or UL 790, Class A; for application and roof slopes indicated; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

## 2.3 ROOFING SHEET MATERIALS

- A. Sheathing Paper: Red-rosin type, minimum 3 lb/100 sq. ft..
- B. Base Sheet: ASTM D 4601, Type II, SBS-modified asphalt-impregnated and -coated sheet, with glass-fiber-reinforcing mat, dusted with fine mineral surfacing on both sides.
  - 1. Weight: 75 lb/100 sq. ft., minimum.
- C. Roofing Membrane Sheet: ASTM D 6163, Grade S, Type I or II, SBS-modified asphalt sheet (reinforced with glass fibers); smooth surfaced; suitable for application method specified.
- D. Granule-Surfaced Roofing Cap Sheet: ASTM D 6164/D 6164M, Grade G, Type I or II, SBS-modified asphalt sheet (reinforced with polyester fabric); granule surfaced; suitable for application method specified, and as follows:
  - 1. Granule Color: White.

## 2.4 BASE FLASHING SHEET MATERIALS

- A. Backer Sheet: ASTM D 6163, Grade S, Type I or II, SBS-modified asphalt sheet (reinforced with glass fibers); smooth surfaced; suitable for application method specified.
- B. Granule-Surfaced Flashing Sheet: ASTM D 6164/D 6164M, Grade G, Type I or II, SBS-modified asphalt sheet (reinforced with polyester fabric); granule surfaced; suitable for application method specified, and as follows:
  - 1. Granule Color: White.

## 2.5 AUXILIARY ROOFING MATERIALS

- A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with roofing.
- B. Asphalt Primer: ASTM D 41/D 41M.
- C. Roofing Asphalt: ASTM D 312, Type III or IV as recommended by roofing system manufacturer for application.
- D. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required by roofing system manufacturer for application.
- E. Mastic Sealant: Polyisobutylene, plain or modified bitumen; nonhardening, nonmigrating, nonskinning, and nondrying.

- F. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Global 4470, designed for fastening roofing components to substrate; tested by manufacturer for required pullout strength, and acceptable to roofing system manufacturer.
- G. Roofing Granules: Ceramic-coated roofing granules, No. 11 screen size with 100 percent passing No. 8 sieve and 98 percent of mass retained on No. 40 sieve, color to match roofing.
- H. Miscellaneous Accessories: Provide those recommended by roofing system manufacturer.

## 2.6 VAPOR RETARDER

- A. Self-Adhering-Sheet Vapor Retarder: ASTM D 1970, polyethylene film laminated to layer of rubberized asphalt adhesive, minimum 40-mil- total thickness; maximum permeance rating of 0.1 perm; cold applied, with slip-resisting surface and release paper backing. Provide primer when recommended by vapor-retarder manufacturer.

## 2.7 ROOF INSULATION

- A. General: Preformed roof insulation boards manufactured or approved by roofing manufacturer, selected from manufacturer's standard sizes suitable for application, of thicknesses indicated.
- B. Polyisocyanurate Board Insulation: ASTM C 1289, Type II, Class 1, Grade 2, felt or glass-fiber mat facer on both major surfaces.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Carlisle SynTec Incorporated.
    - b. Firestone Building Products.
    - c. Johns Manville; a Berkshire Hathaway company.
- C. Tapered Insulation: Provide factory-tapered insulation boards fabricated to slope of 1/4 inch per 12 inches unless otherwise indicated.
- D. Provide preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated.

## 2.8 INSULATION ACCESSORIES

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

- C. Insulation Adhesive: Insulation manufacturer's recommended adhesive formulated to attach roof insulation to substrate or to another insulation layer as follows:
  - 1. Modified asphaltic, asbestos-free, cold-applied adhesive.
  - 2. Bead-applied, low-rise, one-component or multicomponent urethane adhesive.
  - 3. Full-spread spray-applied, low-rise, two-component urethane adhesive.
- D. Insulation Cant Strips: ASTM C 728, perlite insulation board.
- E. Wood Nailer Strips: Comply with requirements in Section 061000 "Rough Carpentry."
- F. Tapered Edge Strips: ASTM C 728, perlite insulation board.
- G. Tapered Edge Strips: ASTM C 208, Type II, Grade 1, cellulosic-fiber insulation board.
- H. Cover Board: ASTM C 1177/C 1177M, glass-mat, water-resistant gypsum substrate, 1/2 inch thick, factory primed.
  - 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. Georgia-Pacific Gypsum LLC.
    - b. National Gypsum Company.
    - c. USG Corporation.
- I. Substrate Joint Tape: 6- or 8-inch- wide, coated, glass fiber.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work:
  - 1. Verify that roof openings and penetrations are in place, curbs are set and braced, and roof-drain bodies are securely clamped in place.
  - 2. Verify that wood cants, blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.
  - 3. Verify that deck is securely fastened with no projecting fasteners and with no adjacent units in excess of 1/16 inch out of plane relative to adjoining deck.
  - 4. Verify that minimum concrete drying period recommended by roofing system manufacturer has passed.
  - 5. Verify that concrete substrate is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
    - a. Test for moisture by pouring 1 pint of hot roofing asphalt on deck at start of each day's work and at start of each roof area or plane. Do not proceed with Work of this Section if test sample foams or can be easily and cleanly stripped after cooling.

6. Verify that concrete-curing compounds that impair adhesion of roofing components to roof deck have been removed.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing installation according to roofing system manufacturer's written instructions. Remove sharp projections.
- B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.
- C. Prime surface of concrete deck with asphalt primer at a rate of 3/4 gal./100 sq. ft., and allow primer to dry.

### 3.3 INSTALLATION, GENERAL

- A. Comply with roofing system manufacturer's written instructions.
- B. Asphalt Heating: Heat asphalt to its equiviscous temperature, measured at the mop cart or mechanical spreader immediately before application. Circulate asphalt during heating. Do not raise asphalt temperature above equiviscous temperature range more than one hour before time of application. Do not exceed asphalt manufacturer's recommended temperature limits during asphalt heating. Do not heat asphalt within 25 deg F of flash point. Discard asphalt maintained at a temperature exceeding finished blowing temperature for more than four hours.
  1. Apply hot roofing asphalt within plus or minus 25 deg F of equiviscous temperature.
- C. Asphalt Heating: Heat and apply SEBS-modified roofing asphalt according to roofing system manufacturer's written instructions.
- D. Substrate-Joint Penetrations: Prevent roofing asphalt and adhesives from penetrating substrate joints, entering building, or damaging roofing system components or adjacent building construction.

### 3.4 VAPOR-RETARDER INSTALLATION

- A. Self-Adhering-Sheet Vapor Retarder: Prime substrate if required by manufacturer. Install self-adhering-sheet vapor retarder over area to receive vapor retarder, side and end lapping each sheet a minimum of 3-1/2 inches and 6 inches, respectively. Seal laps by rolling.
- B. Completely seal vapor retarder at terminations, obstructions, and penetrations to prevent air movement into roofing system.

### 3.5 INSULATION INSTALLATION

- A. Install one lapped base-sheet course and mechanically fasten to substrate according to roofing system manufacturer's written instructions.
- B. Insulation Cant Strips: Install and secure preformed 45-degree insulation cant strips at junctures of roofing system with vertical surfaces or angle changes greater than 45 degrees.
- C. Install tapered insulation under area of roofing to conform to slopes indicated.
- D. Install insulation with long joints of insulation in a continuous straight line, with end joints staggered between rows, abutting edges and ends between boards. Fill gaps exceeding 1/4 inch with insulation.
  - 1. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.
- E. Install insulation under area of roofing to achieve required thickness. Where overall insulation thickness is 2.7 inches or greater, install two or more layers with joints of each succeeding layer staggered from joints of previous layer a minimum of 6 inches in each direction.
  - 1. Where installing composite and noncomposite insulation in two or more layers, install noncomposite board insulation for bottom layer and intermediate layers, if applicable, and install composite board insulation for top layer.
- F. Trim surface of insulation where necessary at roof drains so completed surface is flush and does not restrict flow of water.
- G. Install tapered edge strips at perimeter edges of roof that do not terminate at vertical surfaces.
- H. Mechanically Fastened Insulation: Install each layer of insulation and secure to deck using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to deck type.
  - 1. Fasten insulation according to requirements in FM Global's "RoofNav" for specified Windstorm Resistance Classification.
  - 2. Fasten insulation to resist uplift pressure at corners, perimeter, and field of roof.
- I. Install cover boards over insulation with long joints in continuous straight lines with end joints staggered between rows. Offset joints of insulation below a minimum of 6 inches in each direction. Loosely butt cover boards together and fasten to roof deck. Tape joints if required by roofing system manufacturer.
  - 1. Fasten cover boards according to requirements in FM Global's "RoofNav" for specified Windstorm Resistance Classification.
  - 2. Fasten cover boards to resist uplift pressure at corners, perimeter, and field of roof.
  - 3. Apply hot roofing asphalt to underside, and immediately bond cover board to substrate.



### 3.6 ROOFING INSTALLATION, GENERAL

- A. Install roofing system according to roofing system manufacturer's written instructions and applicable recommendations in ARMA/NRCA's "Quality Control Guidelines for the Application of Polymer Modified Bitumen Roofing" and as follows:
  - 1. Deck Type: C (concrete or nonavailable).
  - 2. Adhering Method: M (mopped)
  - 3. Base Sheet: One.
  - 4. Number of Glass-Fiber Base-Ply Sheets: One.
  - 5. Number of SBS-Modified Asphalt Sheets: Two.
  - 6. Surfacing Type: M (mineral-granule-surfaced cap sheet).
- B. Start installation of roofing in presence of manufacturer's technical personnel.
- C. Coordinate installation of roofing system so insulation and other components of the roofing system not permanently exposed are not subjected to precipitation or left uncovered at the end of the workday or when rain is forecast.
  - 1. Provide tie-offs at end of each day's work to cover exposed roofing sheets and insulation with a course of coated felt set in roofing cement or hot roofing asphalt, with joints and edges sealed.
  - 2. Complete terminations and base flashings, and provide temporary seals to prevent water from entering completed sections of roofing system.
  - 3. Remove and discard temporary seals before beginning work on adjoining roofing.

### 3.7 BASE-SHEET INSTALLATION

- A. Loosely lay one course of sheathing paper, lapping edges and ends a minimum of 2 inches and 6 inches, respectively.
- B. Install lapped base-sheet course, extending sheet over and terminating beyond cants. Attach base sheet as follows:
  - 1. Adhere to substrate in a solid mopping of hot roofing asphalt .

### 3.8 BASE-PLY SHEET INSTALLATION

- A. Install glass-fiber base-ply sheets according to roofing system manufacturer's written instructions starting at low point of roofing system. Align glass-fiber base-ply sheets without stretching. Extend sheets over and terminate beyond cants.
  - 1. Shingle side laps of glass-fiber base-ply sheets uniformly to ensure that required number of glass-fiber base-ply sheets covers substrate at any point. Shingle in direction to shed water.
  - 2. Embed each glass-fiber base-ply sheet in a continuous void-free mopping of hot roofing asphalt to form a uniform membrane without glass-fiber base-ply sheets touching.

### 3.9 SBS-MODIFIED BITUMINOUS MEMBRANE INSTALLATION

- A. Install modified bituminous roofing sheet and cap sheet according to roofing manufacturer's written instructions, starting at low point of roofing system. Extend roofing membrane sheets over and terminate beyond cants, installing as follows:
  - 1. Adhere to substrate in a solid mopping of hot roofing asphalt applied at not less than 425 deg F.
  - 2. Unroll roofing sheets and allow them to relax for minimum time period required by manufacturer.
- B. Laps: Accurately align roofing sheets, without stretching, and maintain uniform side and end laps. Stagger end laps. Completely bond and seal laps, leaving no voids.
  - 1. Repair tears and voids in laps and lapped seams not completely sealed.
  - 2. Apply roofing granules to cover exuded bead at laps while bead is hot.
- C. Install roofing sheets so side and end laps shed water.

### 3.10 FLASHING AND STRIPPING INSTALLATION

- A. Install base flashing over cant strips and other sloped and vertical surfaces, at roof edges, and at penetrations through roof, and secure to substrates according to roofing system manufacturer's written instructions and as follows:
  - 1. Prime substrates with asphalt primer if required by roofing system manufacturer.
  - 2. Backer-Sheet Application: Adhere backer sheet to substrate in a solid mopping of hot roofing asphalt .
  - 3. Flashing-Sheet Application: Adhere flashing sheet to substrate in a solid mopping of hot roofing asphalt applied at not less than 425 deg F. Apply hot roofing asphalt to back of flashing sheet if recommended by roofing system manufacturer.
- B. Extend base flashing up walls or parapets a minimum of 8 inches above roofing membrane and 4 inches onto field of roofing membrane.
- C. Install roofing cap-sheet stripping where metal flanges and edgings are set on roofing according to roofing system manufacturer's written instructions.

### 3.11 WALKWAY INSTALLATION

- A. Walkway Cap-Sheet Strips: Install walkway cap-sheet strips over roofing membrane, using same application method as used for roofing cap sheet.

### 3.12 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to inspect substrate conditions, surface preparation, membrane application, flashings, protection, and drainage components, and to furnish reports to Engineer.

1. Electric Field Vector Mapping (EFVM): Testing agency shall survey entire roof area for potential leaks using electric field vector mapping (EFVM).
- B. Test Cuts: Remove test specimens to evaluate problems observed during quality-assurance inspections of roofing membrane as follows:
  1. Determine approximate quantities of components within roofing membrane according to ASTM D 3617.
  2. Examine test specimens for interply voids according to ASTM D 3617 and to comply with criteria established in Appendix 3 of ARMA/NRCA's "Quality Control Guidelines for the Application of Polymer Modified Bitumen Roofing."
  3. Repair areas where test cuts were made according to roofing system manufacturer's written instructions.
- C. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion.
  1. Notify Engineer and Owner 48 hours in advance of date and time of inspection.
- D. Roofing system will be considered defective if it does not pass tests and inspections.
  1. Additional testing and inspecting, at Contractor's expense, will be performed to determine if replaced or additional work complies with specified requirements.

### 3.13 PROTECTING AND CLEANING

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

### 3.14 ROOFING INSTALLER'S WARRANTY

- A. WHEREAS \_\_\_\_\_ of \_\_\_\_\_, herein called the "Roofing Installer," has performed roofing and associated work ("work") on the following project:
  1. Owner:
  2. Address:
  3. Building Name/Type:
  4. Address:
  5. Area of Work:
  6. Acceptance Date: \_\_\_\_\_.

7. Warranty Period:
8. Expiration Date: \_\_\_\_\_.

- B. AND WHEREAS Roofing Installer has contracted (either directly with Owner or indirectly as a subcontractor) to warrant said work against leaks and faulty or defective materials and workmanship for designated Warranty Period,
- C. NOW THEREFORE Roofing Installer hereby warrants, subject to terms and conditions herein set forth, that during Warranty Period Installer will, at its own cost and expense, make or cause to be made such repairs to or replacements of said work as are necessary to correct faulty and defective work and as are necessary to maintain said work in a watertight condition.
- D. This Warranty is made subject to the following terms and conditions:
  1. Specifically excluded from this Warranty are damages to work and other parts of the building, and to building contents, caused by:
    - a. lightning;
    - b. peak gust wind speed exceeding \_\_\_\_\_;
    - c. fire;
    - d. failure of roofing system substrate, including cracking, settlement, excessive deflection, deterioration, and decomposition;
    - e. faulty construction of parapet walls, copings, chimneys, skylights, vents, equipment supports, and other edge conditions and penetrations of the work;
    - f. vapor condensation on bottom of roofing; and
    - g. activity on roofing by others, including construction contractors, maintenance personnel, other persons, and animals, whether authorized or unauthorized by Owner.
  2. When work has been damaged by any of foregoing causes, Warranty shall be null and void until such damage has been repaired by Roofing Installer and until cost and expense thereof have been paid by Owner or by another responsible party so designated.
  3. Roofing Installer is responsible for damage to work covered by this Warranty but is not liable for consequential damages to building or building contents resulting from leaks or faults or defects of work.
  4. During Warranty Period, if Owner allows alteration of work by anyone other than Roofing Installer, including cutting, patching, and maintenance in connection with penetrations, attachment of other work, and positioning of anything on roof, this Warranty shall become null and void on date of said alterations, but only to the extent said alterations affect work covered by this Warranty. If Owner engages Roofing Installer to perform said alterations, Warranty shall not become null and void unless Roofing Installer, before starting said work, shall have notified Owner in writing, showing reasonable cause for claim, that said alterations would likely damage or deteriorate work, thereby reasonably justifying a limitation or termination of this Warranty.
  5. During Warranty Period, if original use of roof is changed and it becomes used for, but was not originally specified for, a promenade, work deck, spray-cooled surface, flooded basin, or other use or service more severe than originally specified, this Warranty shall become null and void on date of said change, but only to the extent said change affects work covered by this Warranty.

6. Owner shall promptly notify Roofing Installer of observed, known, or suspected leaks, defects, or deterioration and shall afford reasonable opportunity for Roofing Installer to inspect work and to examine evidence of such leaks, defects, or deterioration.
7. This Warranty is recognized to be the only warranty of Roofing Installer on said work and shall not operate to restrict or cut off Owner from other remedies and resources lawfully available to Owner in cases of roofing failure. Specifically, this Warranty shall not operate to relieve Roofing Installer of responsibility for performance of original work according to requirements of the Contract Documents, regardless of whether Contract was a contract directly with Owner or a subcontract with Owner's General Contractor.

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

1. Authorized Signature: \_\_\_\_\_.
2. Name: \_\_\_\_\_.
3. Title: \_\_\_\_\_.

END OF SECTION 075216

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# CHECKLIST FOR ROOFING SYSTEM

FM Global Clients: submit completed form and completed RoofNav Contractor Package to local FM Global field office for review.

## CONTACT INFORMATION:

## FM GLOBAL INDEX NUMBER:

ROOFING CONTRACTOR (NAME, ADDRESS, PROJECT NO.)	TELEPHONE NO.:	CONTACT:
	E-MAIL ADDRESS:	FAX:
CLIENT SITE (NAME & ADDRESS)	TELEPHONE NO.:	CONTACT:
	E-MAIL ADDRESS:	FAX:

## OVERVIEW OF WORK: (Submit 1 form per roof area)

Building Name & Number (provide building diagram as appropriate):			
Type of Work: <input type="checkbox"/> New Construction <input type="checkbox"/> Recover (New roof over existing Roofing System) <input type="checkbox"/> Reroof (New cover/remove existing roofing system to deck) <input type="checkbox"/> Other (describe)			
Building Dimensions: Length:	ft/m;	Width:	ft/m.;
Roof Slope:	in. per ft. / degrees	Height	ft/m.
Parapet Height ,max (in./m):	Parapet Height ,min (in./m): (put "0" if not always present)		
Roof Zone Width/Dimension*:			
Zone 1':	Zone 1:	Zone 2:	Zone 3:
FM Approved RoofNav Assembly Numbers (provide Assembly Number for individual roof zones as appropriate):			

\*Refer to FM Global Property Loss Prevention Data Sheet 1-28, *Wind Design* or RoofNav for determination of various zone dimensions.

## ROOF SURFACING:

<input type="checkbox"/> None			
<input type="checkbox"/> Coating (Trade Name/Application Rate)			
<input type="checkbox"/> Granules (Application Rate)			
<input type="checkbox"/> Gravel/Slag (Application Rate)			
<input type="checkbox"/> Ballast: <input type="checkbox"/> Stone Size <input type="checkbox"/> Pavers (Beveled, strapped or square edge); <input type="checkbox"/> Other:			
Ballast Weight (psf): Zone 1':	Zone 1:	Zone 2:	Zone 3:
Additional Detail:			

## ROOF COVER / MEMBRANE:

(Provide ALL applicable details including trade name, type, number of plies, thickness, reinforced, adhesive, etc.)

Roof Cover: Trade Name:	
Hail Rating Provided:	
<input type="checkbox"/> Single Ply:	<input type="checkbox"/> Adhered <input type="checkbox"/> Fastened <input type="checkbox"/> Ballasted
<input type="checkbox"/> Multi-Ply	Built Up Roofing (BUR) <input type="checkbox"/> Modified Bitumen
Number of Plies:	
<input type="checkbox"/> Lap Width in/mm	<input type="checkbox"/> Lap Adhesion Type
<input type="checkbox"/> Panel:	<input type="checkbox"/> Through Fastened Metal <input type="checkbox"/> Standing Seam metal <input type="checkbox"/> Fiber Reinforced Plastic (FRP) <input type="checkbox"/> Other:
<input type="checkbox"/> Spray Applied	<input type="checkbox"/> Other:
Additional Detail:	

# CHECKLIST FOR ROOFING SYSTEM

## ROOF COVER / MEMBRANE SECUREMENT:

Roof Cover Fasteners: Trade Name:	Length:	Diameter/No.:
Stress Plate/Batten: Trade Name:	Size:	
Row Spacing: Zone 1':	Zone 1:	Zone 2: Zone 3:
Fastener Spacing: Zone 1':	Zone 1:	Zone 2: Zone 3:
Bonding Adhesive: Trade Name:		
Adhesive Ribbon Width (in.):		
Adhesive Ribbon Spacing (in.): Zone 1':	Zone 1:	Zone 2: Zone 3:
Adhesive Application Rate (gal./sq.):		
Additional Detail:		

## INSULATION / COVER BOARD:

Layer	Insulation / Cover Board Trade Name	Board Dimensions (ft. x. ft.)	Thickness (in.)	Fastened	Adhered	Tapered
1. Top		X		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Next		X		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Next		X		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Next		X		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Thermal Barrier		X		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/> Glass Fiber/Mineral Wool/Batt <input type="checkbox"/> Facer Type/Vapor Barrier						
<input type="checkbox"/> Other:						
<input type="checkbox"/> None						
Additional Detail:						

## INSULATION / COVER BOARD SECUREMENT:

Insulation / Cover Board Fasteners: Trade Name:	Type:	Size:
Stress Plate: Trade Name:	Size:	
Fastener Spacing: Zone 1':	Zone 1:	Zone 2: Zone 3:
Bonding Adhesive: Trade Name:		
Adhesive Ribbon Width (in.):		
Adhesive Ribbon Spacing (in.): Zone 1':	Zone 1:	Zone 2: Zone 3:
Adhesive Application Rate (gal./sq.):		
Additional Detail:		

## BASE SHEET: (Include Trade Name, Type, and Width)

<input type="checkbox"/> None	
Trade Name:	Width: <input type="checkbox"/> 36 in. <input type="checkbox"/> 1 meter (39 in.)
<input type="checkbox"/> Fastened	<input type="checkbox"/> Adhered
<input type="checkbox"/> Lap Width in/mm	<input type="checkbox"/> Lap Adhesion Type
<input type="checkbox"/> Air Retarder	<input type="checkbox"/> Vapor Retarder
Additional Detail:	

## BASE SHEET SECUREMENT:

Base Sheet Adhesive Name:	Adhesive Application Rate:
Base Sheet Fastener Trade Name:	Type:
Head Diameter:	Length:
Spacing: (Attached Sketches as necessary)	
Spacing Along Laps: Zone 1':	Zone 1: Zone 2: Zone 3:
No. Intermediate Rows: Zone 1':	Zone 1: Zone 2: Zone 3:
Spacing Along Intermediate Rows: Zone 1':	Zone 1: Zone 2: Zone 3:
Additional Detail:	



# CHECKLIST FOR ROOFING SYSTEM

## DECK:

<input type="checkbox"/> Steel:	Manufacturer:	Type (e.g. wide rib):	Thickness / Gauge:	Yield Strength:
<input type="checkbox"/> LWIC (Form Deck):	<input type="checkbox"/> Cementitious Wood Fiber ( <i>Pullout Test Required</i> ):			
<input type="checkbox"/> Concrete:	<input type="checkbox"/> Pre-cast panels or <input type="checkbox"/> Cast in Place			
<input type="checkbox"/> Wood ( <i>Pullout Test Required</i> ):				
<input type="checkbox"/> Fiber Reinforced Cement:	<input type="checkbox"/> Fiber Reinforced Plastic			
<input type="checkbox"/> Gypsum ( <i>Pullout Test Required</i> ):	<input type="checkbox"/> Plank	or	<input type="checkbox"/> Poured	
<input type="checkbox"/> Other:				
Additional Detail:				

## DECK or ROOF PANEL SECUREMENT:

Deck Or Roof Panel Fasteners:		Type:		
Trade Name:		Size Washer:		
Length:		Washer:		
If Weld: Size:	Weld:	Washer:		
Fastener / Weld Spacing:	Zone 1':	Zone 1:	Zone 2:	Zone 3:
Deck Side Lap Fastener Spacing:	Zone 1':	Zone 1:	Zone 2:	Zone 3:
Additional Detail:				

## ROOF STRUCTURE (Include Size, Gage, Etc.):

<input type="checkbox"/> Purlins	<input type="checkbox"/> "C" or <input type="checkbox"/> "Z"	Thickness:		
Purlin:	Zone 1':	Zone 1:	Zone 2:	Zone 3:
<input type="checkbox"/> Joists	<input type="checkbox"/> Wood or <input type="checkbox"/> Steel			
Joist Spacing:	Zone 1':	Zone 1:	Zone 2:	Zone 3:
<input type="checkbox"/> Beams	<input type="checkbox"/> Wood or <input type="checkbox"/> Steel			
Beam Spacing:	Zone 1':	Zone 1:	Zone 2:	Zone 3:
<input type="checkbox"/> Other:				
Additional Detail:				

## PERIMETER FLASHING: (*Attach a detailed sketch of metal fascia, gravel stop, nailer, blocking, coping, etc.*)

<input type="checkbox"/> FM Approved Flashing				
<input type="checkbox"/> Other ( <i>applicable only when FM Approved system is not available</i> ):				
Manufacturer/Trade Name:				
Flashing Max Wind Rating:				
Fascia / Coping Detail:	Face Height:	Thickness:		
Hook Strip Detail:	Height:	Thickness:	Fastener spacing:	
Nailer / Blocking Details Per FM Global Data Sheet 1-49? <input type="checkbox"/> Yes <input type="checkbox"/> No ( <i>Attach Details</i> )				
Nailer Securement:	Diameter:	Spacing:	Embedment:	
Additional Detail:				

## DRAINAGE:

For new construction: Has roof drainage been designed by a Qualified Engineer per FM Global Loss Prevention Data Sheet 1-54 and the local building code? <input type="checkbox"/> Yes <input type="checkbox"/> No ( <i>Attach details</i> )	
For re-roofing and recovering: will the roof drainage be changed from the original design (i.e. drains inserted/covered/removed, new expansion joints, blocked or reduced scupper size)? <input type="checkbox"/> Yes <input type="checkbox"/> No	
If yes, were the changes reviewed by a Qualified Engineer? <input type="checkbox"/> Yes <input type="checkbox"/> No ( <i>Attach details</i> )	
Is secondary (emergency) roof drainage provided per FM Global Data Sheet 1-54? <input type="checkbox"/> Yes <input type="checkbox"/> No ( <i>Attach details</i> )	
Additional Detail:	

## ROOF MOUNTED EQUIPMENT: (*Attach drawings, calculations and any supporting detail.*)

Roof mounted equipment secured per FM Global Loss Prevention Data Sheet 1-28 and the local building code? <input type="checkbox"/> Yes <input type="checkbox"/> No
Additional Detail:

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## SECTION 077100 - ROOF 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. Section Includes:

- 1. Copings.
  - 2. Roof-edge specialties.
  - 3. Roof-edge drainage systems.

- B. Related Requirements:

- 1. Section 061000 "Rough Carpentry" for wood nailers, curbs, and blocking.
  - 2. Section 074113.16 "Standing-Seam Metal Roof Panels" for roof-edge drainage-system components provided by metal-roof-panel manufacturer.
  - 3. Section 079200 "Joint Sealants" for field-applied sealants between roof specialties and adjacent materials.

- C. Preinstallation Conference: Conduct conference at Project site.

- 1. Meet with Owner, Engineer, Owner's insurer if applicable, roofing-system testing and inspecting agency representative, roofing Installer, roofing-system manufacturer's representative, Installer, structural-support Installer, and installers whose work interfaces with or affects roof specialties, including installers of roofing materials and accessories.
  - 2. Examine substrate conditions for compliance with requirements, including flatness and attachment to structural members.
  - 3. Review special roof details, roof drainage, and condition of other construction that will affect roof specialties.

#### 1.3 ACTION SUBMITTALS

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

- 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

- B. Shop Drawings: For roof specialties.

- 1. Include plans, elevations, expansion-joint locations, keyed details, and attachments to other work. Distinguish between plant- and field-assembled work.

2. Include details for expansion and contraction; locations of expansion joints, including direction of expansion and contraction.
  3. Indicate profile and pattern of seams and layout of fasteners, cleats, clips, and other attachments.
  4. Detail termination points and assemblies, including fixed points.
  5. Include details of special conditions.
- C. Samples: For each type of roof specialty and for each color and texture specified.
- D. Samples for Initial Selection: For each type of roof specialty indicated with factory-applied color finishes.
- E. Regulatory Approvals: Provide copy of current, valid statewide product approval for product, material or system as shown on the drawings and as specified in this Section, in accordance with Rule 9N-3. Product approval shall be for the specific manufacturer, product type, model or style, and the State Approval Number.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For manufacturer.
- B. Product Certificates: For each type of roof specialty.
- C. Product Test Reports: For copings and roof-edge flashings, for tests performed by a qualified testing agency.
- D. Sample Warranty: For manufacturer's special warranty.

#### 1.5 CLOSEOUT SUBMITTALS

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

#### 1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer offering products meeting requirements that are FM Approvals listed for specified class.
- B. Source Limitations: Obtain roof specialties approved by manufacturer providing roofing-system warranty specified in Section.
- C. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and set quality standards for fabrication and installation.
1. Build mockup of typical roof edge, including fascia, gutter and downspout, approximately 10 feet long, including supporting construction, seams, attachments, underlayment, and accessories.
  2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Engineer specifically approves such deviations in writing.

3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

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

#### 1.8 FIELD CONDITIONS

- A. Field Measurements: Verify profiles and tolerances of roof-specialty substrates by field measurements before fabrication, and indicate measurements on Shop Drawings.
- B. Coordination: Coordinate roof specialties with flashing, trim, and construction of parapets, roof deck, roof and wall panels, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

#### 1.9 WARRANTY

- A. Roofing-System Warranty: Roof specialties are included in warranty provisions in Section 075216 "SBS Modified Bituminous Membrane Roofing."
- B. Special Warranty on Painted Finishes: Manufacturer agrees to repair finish or replace roof specialties that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:
  - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
  - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
  - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
2. Finish Warranty Period: 20 years from date of Substantial Completion.

#### 1.10 REGULATORY REQUIREMENTS

- A. The products, materials and assemblies, including anchorage, proposed for the work of this Section shall comply with project specific calculated design pressures and the Florida Building Code (Code), including wind-borne debris region requirements, and shall be designed by the Manufacturer and installed by the Contractor to meet these requirements. Refer to project design pressures in the components and cladding table on the structural drawings. Where a conflict occurs between the requirements of this Specification and the Code, the more stringent requirement shall apply.

- B. It shall be the responsibility of the contractor to provide evidence of code compliance for the products, materials and assemblies, including anchorage specified in this Section. Evidence of code compliance shall be demonstrated by compliance with the Florida Building Code, using one of the methods outlined in Chapter 9N-3 of the Florida Administrative Code, Department of Community Affairs, Florida Building Commission, Product Approval.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. General Performance: Roof specialties shall withstand exposure to weather and resist thermally induced movement without failure, rattling, leaking, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.
- B. FM Approvals' Listing: Manufacture and install copings, roof-edge specialties that are listed in FM Approvals' "RoofNav" and approved for windstorm classification, Class 1-120. Identify materials with FM Approvals' markings.
- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, hole elongation, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Provide clips that resist rotation and avoid shear stress as a result of thermal movements. Base calculations 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.

### 2.2 COPINGS

- A. Metal Copings: Manufactured coping system consisting of metal coping cap in section lengths not exceeding 12 feet, concealed anchorage; with corner units, end cap units, and concealed splice plates with finish matching coping caps.
  - 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. Berridge Manufacturing Company.
    - b. Merchant and Evans.
    - c. PAC-CLAD; Petersen Aluminum Corporation; a Carlisle company.
  - 2. Formed Aluminum Sheet Coping Caps: Aluminum sheet, 0.050 inch thick.
    - a. Surface: Smooth, flat finish.
    - b. Finish: Two-coat fluoropolymer.
    - c. Color: As selected by Engineer from manufacturer's full range.
  - 3. Corners: Factory mitered and mechanically clinched and sealed watertight.
  - 4. Coping-Cap Attachment Method: Snap-on, fabricated from coping-cap material.

- a. Snap-on Coping Anchor Plates: Concealed, galvanized-steel sheet, 12 inches wide, with integral cleats.

## 2.3 ROOF-EDGE SPECIALTIES

- A. Canted Roof-Edge Fascia and Gravel Stop: Manufactured, two-piece, roof-edge fascia consisting of snap-on metal fascia cover in section lengths not exceeding 12 feet and a continuous formed galvanized-steel sheet cant, 0.028 inch thick, minimum, with extended vertical leg terminating in a drip-edge cleat. Provide matching corner units.
  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. Berridge Manufacturing Company.
    - b. Merchant and Evans.
    - c. PAC-CLAD; Petersen Aluminum Corporation; a Carlisle company.
  2. Formed Aluminum Sheet Fascia Covers: Aluminum sheet, 0.050 inch thick.
    - a. Surface: Smooth, flat finish.
    - b. Finish: Two-coat fluoropolymer.
    - c. Color: As selected by Engineer from manufacturer's full range.
  3. Corners: Factory mitered and mechanically clinched and sealed watertight.
  4. Splice Plates: Concealed, of same material, finish, and shape as fascia cover.
  5. Fascia Accessories: Fascia extenders with continuous hold-down cleats.

## 2.4 ROOF-EDGE DRAINAGE SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  1. Architectural Products Company.
  2. Berger Building Products, Inc.
  3. Merchant and Evans.
- B. Gutters: Manufactured in uniform section lengths not exceeding 12 feet, with matching corner units, ends, outlet tubes, and other accessories. Elevate back edge at least 1 inch above front edge. Furnish flat-stock gutter straps, gutter brackets, expansion joints, and expansion-joint covers fabricated from same metal as gutters.
  1. Aluminum Sheet: 0.050 inch thick.
  2. Gutter Profile: As indicated according to SMACNA's "Architectural Sheet Metal Manual."
  3. Corners: Factory mitered and mechanically clinched and sealed watertight.
  4. Gutter Supports: Manufacturer's standard supports as selected by Engineer with finish matching the gutters.
  5. Gutter Accessories: Continuous screened leaf guard with sheet metal frame.

- C. Downspouts: Plain rectangular complete with mitered elbows, manufactured from the following exposed metal. Furnish with metal hangers, from same material as downspouts, and anchors.
  - 1. Formed Aluminum: 0.050 inch thick.
- D. Aluminum Finish: Two-coat fluoropolymer.
  - 1. Color: As selected by Engineer from manufacturer's full range.

## 2.5 MATERIALS

- A. Aluminum Sheet: ASTM B 209, alloy as standard with manufacturer for finish required, with temper to suit forming operations and performance required.
- B. Aluminum Extrusions: ASTM B 221, alloy and temper recommended by manufacturer for type of use and finish indicated, finished as follows:

## 2.6 UNDERLAYMENT MATERIALS

- A. Self-Adhering, High-Temperature Sheet: Minimum 30 to 40 mils thick, consisting of slip-resisting polyethylene-film top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release-paper backing; cold applied. Provide primer when recommended by underlayment manufacturer.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Carlisle Coatings & Waterproofing Inc.
    - b. GCP Applied Technologies Inc.
    - c. Henry Company.
    - d. Owens Corning.
  - 2. Thermal Stability: ASTM D 1970/D 1970M; stable after testing at 240 deg F.
  - 3. Low-Temperature Flexibility: ASTM D 1970/D 1970M; passes after testing at minus 20 deg F.
- B. Felt: ASTM D 226/D 226M, Type II (No. 30), asphalt-saturated organic felt, nonperforated.
- C. Slip Sheet: Rosin-sized building paper, 3-lb/100 sq. ft. minimum.

## 2.7 MISCELLANEOUS MATERIALS

- A. Fasteners: Manufacturer's recommended fasteners, suitable for application and designed to meet performance requirements. Furnish the following unless otherwise indicated:
  - 1. Exposed Penetrating Fasteners: Gasketed screws with hex washer heads matching color of sheet metal.



2. Fasteners for Aluminum: Aluminum or Series 300 stainless steel.
  3. Fasteners for Stainless-Steel Sheet: Series 300 stainless steel.
  4. Fasteners for Zinc-Coated (Galvanized) Steel Sheet: Series 300 stainless steel or hot-dip zinc-coated steel according to ASTM A 153/A 153M or ASTM F 2329.
- B. Elastomeric Sealant: ASTM C 920, elastomeric polyurethane polymer sealant of type, grade, class, and use classifications required by roofing-specialty manufacturer for each application.
- C. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type joints with limited movement.
- D. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.
- E. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required for application.

## 2.8 FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- D. Coil-Coated Aluminum Sheet Finishes:
1. High-Performance Organic Finish: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
    - a. Two-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
    - b. Concealed Surface Finish: Apply pretreatment and manufacturer's standard acrylic or polyester backer finish consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.
- E. Aluminum Extrusion Finishes:
1. High-Performance Organic Finish: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
    - a. Two-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

- b. Concealed Surface Finish: Apply pretreatment and manufacturer's standard acrylic or polyester backer finish consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of the Work.
- B. Examine walls, roof edges, and parapets for suitable conditions for roof specialties.
- C. Verify that substrate is sound, dry, smooth, clean, sloped for drainage where applicable, and securely anchored.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 UNDERLAYMENT INSTALLATION

- A. Self-Adhering Sheet Underlayment: Apply primer if required by manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation. Apply wrinkle free, in shingle fashion to shed water, and with end laps of not less than 6 inches staggered 24 inches between courses. Overlap side edges not less than 3-1/2 inches. Roll laps with roller. Cover underlayment within 14 days.
  - 1. Apply continuously under copings roof-edge specialties.
  - 2. Coordinate application of self-adhering sheet underlayment under roof specialties with requirements for continuity with adjacent air barrier materials.
- B. Felt Underlayment: Install with adhesive for temporary anchorage to minimize use of mechanical fasteners under roof specialties. Apply in shingle fashion to shed water, with lapped joints of not less than 2 inches.
- C. Slip Sheet: Install with tape or adhesive for temporary anchorage to minimize use of mechanical fasteners under roof specialties. Apply in shingle fashion to shed water, with lapped joints of not less than 2 inches.

#### 3.3 INSTALLATION, GENERAL

- A. General: Install roof specialties according to manufacturer's written instructions. Anchor roof specialties securely in place, with provisions for thermal and structural movement. Use fasteners, solder, protective coatings, separators, underlayments, sealants, and other miscellaneous items as required to complete roof-specialty systems.
  - 1. Install roof specialties level, plumb, true to line and elevation; with limited oil-canning and without warping, jogs in alignment, buckling, or tool marks.
  - 2. Provide uniform, neat seams with minimum exposure of solder and sealant.

3. Install roof specialties to fit substrates and to result in weathertight performance. Verify shapes and dimensions of surfaces to be covered before manufacture.
  4. Torch cutting of roof specialties is not permitted.
  5. Do not use graphite pencils to mark metal surfaces.
- B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.
1. Coat concealed side of uncoated aluminum and stainless-steel roof specialties with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
  2. Bed flanges in thick coat of asphalt roofing cement where required by manufacturers of roof specialties for waterproof performance.
- C. Expansion Provisions: Allow for thermal expansion of exposed roof specialties.
1. Space movement joints at a maximum of 12 feet with no joints within 18 inches of corners or intersections unless otherwise indicated on Drawings.
  2. When ambient temperature at time of installation is between 40 and 70 deg F, set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures.
- D. Fastener Sizes: Use fasteners of sizes that penetrate substrate not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.
- E. Seal concealed joints with butyl sealant as required by roofing-specialty manufacturer.
- F. Seal joints as required for weathertight construction. Place sealant to be completely concealed in joint. Do not install sealants at temperatures below 40 deg F.
- G. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pre-tin edges of sheets to be soldered to a width of 1-1/2 inches; however, reduce pre-tinning where pre-tinned surface would show in completed Work. Tin edges of uncoated copper sheets using solder for copper. Do not use torches for soldering. Heat surfaces to receive solder and flow solder into joint. Fill joint completely. Completely remove flux and spatter from exposed surfaces.
- 3.4 COPING INSTALLATION
- A. Install cleats, anchor plates, and other anchoring and attachment accessories and devices with concealed fasteners.
- B. Anchor copings with manufacturer's required devices, fasteners, and fastener spacing to meet performance requirements.
1. Interlock face and back leg drip edges of snap-on coping cap into cleated anchor plates anchored to substrate at manufacturer's required spacing that meets performance requirements.

2. Interlock face-leg drip edge into continuous cleat anchored to substrate at manufacturer's required spacing that meets performance requirements. Anchor back leg of coping with screw fasteners and elastomeric washers at manufacturer's required spacing that meets performance requirements.

### 3.5 ROOF-EDGE SPECIALITIES INSTALLATION

- A. Install cleats, cants, and other anchoring and attachment accessories and devices with concealed fasteners.
- B. Anchor roof edgings with manufacturer's required devices, fasteners, and fastener spacing to meet performance requirements.

### 3.6 ROOF-EDGE DRAINAGE-SYSTEM INSTALLATION

- A. General: Install components to produce a complete roof-edge drainage system according to manufacturer's written instructions. Coordinate installation of roof perimeter flashing with installation of roof-edge drainage system.
- B. Gutters: Join and seal gutter lengths. Allow for thermal expansion. Attach gutters to firmly anchored gutter supports spaced not more than 24 inches apart. Attach ends with rivets and seal with sealant to make watertight. Slope to downspouts.
  1. Install gutter with expansion joints at locations indicated but not exceeding 50 feet apart. Install expansion-joint caps.
  2. Install continuous leaf guards on gutters with noncorrosive fasteners, removable for cleaning gutters.
- C. Downspouts: Join sections with manufacturer's standard telescoping joints. Provide hangers with fasteners designed to hold downspouts securely to walls and 1 inch away from walls; locate fasteners at top and bottom and at approximately 60 inches o.c.
  1. Provide elbows at base of downspouts at grade to direct water away from building.
  2. Connect downspouts to underground drainage system indicated.

### 3.7 CLEANING AND PROTECTION

- A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
- B. Clean and neutralize flux materials. Clean off excess solder and sealants.
- C. Remove temporary protective coverings and strippable films as roof specialties are installed. On completion of installation, clean finished surfaces, including removing unused fasteners, metal filings, pop rivet stems, and pieces of flashing. Maintain roof specialties in a clean condition during construction.
- D. Replace roof specialties that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION 077100

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## SECTION 078413 - PENETRATION FIRESTOPPING

### 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. Penetrations in fire-resistance-rated walls.

- B. Related Requirements:

- 1. Section 078443 "Joint Firestopping" for joints in or between fire-resistance-rated construction, at exterior curtain-wall/floor intersections, and in smoke barriers.

#### 1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

#### 1.4 ACTION SUBMITTALS

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

- B. Product Schedule: For each penetration firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing and inspecting agency.

- 1. Engineering Judgments: Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping system, submit illustration, with modifications marked, approved by penetration firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly. Obtain approval of authorities having jurisdiction prior to submittal.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.

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

## 1.6 CLOSEOUT SUBMITTALS

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

## 1.7 QUALITY ASSURANCE

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

## 1.8 PROJECT CONDITIONS

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

## 1.9 COORDINATION

- A. Coordinate construction of openings and penetrating items to ensure that penetration firestopping systems can be installed according to specified firestopping system design.
- B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration firestopping systems.
- C. Notify Owner's testing agency at least seven days in advance of penetration firestopping installations; confirm dates and times on day preceding each series of installations.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

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



3) FM Global in its "Building Materials Approval Guide."

2.2 PENETRATION FIRESTOPPING SYSTEMS

- A. Penetration Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. 3M Fire Protection Products.
    - b. Hilti, Inc.
    - c. Tremco, Inc.
- B. Penetrations in Fire-Resistance-Rated Walls: Penetration firestopping systems with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.
  - 1. F-Rating: Not less than the fire-resistance rating of constructions penetrated.
  - 2. Fire-resistance-rated walls include fire-barrier walls.
- C. Exposed Penetration Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, per ASTM E 84.
- D. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping system manufacturer and approved by qualified testing and inspecting agency for conditions indicated.
  - 1. Permanent forming/damming/backing materials.
  - 2. Substrate primers.
  - 3. Collars.
  - 4. Steel sleeves.
  - 5. Temporary forming materials.
  - 6. Masking Tape: Type recommended by firestopping manufacturer of width required by project conditions.

2.3 FILL MATERIALS

- A. Cast-in-Place Firestop Devices: Factory-assembled devices for use in cast-in-place concrete floors and consisting of an outer sleeve lined with an intumescent strip, a flange attached to one end of the sleeve for fastening to concrete formwork, and a neoprene gasket.
- B. Latex Sealants: Single-component latex formulations that do not re-emulsify after cure during exposure to moisture.

- C. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.
- D. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced intumescent elastomeric sheet bonded to galvanized-steel sheet.
- E. Intumescent Putties: Nonhardening, water-resistant, intumescent putties containing no solvents or inorganic fibers.
- F. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.
- G. Mortars: Prepackaged dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.
- H. Pillows/Bags: Reusable heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents, and fire-retardant additives. Where exposed, cover openings with steel-reinforcing wire mesh to protect pillows/bags from being easily removed.
- I. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.
- J. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants.

## 2.4 MIXING

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

## PART 3 - EXECUTION

### 3.1 EXAMINATION

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

### 3.2 PREPARATION

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

### 3.3 INSTALLATION

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

### 3.4 IDENTIFICATION

- A. Wall Identification: Permanently label walls containing penetration firestopping systems with the words "FIRE AND/OR SMOKE BARRIER - PROTECT ALL OPENINGS," using lettering not less than 3 inches high and with minimum 0.375-inch strokes.

1. Locate in accessible concealed floor, floor-ceiling, or attic space at 15 feet from end of wall and at intervals not exceeding 30 feet.
- B. Penetration Identification: Identify each penetration firestopping system with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of penetration firestopping system edge so labels are visible to anyone seeking to remove penetrating items or firestopping systems. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:
  1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
  2. Contractor's name, address, and phone number.
  3. Designation of applicable testing and inspecting agency.
  4. Date of installation.
  5. Manufacturer's name.
  6. Installer's name.

### 3.5 FIELD QUALITY CONTROL

- A. Owner will engage a qualified testing agency to perform tests and inspections according to ASTM E 2174.
- B. Where deficiencies are found or penetration firestopping system is damaged or removed because of testing, repair or replace penetration firestopping system to comply with requirements.
- C. Proceed with enclosing penetration firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.

### 3.6 CLEANING AND PROTECTION

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

### 3.7 PENETRATION FIRESTOPPING SYSTEM SCHEDULE

- A. Where UL-classified systems are indicated, they refer to system numbers in UL's "Fire Resistance Directory" under product Category XHEZ.
- B. Penetration Firestopping Systems for Metallic Pipes, Conduit, or Tubing:

1. UL-Classified Systems: W-L- 1302.
2. F-Rating: 2 hours.
3. T-Rating: 1/2 hours.
4. W-Rating: No leakage of water at completion of water leakage testing.
5. Type of Fill Materials: As required to achieve rating.

C. Penetration Firestopping Systems for Nonmetallic Pipe, Conduit, or Tubing:

1. UL-Classified Systems: W-L- 2129.
2. F-Rating: 2 hours.
3. T-Rating: 2 hours.
4. W-Rating: No leakage of water at completion of water leakage testing.
5. Type of Fill Materials: As required to achieve rating.

D. Penetration Firestopping Systems for Electrical Cables:

1. UL-Classified Systems: W-L- 3131.
2. F-Rating: 2 hours.
3. T-Rating: 1/2 hours.
4. W-Rating: No leakage of water at completion of water leakage testing.
5. Type of Fill Materials: As required to achieve rating.

END OF SECTION 078413

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## SECTION 078443 - JOINT FIRESTOPPING

### 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. Joints in or between fire-resistance-rated constructions.
- B. Related Requirements:
  - 1. Section 078413 "Penetration Firestopping" for penetrations in fire-resistance-rated walls, horizontal assemblies, and smoke barriers and for wall identification.

#### 1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Product Schedule: For each joint firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing agency.
  - 1. Engineering Judgments: Where Project conditions require modification to a qualified testing agency's illustration for a particular joint firestopping system condition, submit illustration, with modifications marked, approved by joint firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

#### 1.5 INFORMATIONAL SUBMITTALS

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

## 1.6 CLOSEOUT SUBMITTALS

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

## 1.7 QUALITY ASSURANCE

- A. Installer Qualifications: A firm that has been approved by FM Global according to FM Global 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with UL's "Qualified Firestop Contractor Program Requirements."
- B. Installer Qualifications: A firm with 5 years' experience in successfully installing fire-resistive joint firestopping systems similar to that specified. Have experience, staff, and training to install manufacturer's products per specified requirements. Being able to purchase manufacturer's products does not meet installer qualification.

## 1.8 PROJECT CONDITIONS

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

## 1.9 COORDINATION

- A. Coordinate construction of joints to ensure that joint firestopping systems can be installed according to specified firestopping system design.
- B. Coordinate sizing of joints to accommodate joint firestopping systems.
- C. Notify Owner's testing agency at least seven days in advance of penetration firestopping installations; confirm dates and times on day preceding each series of installations.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics:
  - 1. Perform joint firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
  - 2. Test per testing standards referenced in "Joint Firestopping Systems" Article. Provide rated systems complying with the following requirements:



- a. Joint firestopping systems shall bear classification marking of a qualified testing agency.
  - 1) UL in its "Fire Resistance Directory."
  - 2) Intertek Group in its "Directory of Listed Building Products."

## 2.2 JOINT FIRESTOPPING SYSTEMS

- A. Joint Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of assemblies in or between which joint firestopping systems are installed. Joint firestopping systems shall accommodate building movements without impairing their ability to resist the passage of fire and hot gases.
- B. Joints in or between Fire-Resistance-Rated Construction: Provide joint firestopping systems with ratings determined per ASTM E 1966 or UL 2079.
  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. 3M Fire Protection Products.
    - b. Hilti, Inc.
    - c. Tremco, Inc.
  2. Fire-Resistance Rating: Equal to or exceeding the fire-resistance rating of the wall, floor, or roof in or between which it is installed.
- C. Exposed Joint Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.
- D. Accessories: Provide components of fire-resistive joint systems, including primers and forming materials, that are needed to install elastomeric fill materials and to maintain ratings required. Use only components specified by joint firestopping system manufacturer and approved by the qualified testing agency for conditions indicated.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

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

### 3.2 PREPARATION

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

### 3.3 INSTALLATION

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

### 3.4 IDENTIFICATION

- A. Joint Identification: Identify joint firestopping systems with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of joint edge so labels are visible to anyone seeking to remove or joint firestopping system. Use mechanical fasteners or

self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:

1. The words "Warning - Joint Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
2. Contractor's name, address, and phone number.
3. Designation of applicable testing agency.
4. Date of installation.
5. Manufacturer's name.
6. Installer's name.

### 3.5 FIELD QUALITY CONTROL

- A. Inspecting Agency: Owner will engage a qualified testing agency to perform tests and inspections according to ASTM E 2393.
- B. Where deficiencies are found or joint firestopping systems are damaged or removed due to testing, repair or replace joint firestopping systems so they comply with requirements.
- C. Proceed with enclosing joint firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.

### 3.6 CLEANING AND PROTECTION

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

### 3.7 JOINT FIRESTOPPING SYSTEM SCHEDULE

- A. Where UL-classified systems are indicated, they refer to system numbers in UL's "Fire Resistance Directory" under product Category XHBN or Category XHDG.
- B. Head-of-Wall, Fire-Resistive Joint Firestopping Systems:
  1. UL-Classified Systems: HW-D- 0489.
  2. Assembly Rating: 2 hours.
  3. Nominal Joint Width: As indicated.
  4. Movement Capabilities: Class I.

C. Bottom-of-Wall, Joint Firestopping Systems:

1. UL-Classified Systems: BW- S- 0007.
2. Assembly Rating: 2 hours.
3. Nominal Joint Width: As indicated.
4. Movement Capabilities: Class I.

END OF SECTION 078443

## SECTION 079200 - JOINT SEALANTS

### 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. Silicone joint sealants.
  - 2. Nonstaining silicone joint sealants.
  - 3. Urethane joint sealants.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each joint-sealant product.
- B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.
- C. Joint-Sealant Schedule: Include the following information:
  - 1. Joint-sealant application, joint location, and designation.
  - 2. Joint-sealant manufacturer and product name.
  - 3. Joint-sealant formulation.
  - 4. Joint-sealant color.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified testing agency.
- B. Product Test Reports: For each kind of joint sealant, for tests performed by a qualified testing agency.
- C. Sample Warranties: For special warranties.

#### 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

- B. Product Testing: Test joint sealants using a qualified testing agency.
  - 1. Testing Agency Qualifications: Qualified according to ASTM C 1021 to conduct the testing indicated.

## 1.6 FIELD CONDITIONS

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

## 1.7 WARRANTY

- A. Special Installer's Warranty: Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
  - 1. Warranty Period: Two years from date of Substantial Completion.
- B. Special Manufacturer's Warranty: Manufacturer agrees to furnish joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
  - 1. Warranty Period: Five years from date of Substantial Completion.
- C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:
  - 1. Movement of the structure caused by stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
  - 2. Disintegration of joint substrates from causes exceeding design specifications.
  - 3. Mechanical damage caused by individuals, tools, or other outside agents.
  - 4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

## PART 2 - PRODUCTS

### 2.1 JOINT SEALANTS, GENERAL

- A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.

- B. Colors of Exposed Joint Sealants: As selected by Engineer from manufacturer's full range.

## 2.2 SILICONE JOINT SEALANTS

- A. Silicone, S, NS, 50, NT: Single-component, nonsag, plus 50 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 50, Use NT.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
- a. GE Construction Sealants; Momentive Performance Materials Inc.
  - b. May National Associates, Inc.; a subsidiary of Sika Corporation.
  - c. Pecora Corporation.
  - d. Sika Corporation; Joint Sealants.
  - e. The Dow Chemical Company.

## 2.3 NONSTAINING SILICONE JOINT SEALANTS

- A. Nonstaining Joint Sealants: No staining of substrates when tested according to ASTM C 1248.
- B. Silicone, Nonstaining, S, NS, 50, NT: Nonstaining, single-component, nonsag, plus 50 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 50, Use NT.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
- a. GE Construction Sealants; Momentive Performance Materials Inc.
  - b. May National Associates, Inc.; a subsidiary of Sika Corporation.
  - c. Pecora Corporation.
  - d. Sika Corporation; Joint Sealants.
  - e. The Dow Chemical Company.
  - f. Tremco Incorporated.

## 2.4 URETHANE JOINT SEALANTS

- A. Urethane, S, NS, 25, NT: Single-component, nonsag, nontraffic-use, plus 25 percent and minus 25 percent movement capability, urethane joint sealant; ASTM C 920, Type S, Grade NS, Class 25, Use NT.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
- a. BASF Corporation.
  - b. Bostik, Inc.

- c. Pecora Corporation.
  - d. Sika Corporation; Joint Sealants.
  - e. Tremco Incorporated.
- B. Urethane, M, P, 50, T, NT: Multicomponent, pourable, plus 50 percent and minus 50 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C 920, Type M, Grade P, Class 50, Uses T and NT.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. BASF Corporation.
    - b. Bostik, Inc.
    - c. Pecora Corporation.
    - d. Sika Corporation; Joint Sealants.
    - e. Tremco Incorporated.

## 2.5 JOINT-SEALANT BACKING

- A. Sealant Backing Material, General: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. BASF Corporation.
    - b. Construction Foam Products; a division of Nomaco, Inc.
- B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin), and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
- C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

## 2.6 MISCELLANEOUS MATERIALS

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



- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

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

#### 3.2 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
  - 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
  - 2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:
    - a. Concrete.
    - b. Masonry.
    - c. Unglazed surfaces of ceramic tile.
  - 3. Remove laitance and form-release agents from concrete.
  - 4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:
    - a. Metal.
    - b. Glass.
    - c. Glazed surfaces of ceramic tile.
- B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or

by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

### 3.3 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
  - 1. Do not leave gaps between ends of sealant backings.
  - 2. Do not stretch, twist, puncture, or tear sealant backings.
  - 3. Remove absorbent sealant backings that have become wet before sealant application, and replace them with dry materials.
- D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
  - 1. Place sealants so they directly contact and fully wet joint substrates.
  - 2. Completely fill recesses in each joint configuration.
  - 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
  - 1. Remove excess sealant from surfaces adjacent to joints.
  - 2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
  - 3. Provide concave joint profile per Figure 8A in ASTM C 1193 unless otherwise indicated.

### 3.4 CLEANING

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

### 3.5 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, remove, and repair damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

### 3.6 JOINT-SEALANT SCHEDULE

- A. Joint-Sealant Application: Exterior joints in horizontal traffic surfaces.
  - 1. Joint Locations:
    - a. Tile control and expansion joints.
    - b. Joints between different materials listed above.
    - c. Other joints as indicated on Drawings.
  - 2. Joint Sealant: Urethane, M, P, 50, T, NT.
  - 3. Joint-Sealant Color: As selected by Engineer from manufacturer's full range of colors.
- B. Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal nontraffic surfaces.
  - 1. Joint Locations:
    - a. Control and expansion joints in unit masonry.
    - b. Joints in glass unit masonry assemblies.
    - c. Joints between different materials listed above.
    - d. Perimeter joints between materials listed above and frames of doors and louvers.
    - e. Other joints as indicated on Drawings.
  - 2. Joint Sealant: Silicone, nonstaining, S, NS, 50, NT.
  - 3. Joint-Sealant Color: As selected by Engineer from manufacturer's full range of colors.
- C. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces.
  - 1. Joint Locations:
    - a. Control and expansion joints on exposed interior surfaces of exterior walls.
    - b. Tile control and expansion joints.
    - c. Vertical joints on exposed surfaces of unit masonry walls and partitions.
    - d. Other joints as indicated on Drawings.
  - 2. Joint Sealant: Urethane, S, NS, 25, NT.
  - 3. Joint-Sealant Color: As selected by Engineer from manufacturer's full range of colors.

END OF SECTION 079200

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## SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

### 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. Interior standard steel doors and frames.
- B. Related Requirements:
  - 1. Section 087100 "Door Hardware" for door hardware for hollow-metal doors.

#### 1.3 DEFINITIONS

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

#### 1.4 COORDINATION

- A. Coordinate anchorage installation for hollow-metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.
- B. Coordinate requirements for installation of door hardware, electrified door hardware, and access control and security systems.

#### 1.5 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

#### 1.6 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, core descriptions, and finishes.
- B. Shop Drawings: Include the following:

1. Elevations of each door type.
  2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
  3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
  4. Locations of reinforcement and preparations for hardware.
  5. Details of each different wall opening condition.
  6. Details of electrical raceway and preparation for electrified hardware, access control systems, and security systems.
  7. Details of anchorages, joints, field splices, and connections.
  8. Details of accessories.
  9. Details of moldings, removable stops, and glazing.
- C. Samples for Initial Selection: For hollow-metal doors and frames with factory-applied color finishes.
- D. Product Schedule: For hollow-metal doors and frames, prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final door hardware schedule.

#### 1.7 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each type of thermally rated door assemblies, for tests performed by a qualified testing agency indicating compliance with performance requirements.

#### 1.8 QUALITY ASSURANCE

#### 1.9 DELIVERY, STORAGE, AND HANDLING

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

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Ceco Door; ASSA ABLOY.
2. Curries Company; ASSA ABLOY.
3. Steelcraft; an Allegion brand.

## 2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings indicated on Drawings, based on testing at positive pressure according to NFPA 252 or UL 10C.
- B. Fire-Rated, Borrowed-Lite Assemblies: Assemblies complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 257 or UL 9.
- C. Thermally Rated Door Assemblies: Provide door assemblies with U-factor of not more than 0.50 deg Btu/F x h x sq. ft. when tested according to ASTM C 518.

## 2.3 INTERIOR STANDARD STEEL DOORS AND FRAMES

- A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- B. Heavy-Duty Doors and Frames: ANSI/SDI A250.8, Level 2; ANSI/SDI A250.4, Level B. At locations indicated in the Door and Frame Schedule.
  1. Doors:
    - a. Type: As indicated in the Door and Frame Schedule.
    - b. Thickness: 1-3/4 inches.
    - c. Face: Uncoated steel sheet, minimum thickness of 0.042 inch.
    - d. Edge Construction: Model 1, Full Flush.
    - e. Edge Bevel: Provide manufacturer's standard beveled or square edges.
    - f. Core: Manufacturer's standard.
    - g. Fire-Rated Core: Manufacturer's standard laminated mineral board core for fire-rated doors.
  2. Frames:
    - a. Materials: Uncoated steel sheet, minimum thickness of 0.053 inch.
    - b. Frames: Fabricated from same thickness material as adjacent door frame.
    - c. Construction: Knocked down and Slip-on drywall.
  3. Exposed Finish: Prime.

## 2.4 FRAME ANCHORS

- A. Jamb Anchors:
  - 1. Type: Anchors of minimum size and type required by applicable door and frame standard, and suitable for performance level indicated.
  - 2. Quantity: Minimum of three anchors per jamb, with one additional anchor for frames with no floor anchor. Provide one additional anchor for each 24 inches of frame height above 7 feet.
  - 3. Postinstalled Expansion Anchor: Minimum 3/8-inch- diameter bolts with expansion shields or inserts, with manufacturer's standard pipe spacer.
- B. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor.
- C. Floor Anchors for Concrete Slabs with Underlayment: Adjustable-type anchors with extension clips, allowing not less than 2-inch height adjustment. Terminate bottom of frames at top of underlayment.
- D. Material: ASTM A879/A879M, Commercial Steel (CS), 04Z coating designation; mill phosphatized.
  - 1. For anchors built into exterior walls, steel sheet complying with ASTM A1008/A1008M or ASTM A1011/A1011M; hot-dip galvanized according to ASTM A153/A153M, Class B.

## 2.5 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- B. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- C. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B.
- D. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A153/A153M.
- E. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.
- F. Mineral-Fiber Insulation: ASTM C665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E136 for combustion characteristics.
- G. Glazing: Comply with requirements in Section 088000 "Glazing."



## 2.6 FABRICATION

- A. Hollow-Metal Frames: Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as frames.
  - 1. Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by welding, or by rigid mechanical anchors.
  - 2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
  - 3. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.
    - a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
- B. Hardware Preparation: Factory prepare hollow-metal doors and frames to receive templated mortised hardware, and electrical wiring; include cutouts, reinforcement, mortising, drilling, and tapping according to ANSI/SDI A250.6, the Door Hardware Schedule, and templates.
  - 1. Reinforce doors and frames to receive non-templated, mortised, and surface-mounted door hardware.
  - 2. Comply with BHMA A156.115 for preparing hollow-metal doors and frames for hardware.
- C. Glazed Lites: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with mitered hairline joints.
  - 1. Provide stops and moldings flush with face of door, and with beveled stops unless otherwise indicated.
  - 2. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
  - 3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames. Provide loose stops and moldings on inside of hollow-metal doors and frames.
  - 4. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.
  - 5. Provide stops for installation with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches o.c. and not more than 2 inches o.c. from each corner.

## 2.7 STEEL FINISHES

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

## PART 3 - EXECUTION

### 3.1 PREPARATION

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

### 3.2 INSTALLATION

- A. Install hollow-metal doors and frames plumb, rigid, properly aligned, and securely fastened in place. Comply with approved Shop Drawings and with manufacturer's written instructions.
- B. Hollow-Metal Frames: Comply with ANSI/SDI A250.11.
  - 1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces without damage to completed Work.
    - a. Where frames are fabricated in sections, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces. Touch-up finishes.
    - b. Install frames with removable stops located on secure side of opening.
  - 2. Fire-Rated Openings: Install frames according to NFPA 80.
  - 3. Floor Anchors: Secure with postinstalled expansion anchors.
    - a. Floor anchors may be set with power-actuated fasteners instead of post-installed expansion anchors if so indicated and approved on Shop Drawings.
  - 4. Solidly pack mineral-fiber insulation inside frames.
  - 5. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout or mortar.
  - 6. In-Place Concrete or Masonry Construction: Secure frames in place with post-installed expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
  - 7. Installation Tolerances: Adjust hollow-metal frames to the following tolerances:
    - a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
    - b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
    - c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
    - d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.

- C. Hollow-Metal Doors: Fit and adjust hollow-metal doors accurately in frames, within clearances specified below.
  - 1. Non-Fire-Rated Steel Doors: Comply with ANSI/SDI A250.8.
  - 2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
- D. Glazing: Comply with installation requirements in Section 088000 "Glazing" and with hollow-metal manufacturer's written instructions.

### 3.3 FIELD QUALITY CONTROL

- A. Inspections:
  - 1. Fire-Rated Door Inspections: Inspect each fire-rated door according to NFPA 80, Section 5.2.
  - 2. Egress Door Inspections: Inspect each door equipped with panic hardware, each door equipped with fire exist hardware, each door located in an exit enclosure, each electrically controlled egress door, and each door equipped with special locking arrangements according to NFPA 101, Section 7.2.1.15.
- B. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.
- C. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.

### 3.4 REPAIR

- A. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.
- B. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.
- C. Factory-Finish Touchup: Clean abraded areas and repair with same material used for factory finish according to manufacturer's written instructions.
- D. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

END OF SECTION 081113

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## SECTION 081500 - FIBERGLASS REINFORCED PLASTIC DOORS AND ALUMINUM FRAMES

### 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 fiberglass reinforced plastic (FRP) doors and aluminum frames.
- B. Related Requirements:
  - 1. Section 087100 "Door Hardware" for door hardware.

#### 1.3 COORDINATION

- A. Coordinate anchorage installation for fiberglass reinforced plastic (FRP) doors and frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.
- B. Coordinate requirements for installation of door hardware, electrified door hardware, and access control and security systems.

#### 1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

#### 1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, core descriptions and finishes.
- B. Shop Drawings: Include the following:
  - 1. Elevations of each door type.
  - 2. Details of doors, including vertical- and horizontal-edge details and materials thicknesses.
  - 3. Frame details for each frame type, including dimensioned profiles and material thicknesses.
  - 4. Locations of reinforcement and preparations for hardware.
  - 5. Details of each different wall opening condition.

6. Details of anchorages, joints, field splices, and connections.
  7. Details of accessories.
  8. Details of moldings, removable stops, and glazing.
- C. Samples: For fiberglass reinforced plastic (FRP) doors and frames with factory-applied color finishes.
1. Finishes: For each type of exposed finish required, prepared on Samples of not less than 3 by 5 inches.
    - a. Provide sample which indicate gloss level.
  2. Fabrication: Prepare Samples approximately 12 by 12 inches to demonstrate compliance with requirements for quality of materials and construction:
    - a. Doors: Show vertical-edge, top, and bottom construction; core construction; and hinge and other applied hardware reinforcement. Include separate section showing glazing and louvers if applicable.
    - b. Frames: Show profile, corner joint, floor and wall anchors, and silencers. Include separate section showing hollow metal construction and glazing if applicable.
- D. Product Schedule: For fiberglass reinforced plastic (FRP) doors and frames, prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final door hardware schedule.
- E. Regulatory Approvals: Provide copy of current, valid statewide product approval for product, material or system as shown on the drawings and as specified in this Section, in accordance with Rule 9N-3. Product approval shall be for the specific manufacturer, product type, model or style, and the State Approval Number.

## 1.6 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each type of fiberglass reinforced plastic (FRP) doors and frames, for tests performed by a qualified testing agency.
- B. Oversize Construction Certification: For assemblies required to be fire-rated and exceeding limitations of labeled assemblies.

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver fiberglass reinforced plastic (FRP) doors and frames in manufacturer's original unopened packaging. Mark and remove damaged materials from the project site. Where materials are covered by a referenced specification, label the package with the specification number, type, and class, as applicable. Deliver materials in sufficient quantity to allow work to proceed without interruption.

B. Storage:

1. Protect materials against moisture absorption and contamination or other damage.
2. Store all materials on clean raised platforms or pallets one level high in dry locations with adequate ventilation, such as an enclosed building or closed trailer.
3. Do not store materials in buildings under construction until concrete, mortar, and plaster work is finished and dry.
4. Do not store materials outdoors.
5. Do not store materials in contact with other materials that might cause staining, denting, or other surface damage.

C. Handling:

1. Prevent damage to corners, edges and ends of materials. Do not install damaged materials in the work. Select and operate material handling equipment to prevent damage to materials.

## 1.8 REGULATORY REQUIREMENTS

A. Provide products, materials and assemblies, including anchorage, proposed for the work of this Section that comply with project specific calculated design pressures and the Florida Building Code, including wind-borne debris region requirements. Provide products designed by the Manufacturer and installed by the Contractor to meet these requirements.

1. Provide products that conform to the project design pressures in the components and cladding table on the structural drawings. Where a conflict occurs between the requirements of this Specification and the Florida Building Code, the more stringent requirement shall apply.

B. Provide documentation that the Florida Building Code compliance for the products, materials and assemblies, including anchorage specified in this Section have been incorporated into the Work. Demonstrate code compliance with the Florida Building Code, using one of the methods outlined in Chapter 9N-3 of the Florida Administrative Code, Department of Community Affairs, Florida Building Commission, Product Approval documentation.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Aluminum Alloy for Frames: ASTM B 221 / ASTM B 221M, alloy 6063-T5 for extrusions; ASTM B 209 / B 209M, alloy and temper best suited for aluminum sheets and strips.
- B. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.

- C. Bituminous Coating: Cold-applied asphalt mastic, compounded for 15-mil (0.4-mm) dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

## 2.2 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - 1. Special-Lite.
  - 2. Or equal products not accepted for this item.

## 2.3 DOORS

- A. Non-Rated Openings: Provide the following:
  - 1. Face Sheets - Seamless fiberglass reinforced polyester plastic, 0.110-in thick.
  - 2. Internal Stiles and Rails - Structural fiberglass reinforced plastic with solid polymer corner reinforcement.
  - 3. Core - Polyurethane, 1-1/2-inches thick, U factor - 0.14 deg Btu/F x h x sq. ft..
  - 4. Hardware Reinforcement - Solid polymer.
  - 5. Intermediate Framing - Supply structural FRP as and where required for door integrity.
  - 6. Chemically weld entire door.
  - 7. Polyester gel-coat entire door following hardware machining, 15 mils plus/minus 3 mils dry film thickness.
- B. Exterior Door Model SL-17, Full Flush.
- C. Interior Door Model SL-17.

## 2.4 FRAMES

- A. Aluminum Framing: ASTM B 221, with alloy and temper required to suit structural and finish requirements, and not less than 0.062 inch thick.
- B. Door Frames: Extruded aluminum, reinforced for hinges, strikes, and closers.
- C. Provide concealed corner reinforcements and alignment clips for accurately fitted hairline joints at butted and mitered connections.
- D. Factory prepare aluminum frames to receive templated mortised hardware; include cutouts, reinforcements, mortising, drilling, and tapping, according to the Door Hardware Schedule and templates furnished as specified in Section 087100 "Door Hardware."

## 2.5 FASTENERS

- A. Stainless steel fasteners, 300 Series as approved, shall be used for frame assembly and for all other fasteners.



## 2.6 PERFORMANCE REQUIREMENTS

- A. Air Infiltration: When tested in accordance with ASTM E283, air infiltration is not to exceed 0.06 cubic feet per minute per square foot of fixed area at a test pressure of 6.24 pounds per square foot at 50 mile per hour wind.
- B. Water Penetration: When tested in accordance with ASTM E331, no water penetration is allowed, at a pressure of 8 pounds per square foot of fixed area.
- C. Provisions for Thermal Movement: Design doors and frames to provide for expansion and contraction of the component parts caused by an ambient temperature range of minus 0 to 100 degrees F causing buckling, opening of joints, overstressing of fasteners, or other harmful effects.

## 2.7 FABRICATION

- A. FRP Doors:
  - 1. Steel-Stiffened Door Cores: Provide minimum thickness 0.026 inch, steel vertical stiffeners of same material as face sheets extending full-door height, with vertical webs spaced not more than 6 inches apart. Spot weld to face sheets no more than 5 inches o.c. Fill spaces between stiffeners with glass- or mineral-fiber insulation.
  - 2. Vertical Edges for Single-Acting Doors: Provide beveled or square edges at manufacturer's discretion.
  - 3. Top Edge Closures: Close top edges of doors with flush closures of same material as face sheets.
  - 4. Bottom Edge Closures: Close bottom edges of doors with end closures or channels of same material as face sheets.
- B. Aluminum Frames: Extruded aluminum shapes with contours approximately as indicated. Provide removable glass stops and glazing beads for frames accommodating fixed glass. Use countersunk stainless steel Phillips screws for exposed fastenings, and space not more than 12 inches on center. Mill joints in frame members to a hairline fit, reinforce, and secure mechanically.
  - 1. Construction: Non-thermal at interior locations; thermally broken at exterior locations.
- C. Fabricate concealed stiffeners and edge channels from either cold- or hot-rolled steel sheet.
- D. Hardware Preparation: Factory prepare hollow-metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the Door Hardware Schedule, and templates.
  - 1. Reinforce doors and frames to receive non-templated, mortised, and surface-mounted door hardware.
  - 2. Comply with applicable requirements in SDI A250.6 and BHMA A156.115 for preparation of hollow-metal work for hardware.

## 2.8 FRP FINISH

- A. Gelcoat Matte Finish, 25 mil (smooth face sheets only), from manufacture's full range of colors

## 2.9 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class I, 0.018 mm or thicker.

# PART 3 - EXECUTION

## 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Verify that wall thickness does not exceed standard tolerances allowed by throat size of indicated aluminum frame.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

## 3.2 PREPARATION

- A. Drill and tap doors and frames to receive non-templated, mortised, and surface-mounted door hardware.

## 3.3 INSTALLATION

- A. Install aluminum frames plumb, rigid, properly aligned, and securely fastened in place; according to manufacturer's written instructions.
- B. Install frame components in the longest possible lengths with no piece less than 48 inches; components 96 inches or shorter shall be one piece.
  - 1. Use concealed installation clips to produce tightly fitted and aligned splices and connections.
  - 2. Secure clips to extruded main-frame components and not to snap-in or trim members.
  - 3. Do not leave screws or other fasteners exposed to view when installation is complete.
- C. Fit and hang door in accordance with clearances specified below:
  - 1. Clearance Tolerances:
    - a. Jambs and Head: Plus 1/8-inch or minus 1/16-inch.
    - b. Pairs of Doors: Plus 1/8 inch or minus 1/16-inch.
    - c. Bottom of Door and Top of Threshold: Maximum 3/8-inch.
    - d. Bottom of Door and Top of finish floor (No Threshold: Maximum 3/4-inch.

### 3.4 ADJUSTING

- A. Inspect installation, correct misalignments, and tighten loose connections.
- B. Doors: Adjust doors to operate smoothly and easily, without binding or warping. Adjust hardware to function smoothly and lubricate as recommended by manufacturer.
- C. Clean exposed frame surfaces promptly after installation, using cleaning methods recommended in writing by frame manufacturer and according to AAMA 609 & 610.
- D. Touch Up: Repair marred surfaces to blend inconspicuously with adjacent unrepaired surface so touchup is not visible from a distance of 48 inches as viewed by Engineer. Remove and replace doors and frames with damaged finish that cannot be satisfactorily repaired.

END OF SECTION 081500

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## SECTION 083323 - OVERHEAD COILING DOORS

### 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. Insulated service doors.

- B. Related Requirements:

- 1. Section 055000 "Metal Fabrications" for miscellaneous steel supports, door-opening framing, corner guards, and bollards.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type and size of overhead coiling door and accessory.

- 1. Include construction details, material descriptions, dimensions of individual components, profiles for slats, and finishes.
  - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished accessories.
  - 3. Include description of automatic-closing device and testing and resetting instructions.

- B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data.

- 1. Include plans, elevations, sections, and mounting details.
  - 2. Include details of equipment assemblies, and indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.
  - 3. Include points of attachment and their corresponding static and dynamic loads imposed on structure.
  - 4. For exterior components, include details of provisions for assembly expansion and contraction and for excluding and draining moisture to the exterior.
  - 5. Show locations of controls, locking devices, and other accessories.

- C. Samples for Initial Selection: Manufacturer's finish charts showing full range of colors and textures available for units with factory-applied finishes.

- 1. Include similar Samples of accessories involving color selection.

- D. Regulatory Approvals: Provide copy of current, valid statewide product approval for product, material or system as shown on the drawings and as specified in this section, in accordance with Rule 9N-3. Product approval shall be for the specific manufacturer, product type, model or style, and the State Approval Number.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Sample Warranty: For special warranty.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Special warranty.
- B. Maintenance Data: For overhead coiling doors to include in maintenance manuals.

#### 1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer for both installation and maintenance of units required for this Project.
  - 1. Maintenance Proximity: Not more than two hours' normal travel time from Installer's place of business to Project site.

#### 1.7 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of doors that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Two years from date of Substantial Completion.

#### 1.8 REGULATORY REQUIREMENTS

- A. Provide products, materials and assemblies, including anchorage, proposed for the work of this Section that comply with project specific calculated design pressures and the Florida Building Code, including wind-borne debris region requirements. Provide products designed by the Manufacturer and installed by the Contractor to meet these requirements.
  - 1. Provide products that conform to the project design pressures in the components and cladding table on the structural drawings. Where a conflict occurs between the requirements of this Specification and the Florida Building Code, the more stringent requirement shall apply.
- B. Provide documentation that the Florida Building Code compliance for the products, materials and assemblies, including anchorage specified in this section have been incorporated into the

Work. Demonstrate code compliance with the Florida Building Code, using one of the methods outlined in Chapter 9N-3 of the Florida Administrative Code, Department of Community Affairs, Florida Building Commission, Product Approval documentation.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Source Limitations: Obtain overhead coiling doors from single source from single manufacturer.
  - 1. Obtain operators and controls from overhead coiling-door manufacturer.

### 2.2 PERFORMANCE REQUIREMENTS

- A. Structural Performance, Exterior Doors: Capable of withstanding the following design wind loads:
  - 1. Design Wind Load: As indicated on Structural Drawings.
  - 2. Testing: According to ASTM E330/E330M.
  - 3. Deflection Limits: Design overhead coiling doors to withstand design wind load without evidencing permanent deformation or disengagement of door components.

### 2.3 DOOR ASSEMBLY

- A. Insulated Service Door: Overhead coiling door formed with curtain of interlocking metal slats.
  - 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. Cookson Company.
    - b. Cornell.
    - c. Overhead Door Corporation.
- B. Operation Cycles: Door components and operators capable of operating for not less than 50,000. One operation cycle is complete when a door is opened from the closed position to the fully open position and returned to the closed position.
  - 1. Include tamperproof cycle counter.
- C. Air Infiltration: Maximum rate of 0.4 cfm/sq. ft. at 15 and 25 mph when tested according to ASTM E283.
- D. STC Rating: 26.
- E. Curtain R-Value: 4.5 deg F x h x sq. ft./Btu.

- F. Door Curtain Material: Galvanized steel.
- G. Door Curtain Slats: Flat profile slats of 2-5/8-inch center-to-center height.
  - 1. Insulated-Slat Interior Facing: Metal.
  - 2. Gasket Seal. Manufacturer's standard continuous gaskets between slats.
- H. Bottom Bar: Two angles, each not less than 1-1/2 by 1-1/2 by 1/8 inch thick; fabricated from hot-dip galvanized steel and finished to match door.
- I. Curtain Jamb Guides: Galvanized steel with exposed finish matching curtain slats.
- J. Hood: Match curtain material and finish.
  - 1. Shape: Round.
  - 2. Mounting: Face of wall.
- K. Locking Devices: Equip door with slide bolt for padlock.
- L. Manual Door Operator: Chain-hoist operator Manufacturer's standard crank operator Awning-crank operator Wall-crank operator.
- M. Door Finish:
  - 1. Powder-Coated Finish: Color as selected by Engineer from manufacturer's full range.
  - 2. Interior Curtain-Slat Facing: Match finish of exterior curtain-slat face.

## 2.4 DOOR CURTAIN MATERIALS AND CONSTRUCTION

- A. Door Curtains: Fabricate overhead coiling-door curtain of interlocking metal slats, designed to withstand wind loading indicated, in a continuous length for width of door without splices. Unless otherwise indicated, provide slats of thickness and mechanical properties recommended by door manufacturer for performance, size, and type of door indicated, and as follows:
  - 1. Steel Door Curtain Slats: Zinc-coated (galvanized), cold-rolled structural-steel sheet; complying with ASTM A653/A653M, with G90 zinc coating; nominal sheet thickness (coated) of 0.028 inch; and as required.
  - 2. Insulation: Fill slats for insulated doors with manufacturer's standard thermal insulation complying with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, according to ASTM E84 or UL 723. Enclose insulation completely within slat faces.
  - 3. Metal Interior Curtain-Slat Facing: Match metal of exterior curtain-slat face, with minimum steel thickness of 0.010 inch.
- B. Curtain Jamb Guides: Manufacturer's standard angles or channels and angles of same material and finish as curtain slats unless otherwise indicated, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Slot bolt holes for guide adjustment. Provide removable stops on guides to prevent overtravel of curtain, and a continuous bar for holding windlocks.



## 2.5 HOODS

- A. General: Form sheet metal hood to entirely enclose coiled curtain and operating mechanism at opening head. Contour to fit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Form closed ends for surface-mounted hoods and fascia for any portion of between-jamb mounting that projects beyond wall face. Equip hood with intermediate support brackets as required to prevent sagging.
  - 1. Galvanized Steel: Nominal 0.028-inch- thick, hot-dip galvanized-steel sheet with G90 zinc coating, complying with ASTM A653/A653M.

## 2.6 LOCKING DEVICES

- A. Slide Bolt: Fabricate with side-locking bolts to engage through slots in tracks for locking by padlock, located on both left and right jamb sides, operable from coil side.
- B. Chain Lock Keeper: Suitable for padlock.

## 2.7 CURTAIN ACCESSORIES

- A. Weatherseals for Exterior Doors: Equip each exterior door with weather-stripping gaskets fitted to entire exterior perimeter of door for a weather-resistant installation unless otherwise indicated.
  - 1. At door head, use 1/8-inch- thick, replaceable, continuous-sheet baffle secured to inside of hood or field-installed on the header.
  - 2. At door jambs, use replaceable, adjustable, continuous, flexible, 1/8-inch- thick seals of flexible vinyl, rubber, or neoprene.
- B. Push/Pull Handles: Equip each push-up-operated or emergency-operated door with lifting handles on each side of door, finished to match door.
- C. Pull-Down Strap: Provide pull-down straps for doors more than 84 inches high.

## 2.8 COUNTERBALANCE MECHANISM

- A. General: Counterbalance doors by means of manufacturer's standard mechanism with an adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to top of curtain with barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.

## 2.9 MANUAL DOOR OPERATORS

- A. General: Equip door with manual door operator by door manufacturer.
- B. Chain-Hoist Operator: Consisting of endless steel hand chain, chain-pocket wheel and guard, and gear-reduction unit with a maximum 25-lbf force for door operation. Provide alloy-steel hand chain with chain holder secured to operator guide.

## 2.10 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM/NOMMA 500 for recommendations for applying and designating finishes.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

## 2.11 STEEL AND GALVANIZED-STEEL FINISHES

- A. Powder-Coat Finish: Manufacturer's baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry film thickness.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

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

### 3.2 INSTALLATION

- A. Install overhead coiling doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.
- B. Install overhead coiling doors, hoods, controls, and operators at the mounting locations indicated for each door.

### 3.3 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
  - 1. Test door release, closing, and alarm operations when activated by smoke detector or building's fire-alarm system. Test manual operation of closed door. Reset door-closing mechanism after successful test.
  - 2. Fire-Rated Door Inspections: Inspect each fire-rated door in accordance with NFPA 80, section 5.2.
- B. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.

- C. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.

#### 3.4 ADJUSTING

- A. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion.
  - 1. Adjust exterior doors and components to be weather resistant.
- B. Lubricate bearings and sliding parts as recommended by manufacturer.
- C. Adjust seals to provide tight fit around entire perimeter.

#### 3.5 MAINTENANCE SERVICE

- A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by skilled employees of coiling-door Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
  - 1. Perform maintenance, including emergency callback service, during normal working hours.
  - 2. Include 24-hour-per-day, seven-day-per-week, emergency callback service.

#### 3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain overhead coiling doors.

END OF SECTION 083323

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## SECTION 083483 - FLOOR DOORS (ACCESS HATCHES)

### 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. JEA Water and Wastewater Standards Section 433.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Aluminum floor doors.
- B. Related Requirements:
  - 1. Section 05500 "Metal Fabrications".

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include construction details materials, individual components and profiles, and finishes.
- B. Product Schedule: For floor doors.

### PART 2 - PRODUCTS

#### 2.1 ALUMINUM FLOOR DOORS

- A. Gutter Channel Frame Aluminum Floor Door:
  - 1. See Contract Drawings for specific type of floor door. Provide the following types of gutter channel frame aluminum floor doors:
    - a. Concrete embedded frame (chemical injection vault floor door)
  - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the followings manufacturers:
    - a. Halliday Products.
    - b. U.S.F. Fabrication.

3. Frame: Mill finish aluminum, gutter profile, with integral drainage coupling and perimeter gasket.
4. Door: Double leaf or as indicated on Contract Drawings; 1/4-inch-thick, diamond-pattern mill-finish aluminum plate.
5. Loading Capacity: AASHTO H20 concentrated wheel load, without impact.
6. Options: Odor gasket.
7. Hardware:
  - a. Material and Finish: Type 316 stainless steel, including latch and lifting mechanism assemblies, hold-open arms, and brackets, hinges, pins, and fasteners.
  - b. Hinges: Heavy-duty butt hinges with stainless steel pins.
  - c. Operating Mechanism: Adjustable counterbalancing springs, heavy-duty hold-open arm that automatically locks door open at 90 degrees, release handle with vinyl grip that allows for one-handed closure, and recessed lift handle.
  - d. Latch: Stainless steel slam latch.
  - e. Lock: Recessed padlock hasp.

## 2.2 MATERIALS

- A. Aluminum Extrusions: ASTM B221, Alloy 6063-T6.
- B. Aluminum-Alloy Rolled Tread Plate: ASTM B632/B632M, Alloy 6061-T6.
- C. Aluminum Sheet: ASTM B209, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.
- D. Frame Anchors: Same material as door face.
- E. Inserts, Bolts, and Anchor Fasteners: Type 316 Stainless Steel and 316L for welded hardware.

## 2.3 FABRICATION

- A. General: Provide floor doors manufactured as integral units ready for installation.
- B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.
- C. Grind exposed welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure floor doors to types of supports indicated.
- D. Latching Mechanisms: Furnish number required to hold doors in flush, smooth plane when closed.
  1. For cylinder locks, furnish two keys per lock and key all locks alike.
  2. For recessed panel doors, provide access sleeves for each locking device. Furnish plastic grommets and install in holes cut through finish.

- E. Aluminum: After fabrication, apply manufacturer's standard protective coating on aluminum that comes in contact with concrete.

## 2.4 FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

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

### 3.2 INSTALLATION, GENERAL

- A. Comply with manufacturer's written instructions for installing floor doors.

### 3.3 FIELD QUALITY CONTROL

- A. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.
- B. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.

### 3.4 ADJUSTING

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

END OF SECTION 083483

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## SECTION 084523 - FIBERGLASS-SANDWICH-PANEL ASSEMBLIES

### 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 aluminum-framed assemblies incorporating fiberglass-sandwich panels as follows:
  - 1. Wall assemblies.

#### 1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for aluminum components of panel assemblies.
- B. Shop Drawings: For panel assemblies.
  - 1. Include plans, elevations, sections, details, and attachments to other work.
  - 2. Include details of provisions for assembly expansion and contraction and for draining moisture within the assembly to the exterior.
- C. Samples: In manufacturer's standard size.
  - 1. For each type of fiberglass-sandwich panel.
  - 2. For each type of exposed finish for framing members.
- D. Fabrication Samples: Of each framing system intersection and adjacent panels, made from 12-inch lengths of full-size framing members and showing details of the following:
  - 1. Joinery.
  - 2. Anchorage.
  - 3. Expansion provisions.
  - 4. Fiberglass-sandwich panels.
  - 5. Flashing and drainage.

- E. Regulatory Approvals: Provide copy of current, valid statewide product approval for product, material or system as shown on the drawings and as specified in this Section, in accordance with Rule 9N-3. Product approval shall be for the specific manufacturer, product type, model or style, and the State Approval Number.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer and manufacturer.
- B. Product Test Reports: For each fiberglass-sandwich-panel assembly, for tests performed by a qualified testing agency.
- C. Evaluation Reports: For fiberglass-sandwich-panel assemblies from ICC-ES.
- D. Field quality-control reports.
- E. Sample Warranties: For special warranties.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For panel assemblies to include in maintenance manuals.

#### 1.7 QUALITY ASSURANCE

- A. Manufacturer Qualifications: For fiberglass-sandwich panels, a qualified manufacturer whose facilities, processes, and products are monitored by an independent, accredited quality-control agency for compliance with applicable requirements in ICC-ES AC04 or ICC-ES AC177.
- B. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

#### 1.8 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of panel assemblies that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Structural failures including, but not limited to, excessive deflection.
    - b. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
    - c. Water leakage.
  - 2. Warranty Period: Two years from date of Substantial Completion.
- B. Manufacturer's Special Warranty: Manufacturer agrees to repair or replace fiberglass-sandwich panels that exhibit defects in materials or workmanship within specified warranty period.

1. Defects include, but are not limited to, the following:
    - a. Fiberbloom.
    - b. Delamination of coating, if any, from exterior face sheet.
    - c. Color change exceeding requirements.
    - d. Delamination of panel face sheets from panel cores.
  2. Warranty Period: 10 years from date of Substantial Completion.
- C. Special Aluminum-Finish Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components on which finishes fail within specified warranty period. Warranty does not include normal weathering.
1. Failures include, but are not limited to, checking, crazing, peeling, chalking, and fading of finishes.
  2. Warranty Period: Five years from date of Substantial Completion.

## 1.9 REGULATORY REQUIREMENTS

- A. Provide products, materials and assemblies, including anchorage, proposed for the work of this Section that comply with project specific calculated design pressures and the Florida Building Code, including wind-borne debris region requirements. Provide products designed by the Manufacturer and installed by the Contractor to meet these requirements.
1. Provide products that conform to the project design pressures in the components and cladding table on the structural drawings. Where a conflict occurs between the requirements of this Specification and the Florida Building Code, the more stringent requirement shall apply.
- B. Provide documentation that the Florida Building Code compliance for the products, materials and assemblies, including anchorage specified in this Section have been incorporated into the Work. Demonstrate code compliance with the Florida Building Code, using one of the methods outlined in Chapter 9N-3 of the Florida Administrative Code, Department of Community Affairs, Florida Building Commission, Product Approval documentation.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design fiberglass-sandwich-panel assemblies.
- B. Structural Loads: As indicated on Structural Drawings.
- C. Deflection Limits:
1. Vertical Panel Assemblies: Limited to 1/60 of clear span for each assembly component.

- D. Structural-Test Performance: Provide panel assemblies tested according to ASTM E330, as follows:
1. When tested at positive and negative wind-load design pressures, assemblies do not show evidence of deflection exceeding specified limits.
  2. When tested at 150 percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not show evidence of material failures, structural distress, and permanent deformation of main framing members exceeding 0.2 percent of span.
  3. Test Durations: As required by design wind velocity, but not less than 10 seconds.
- E. Water Penetration under Static Pressure: Provide panel assemblies that do not evidence water penetration through fixed glazing and framing areas when tested according to ASTM E331 at a minimum static-air-pressure difference of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft..
- F. Water Penetration under Dynamic Pressure: Provide panel assemblies that do not evidence water leakage through fixed glazing and framing areas when tested according to AAMA 501.1 under dynamic pressure equal to 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft..
1. Maximum Water Leakage: No uncontrolled water penetrating aluminum-framed systems or water appearing on systems' normally exposed interior surfaces from sources other than condensation. Water leakage does not include water that is controlled by flashing and gutters and drained to the exterior, or water that cannot damage adjacent materials or finishes.
- G. Thermal Movements: Allow for thermal movements from ambient- and surface-temperature changes. Base calculations 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.
- H. Energy Performance: Provide panel assemblies with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below and certified and labeled according to NFRC:
1. Thermal Transmittance (U-Factor): Fixed glazing and framing areas shall have U-factor of not more than 0.65 Btu/sq. ft. x h x deg F as determined according to NFRC 100.
  2. Solar Heat Gain Coefficient (SHGC): Fixed glazing and framing areas shall have a SHGC of no greater than 0.6 as determined according to NFRC 200.
  3. Air Infiltration: Maximum air leakage through fixed glazing and framing areas of 0.30 cfm/sq. ft. of fixed wall area as determined according to ASTM E283 at a minimum static-air-pressure differential of 6.24 lbf/sq. ft..

## 2.2 FIBERGLASS-SANDWICH-PANEL ASSEMBLIES

- A. Fiberglass-Sandwich-Panel Assemblies: Translucent assemblies that are supported by aluminum framing and glazed with fiberglass-sandwich panels.

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. Kalwall Corporation.
  - b. Major Industries, Inc.

## 2.3 FIBERGLASS-SANDWICH PANELS

- A. Fiberglass-Sandwich Panels: Uniformly colored, translucent, thermoset, fiberglass-reinforced-polymer face sheets bonded to both sides of a grid core.
  1. Core Insulation: Fill panel cores with aerogel.
- B. Panel Thickness: 2-3/4 inches.
- C. Grid Core: Mechanically interlocked, extruded-aluminum I-beams, with a minimum flange width of 7/16 inch.
  1. Extruded Aluminum: ASTM B221, in alloy and temper recommended in writing by manufacturer.
  2. I-Beam Construction: Thermally broken, extruded aluminum.
  3. Grid Pattern: Inline rectangle, nominal 12 by 24 inches.
- D. Exterior Face Sheet:
  1. Thickness: 0.070 inch.
  2. Color: As selected by Engineer from manufacturer's full range.
  3. Protective Weathering Surface: Manufacturer's standard.
- E. Interior Face Sheet:
  1. Thickness: 0.045 inch.
  2. Color: As selected by Engineer from manufacturer's full range.
- F. Fiberglass-Sandwich-Panel Adhesive: Manufacturer's standard for permanent adhesion of facings to cores.
- G. Panel Strength:
  1. Maximum Panel Deflection: 3-1/2 inches when a 4-by-12-foot panel is tested according to ASTM E72 at 34 lbf/sq. ft., with a maximum 0.090-inch set deflection after five minutes.
  2. Panel Support Strength: Capable of supporting, without failure, a 300-lbf concentrated load when applied to a 3-inch- diameter disk according to ASTM E661.
- H. Panel Performance:
  1. Self-Ignition Temperature: 650 deg F or more according to ASTM D1929.
  2. Smoke-Developed Index: 450 or less according to ASTM E 84, or 75 or less according to ASTM D2843.

3. Combustibility Classification: Class CC1 based on testing according to ASTM D635.
4. Interior Finish Classification: Class A based on testing according to ASTM E84.
5. Color Change: Not more than 3.0 units Delta E, when measured according to ASTM D2244, after outdoor weathering compliant with procedures in ASTM D1435.
  - a. Outdoor Weathering Conditions: Sixty months in southern Florida.
6. Impact Resistance: No fracture or tear at impact of 70 ft. x lbf by a 3-1/4-inch- diameter, 5-lb freefalling ball according to UL 972 test procedure.
7. Haze Factor: Greater than 90 percent when tested according to ASTM D1003.

## 2.4 ALUMINUM FRAMING SYSTEMS

- A. Components: Manufacturer's standard extruded-aluminum members of thickness required and reinforced as required to support imposed loads.
  1. Construction: Thermally broken, extruded aluminum.
- B. Aluminum: Alloy and temper recommended in writing by manufacturer for type of use and finish indicated.
  1. Sheet and Plate: ASTM B209.
  2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B221.
  3. Extruded Structural Pipe and Tubes: ASTM B429.
  4. Structural Profiles: ASTM B308.
- C. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning skylight components.
- D. Fasteners and Accessories: Manufacturer's standard, corrosion-resistant, nonstaining, and nonbleeding fasteners and accessories; compatible with adjacent materials.
  1. At closures, retaining caps, or battens, use ASTM A193, 300 series stainless-steel screws.
  2. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
  3. At movement joints, use slip-joint linings, spacers, and sleeves of material and type recommended in writing by manufacturer.
- E. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A123 or ASTM A153 requirements.
- F. Anchor Bolts: ASTM A307, Grade A, galvanized steel.
- G. Concealed Flashing: Corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.
- H. Exposed Flashing and Closures: Aluminum sheet not less than 0.040 inch thick, finished to match framing.
- I. Framing Gaskets: Manufacturer's standard.

- J. Frame-System Sealants: As specified in Section 079200 "Joint Sealants."
- K. Corrosion-Resistant Coating: Cold-applied asphalt mastic, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

## 2.5 FABRICATION

### A. Frame System Fabrication:

- 1. Fabricate components that, when assembled, have the following characteristics:
  - a. Profiles that are sharp, straight, and free of defects or deformations.
  - b. Accurately fitted joints with ends coped or mitered.
  - c. Internal guttering systems or other means to drain water passing through joints, and moisture migrating within assembly to exterior.
- 2. Fabricate sill closures with weep holes and for installation as continuous component.
- 3. Reinforce components as required to receive fastener threads.

### B. Panel Fabrication: Factory assemble and seal panels.

- 1. Laminate face sheets to grid core under a controlled process using heat and pressure to produce straight adhesive bonding lines that cover width of core members and that have sharp edges.
  - a. White spots indicating lack of bond at intersections of grid-core members are limited in number to four for every 40 sq. ft. of panel and limited in diameter to 3/64 inch.
- 2. Fabricate with grid pattern that is symmetrical about centerlines of each panel.
- 3. Fabricate panel to allow condensation within panel to escape.
- 4. Reinforce panel corners.

## 2.6 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

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

### 3.2 INSTALLATION

- A. General: Comply with manufacturer's written instructions.
  - 1. Do not install damaged components.
  - 2. Fit joints between aluminum components to produce hairline joints free of burrs and distortion.
  - 3. Rigidly secure nonmovement joints.
  - 4. Install anchors with separators and isolators to prevent metal corrosion, electrolytic deterioration, and immobilization of moving joints.
  - 5. Seal joints watertight unless otherwise indicated.
- B. Metal Protection: Where aluminum components will contact dissimilar materials, protect against galvanic action by painting contact surfaces with corrosion-resistant coating or by installing nonconductive spacers as recommended in writing by manufacturer for this purpose.
- C. Install components plumb and true in alignment with established lines and elevations.
- D. Skylight Assemblies: Install continuous aluminum sill closures with weatherproof expansion joints and locked and sealed corners. Locate weep holes at rafters. Install components to drain water passing through joints and moisture migrating within assembly to exterior.
- E. Erection Tolerances: Install panel assemblies to comply with the following maximum tolerances:
  - 1. Alignment: Limit offset from true alignment to 1/32 inch where surfaces abut in line, edge to edge, at corners, or where a reveal or protruding element separates aligned surfaces by less than 3 inches; otherwise, limit offset to 1/8 inch.
  - 2. Location and Plane: Limit variation from true location and plane to 1/8 inch in 12 feet, but no greater than 1/2 inch over total length.

### 3.3 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
  - 1. Water-Spray Test: Before installation of interior finishes has begun, panel assemblies shall be tested according to AAMA 501.2 and shall not show evidence of water penetration.
- B. Repair or remove work where test results and inspections indicate that it does not comply with specified requirements.
- C. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- D. Prepare test and inspection reports.

END OF SECTION 084523



## SECTION 085113 - ALUMINUM WINDOWS

### 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 aluminum windows for exterior locations.
- B. Related Requirements:
  - 1. Section 088000 "Glazing" for glazing units.

#### 1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
  - 1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
  - 2. Review and discuss the finishing of aluminum windows that is required to be coordinated with the finishing of other aluminum work for color and finish matching.
  - 3. Review, discuss, and coordinate the interrelationship of aluminum windows with other exterior wall components. Include provisions for anchoring, flashing, weeping, sealing perimeters, and protecting finishes.
  - 4. Review and discuss the sequence of work required to construct a watertight and weathertight exterior building envelope.
  - 5. Inspect and discuss the condition of substrate and other preparatory work performed by other trades.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, glazing and fabrication methods, dimensions of individual components and profiles, hardware, and finishes for aluminum windows.
- B. Shop Drawings: For aluminum windows.
  - 1. Include plans, elevations, sections, hardware, accessories, insect screens, operational clearances, and details of installation, including anchor, flashing, and sealant installation.

- C. Samples: For each exposed product and for each color specified, 2 by 4 inches in size.
- D. Samples for Initial Selection: For units with factory-applied finishes.
  - 1. Include Samples of hardware and accessories involving color selection.
- E. Product Schedule: For aluminum windows. Use same designations indicated on Drawings.
- F. Regulatory Approvals: Provide copy of current, valid statewide product approval for product, material or system as shown on the drawings and as specified in this Section, in accordance with Rule 9N-3. Product approval shall be for the specific manufacturer, product type, model or style, and the State Approval Number.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For manufacturer and Installer.
- B. Product Test Reports: For each type of aluminum window, for tests performed by a qualified testing agency.
- C. Field quality-control reports.
- D. Sample Warranties: For manufacturer's warranties.

#### 1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A manufacturer capable of fabricating aluminum windows that meet or exceed performance requirements indicated and of documenting this performance by test reports and calculations.
- B. Installer Qualifications: An installer acceptable to aluminum window manufacturer for installation of units required for this Project.

#### 1.7 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace aluminum windows that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Failure to meet performance requirements.
    - b. Structural failures including excessive deflection, water leakage, condensation, and air infiltration.
    - c. Faulty operation of movable sash and hardware.
    - d. Deterioration of materials and finishes beyond normal weathering.
    - e. Failure of insulating glass.

2. Warranty Period:

- a. Window: 10 years from date of Substantial Completion.
- b. Glazing Units: Five years from date of Substantial Completion.
- c. Aluminum Finish: 10 years from date of Substantial Completion.

1.8 REGULATORY REQUIREMENTS

- A. Provide products, materials and assemblies, including anchorage, proposed for the work of this Section that comply with project specific calculated design pressures and the Florida Building Code, including wind-borne debris region requirements. Provide products designed by the Manufacturer and installed by the Contractor to meet these requirements.
  - 1. Provide products that conform to the project design pressures in the components and cladding table on the structural drawings. Where a conflict occurs between the requirements of this Specification and the Florida Building Code, the more stringent requirement shall apply.
- B. Provide documentation that the Florida Building Code compliance for the products, materials and assemblies, including anchorage specified in this Section have been incorporated into the Work. Demonstrate code compliance with the Florida Building Code, using one of the methods outlined in Chapter 9N-3 of the Florida Administrative Code, Department of Community Affairs, Florida Building Commission, Product Approval documentation

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain aluminum windows from single source from single manufacturer.

2.2 WINDOW PERFORMANCE REQUIREMENTS

- A. Product Standard: Comply with AAMA/WDMA/CSA 101/I.S.2/A440 for definitions and minimum standards of performance, materials, components, accessories, and fabrication unless more stringent requirements are indicated.
  - 1. Window Certification: AAMA certified with label attached to each window.
- B. Performance Class and Grade: AAMA/WDMA/CSA 101/I.S.2/A440 as follows:
  - 1. Minimum Performance Class: CW.
  - 2. Minimum Performance Grade: 30.
- C. Thermal Transmittance: NFRC 100 maximum whole-window U-factor of 0.50 Btu/sq. ft. x h x deg F.
- D. Solar Heat-Gain Coefficient (SHGC): NFRC 200 maximum whole-window SHGC of 0.33 for South facing windows and 0.25 for North, East and West facing windows.

- E. Condensation-Resistance Factor (CRF): Provide aluminum windows tested for thermal performance according to AAMA 1503, showing a CRF of 45.
- F. Thermal Movements: Provide aluminum windows, including anchorage, that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, 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: 120 deg F ambient; 180 deg F material surfaces.
- G. Outside-Inside Transmission Class (OITC): Rated for not less than 26 OITC when tested for laboratory sound transmission loss according to ASTM E90 and determined by ASTM E1332.

## 2.3 ALUMINUM WINDOWS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. EFCO Corporation.
  - 2. Kawneer North America, an Arconic company.
  - 3. YKK AP America Inc.
- B. Types: Provide the following types in locations indicated on Drawings:
  - 1. Fixed.
- C. Frames and Sashes: Aluminum extrusions complying with AAMA/WDMA/CSA 101/I.S.2/A440.
  - 1. Thermally Improved Construction: Fabricate frames, sashes, and muntins with an integral, concealed, low-conductance thermal barrier located between exterior materials and window members exposed on interior side in a manner that eliminates direct metal-to-metal contact.
- D. Weather Stripping: Provide full-perimeter weather stripping for each operable sash unless otherwise indicated.
- E. Fasteners: Noncorrosive and compatible with window members, trim, hardware, anchors, and other components.
  - 1. Exposed Fasteners: Do not use exposed fasteners to greatest extent possible. For application of hardware, use fasteners that match finish hardware being fastened.

## 2.4 ACCESSORIES

- A. Subsills: Thermally broken, extruded-aluminum subsills in configurations indicated on Drawings.
- B. Interior Trim: Extruded-aluminum profiles in sizes and configurations indicated on Drawings.

- C. Panning Trim: Extruded-aluminum profiles in sizes and configurations indicated on Drawings.
- D. Receptor System: Two-piece, snap-together, thermally broken, extruded-aluminum receptor system that anchors windows in place.

## 2.5 FABRICATION

- A. Fabricate aluminum windows in sizes indicated. Include a complete system for assembling components and anchoring windows.
- B. Glaze aluminum windows in the factory.
- C. Weather strip each operable sash to provide weathertight installation.
- D. Weep Holes: Provide weep holes and internal passages to conduct infiltrating water to exterior.
- E. Provide water-shed members above side-hinged sashes and similar lines of natural water penetration.
- F. Mullions: Provide mullions and cover plates, matching window units, complete with anchors for support to structure and installation of window units. Allow for erection tolerances and provide for movement of window units due to thermal expansion and building deflections. Provide mullions and cover plates capable of withstanding design wind loads of window units.
- G. Window Assemblies: Provide fixed units in configuration indicated. Provide window frames, sashes, hardware, and other trim and components necessary for a complete, secure, and weathertight installation, including the following:
  - 1. Exterior head and sill casings and trim.
- H. Complete fabrication, assembly, finishing, hardware application, and other work in the factory to greatest extent possible. Disassemble components only as necessary for shipment and installation.

## 2.6 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

## 2.7 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 openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Verify rough opening dimensions, levelness of sill plate, and operational clearances.
- C. Examine wall flashings, vapor retarders, water and weather barriers, and other built-in components to ensure weathertight window installation.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Comply with manufacturer's written instructions for installing windows, hardware, accessories, and other components. For installation procedures and requirements not addressed in manufacturer's written instructions, comply with installation requirements in ASTM E2112.
- B. Install windows level, plumb, square, true to line, without distortion or impeding thermal movement, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction to produce weathertight construction.
- C. Install windows and components to drain condensation, water penetrating joints, and moisture migrating within windows to the exterior.
- D. Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials.

### 3.3 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
  - 1. Testing and inspecting agency will interpret tests and state in each report whether tested work complies with or deviates from requirements.

- B. Testing Services: Testing and inspecting of installed windows shall take place as follows:
1. Testing Methodology: Testing of windows for air infiltration and water resistance shall be performed according to AAMA 502.
  2. Air-Infiltration Testing:
    - a. Test Pressure: That required to determine compliance with AAMA/WDMA/CSA 101/I.S.2/A440 performance class indicated.
    - b. Allowable Air-Leakage Rate: 1.5 times the applicable AAMA/WDMA/CSA 101/I.S.2/A440 rate for product type and performance class rounded down to one decimal place.
  3. Water-Resistance Testing:
    - a. Test Pressure: Two-thirds times test pressure required to determine compliance with AAMA/WDMA/CSA 101/I.S.2/A440 performance grade indicated.
    - b. Allowable Water Infiltration: No water penetration.
  4. Testing Extent: Three windows of each type as selected by Engineer and a qualified independent testing and inspecting agency. Windows shall be tested after perimeter sealants have cured.
  5. Test Reports: Prepared according to AAMA 502.
- C. Windows will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

### 3.4 ADJUSTING, CLEANING, AND PROTECTION

- A. Adjust operating sashes and hardware for a tight fit at contact points and weather stripping for smooth operation and weathertight closure.
- B. Clean exposed surfaces immediately after installing windows. Avoid damaging protective coatings and finishes. Remove excess sealants, glazing materials, dirt, and other substances.
1. Keep protective films and coverings in place until final cleaning.
- C. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.
- D. Protect window surfaces from contact with contaminating substances resulting from construction operations. If contaminating substances do contact window surfaces, remove contaminants immediately according to manufacturer's written instructions.

END OF SECTION 085113

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## SECTION 087100 - DOOR HARDWARE

### 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. Mechanical door hardware for the following:
    - a. Swinging doors.
  - 2. Cylinders for door hardware specified in other Sections.
  - 3. Electrified door hardware.
- B. Related Requirements:
  - 1. Section 081500 Fiberglass Reinforced Plastic Doors and Aluminum Door Frames.

#### 1.3 COORDINATION

- A. Installation Templates: Distribute for doors, frames, and other work specified to be factory prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.
- B. Security: Coordinate installation of door hardware, keying, and access control with Owner's security consultant.

#### 1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
  - 1. Conference participants shall include Installer's Architectural Hardware Consultant and Owner's security consultant.

#### 1.5 ACTION SUBMITTALS

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

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

#### 1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and Architectural Hardware Consultant.
- B. Product Certificates: For each type of electrified door hardware.
  1. Certify that door hardware for use on each type and size of labeled fire-rated doors complies with listed fire-rated door assemblies.
- C. Product Test Reports: For compliance with accessibility requirements, for tests performed by manufacturer and witnessed by a qualified testing agency, for door hardware on doors located in accessible routes.
- D. Field quality-control reports.
- E. Sample Warranty: For special warranty.

## 1.7 CLOSEOUT SUBMITTALS

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

## 1.8 QUALITY ASSURANCE

- A. Installer Qualifications: Supplier of products and an employer of workers trained and approved by product manufacturers and of an Architectural Hardware Consultant who is available during the course of the Work to consult Contractor, Engineer, and Owner about door hardware and keying.
  - 1. Warehousing Facilities: In Project's vicinity.
  - 2. Scheduling Responsibility: Preparation of door hardware and keying schedule.
  - 3. Engineering Responsibility: Preparation of data for electrified door hardware, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.

## 1.9 DELIVERY, STORAGE, AND HANDLING

- A. Inventory door hardware on receipt and provide secure lock-up for door hardware delivered to Project site.
- B. Tag each item or package separately with identification coordinated with the final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package.
- C. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.
- D. Deliver keys and permanent cores to Owner by registered mail or overnight package service.

## 1.10 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Structural failures including excessive deflection, cracking, or breakage.
    - b. Faulty operation of doors and door hardware.
    - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.
  - 2. Warranty Period: Three years from date of Substantial Completion unless otherwise indicated below:
    - a. Exit Devices: Two years from date of Substantial Completion.
    - b. Manual Closers: 10 years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Source Limitations: Obtain each type of door hardware from single manufacturer.
  - 1. Provide electrified door hardware from same manufacturer as mechanical door hardware unless otherwise indicated. Manufacturers that perform electrical modifications and that are listed by a testing and inspecting agency acceptable to authorities having jurisdiction are acceptable.

### 2.2 PERFORMANCE REQUIREMENTS

- A. Means of Egress Doors: Latches do not require more than 15 lbf to release the latch. Locks do not require use of a key, tool, or special knowledge for operation.
- B. Accessibility Requirements: For door hardware on doors in an accessible route, comply with Florida Building Code, Accessibility.
  - 1. Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf.
  - 2. Bevel raised thresholds with a slope of not more than 1:2. Provide thresholds not more than 1/2 inch high.
  - 3. Adjust door closer sweep periods so that, from an open position of 90 degrees, the door will take at least 5 seconds to move to a position of 12 degrees from the latch.
  - 4. Adjust spring hinges so that, from an open position of 70 degrees, the door will take at least 1.5 seconds to move to the closed position.

### 2.3 SCHEDULED DOOR HARDWARE

- A. Provide products for each door that comply with requirements indicated in Part 2 and door hardware schedule.
  - 1. Door hardware is scheduled in Part 3.

### 2.4 HINGES

- A. Hinges: BHMA A156.1.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Hager Companies.
    - b. Stanley Commercial Hardware; a division of Stanley Security Solutions.

## 2.5 MECHANICAL LOCKS AND LATCHES

- A. Lock Functions: As indicated in door hardware schedule.
- B. Lock Throw: Comply with testing requirements for length of bolts required for labeled fire doors, and as follows:
  - 1. Mortise Locks: Minimum 3/4-inch latchbolt throw.
  - 2. Deadbolts: Minimum 1-inch bolt throw.
- C. Lock Backset: 2-3/4 inches unless otherwise indicated.
- D. Lock Trim:
  - 1. Levers: .
    - a. "P Lever Design," by SARGENT Manufacturing Company; an ASSA ABLOY Group company (SGT).
    - b. "17 (D Sparta)," by Schlage Commercial Lock Division; Allegion, plc (SCH).
    - c. "JEFFERSON - JNE," by Yale Commercial Locks and Hardware; an ASSA ABLOY Group company (YAL).
  - 2. Lockset Designs: Provide designs that match those scheduled.
- E. Strikes: Provide manufacturer's standard strike for each lock bolt or latchbolt complying with requirements indicated for applicable lock or latch and with strike box and curved lip extended to protect frame; finished to match lock or latch.
  - 1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
  - 2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
  - 3. Aluminum-Frame Strike Box: Manufacturer's special strike box fabricated for aluminum framing.
  - 4. Rabbet Front and Strike: Provide on locksets for rabbeted meeting stiles.

## 2.6 EXIT DEVICES AND AUXILIARY ITEMS

- A. Exit Devices and Auxiliary Items: BHMA A156.3.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Allegion plc.
    - b. Corbin Russwin, Inc.; an ASSA ABLOY Group company.
    - c. SARGENT Manufacturing Company; ASSA ABLOY.
    - d. Yale Security Inc; an ASSA ABLOY Group company.

## 2.7 LOCK CYLINDERS

- A. Lock Cylinders: Tumbler type, constructed from brass or bronze, stainless steel, or nickel silver.
- B. Standard Lock Cylinders: BHMA A156.5; Grade 1 permanent cores; face finished to match lockset.
  - 1. Core Type: Interchangeable.
- C. Construction Master Keys: Provide cylinders with feature that permits voiding of construction keys without cylinder removal. Provide 10 construction master keys.
- D. Construction Cores: Provide construction cores that are replaceable by permanent cores. Provide 10 construction master keys.

## 2.8 KEYING

- A. Keying System: Factory registered, complying with guidelines in BHMA A156.28, appendix. Provide one extra key blank for each lock.
  - 1. No Master Key System: Only change keys operate cylinders.
    - a. Provide three-cylinder change keys.
  - 2. Master Key System: Change keys and a master key operate cylinders.
    - a. Provide three-cylinder change keys and five master keys.
  - 3. Grand Master Key System: Change keys, a master key, and a grand master key operate cylinders.
    - a. Provide three-cylinder change keys and five each of master and grand master keys.
  - 4. Great-Grand Master Key System: Change keys, a master key, a grand master key, and a great-grand master key operate cylinders.
    - a. Provide three-cylinder change keys and five each of master, grand master, and great-grand master keys.
  - 5. Existing System:
    - a. Master key or grand master key locks to Owner's existing system.
    - b. Re-key Owner's existing master key system into new keying system.
  - 6. Keyed Alike: Key all cylinders to same change key.
- B. Keys: Nickel silver.
  - 1. Stamping: Permanently inscribe each key with a visual key control number and include the following notation:

- a. Notation: "DO NOT DUPLICATE."

## 2.9 OPERATING TRIM

- A. Operating Trim: BHMA A156.6; aluminum unless otherwise indicated.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Allegion plc.
    - b. Hager Companies.
    - c. Rockwood Manufacturing Company; an ASSA ABLOY Group company.
    - d. Trimco.

## 2.10 SURFACE CLOSERS

- A. Surface Closers: BHMA A156.4; rack-and-pinion hydraulic type with adjustable sweep and latch speeds controlled by key-operated valves and forged-steel main arm. Comply with manufacturer's written instructions for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Allegion plc.
    - b. Corbin Russwin, Inc.; an ASSA ABLOY Group company.
    - c. SARGENT Manufacturing Company; ASSA ABLOY.
    - d. Yale Security Inc; an ASSA ABLOY Group company.

## 2.11 MECHANICAL STOPS AND HOLDERS

- A. Wall- and Floor-Mounted Stops: BHMA A156.16.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Allegion plc.
    - b. Hager Companies.
    - c. Rockwood Manufacturing Company; an ASSA ABLOY Group company.
    - d. Trimco.

## 2.12 DOOR GASKETING

- A. Door Gasketing: BHMA A156.22; with resilient or flexible seal strips that are easily replaceable and readily available from stocks maintained by manufacturer.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Hager Companies.
  - b. Pemko; an ASSA ABLOY Group Company.
  - c. Zero International; an Allegion brand.
- B. Maximum Air Leakage: When tested according to ASTM E283 with tested pressure differential of 0.3-inch wg, as follows:
  1. Smoke-Rated Gasketing: 0.3 cfm/sq. ft. of door opening.
  2. Gasketing on Single Doors: 0.3 cfm/sq. ft. of door opening.
  3. Gasketing on Double Doors: 0.50 cfm per foot of door opening.

## 2.13 THRESHOLDS

- A. Thresholds: BHMA A156.21; fabricated to full width of opening indicated.
  1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Hager Companies.
    - b. Pemko; an ASSA ABLOY Group Company.
    - c. Reese Enterprises, Inc.
    - d. Zero International; an Allegion brand.

## 2.14 FABRICATION

- A. Manufacturer's Nameplate: Do not provide products that have manufacturer's name or trade name displayed in a visible location except in conjunction with required fire-rating labels and as otherwise approved by Engineer.
  1. Manufacturer's identification is permitted on rim of lock cylinders only.
- B. Base Metals: Produce door hardware units of base metal indicated, fabricated by forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness. Furnish metals of a quality equal to or greater than that of specified door hardware units and BHMA A156.18.
- C. Fasteners: Provide door hardware manufactured to comply with published templates prepared for machine, wood, and sheet metal screws. Provide screws that comply with commercially recognized industry standards for application intended, except aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware unless otherwise indicated.
  1. Concealed Fasteners: For door hardware units that are exposed when door is closed, except for units already specified with concealed fasteners. Do not use through bolts for installation where bolt head or nut on opposite face is exposed unless it is the only means



of securely attaching the door hardware. Where through bolts are used on hollow door and frame construction, provide sleeves for each through bolt.

2. Fire-Rated Applications:

a. Wood or Machine Screws: For the following:

- 1) Hinges mortised to doors or frames.
- 2) Strike plates to frames.
- 3) Closers to doors and frames.

b. Steel Through Bolts: For the following unless door blocking is provided:

- 1) Surface hinges to doors.
- 2) Closers to doors and frames.
- 3) Surface-mounted exit devices.

3. Spacers or Sex Bolts: For through bolting of hollow-metal doors.

4. Gasketing Fasteners: Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.

2.15 FINISHES

- A. Provide finishes complying with BHMA A156.18 as indicated in door hardware schedule.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance of the Work.
- B. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Steel Doors and Frames: For surface-applied door hardware, drill and tap doors and frames according to ANSI/SDI A250.6.

### 3.3 INSTALLATION

- A. Mounting Heights: Mount door hardware units at heights to comply with the following unless otherwise indicated or required to comply with governing regulations.
  - 1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
  - 2. Custom Steel Doors and Frames: HMMA 831.
  - 3. Wood Doors: DHI's "Recommended Locations for Architectural Hardware for Wood Flush Doors."
- B. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work. Do not install surface-mounted items until finishes have been completed on substrates involved.
  - 1. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
  - 2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.
- C. Hinges: Install types and in quantities indicated in door hardware schedule, but not fewer than the number recommended by manufacturer for application indicated or one hinge for every 30 inches of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.
- D. Intermediate Offset Pivots: Where offset pivots are indicated, provide intermediate offset pivots in quantities indicated in door hardware schedule, but not fewer than one intermediate offset pivot per door and one additional intermediate offset pivot for every 30 inches of door height greater than 90 inches.
- E. Lock Cylinders: Install construction cores to secure building and areas during construction period.
  - 1. Replace construction cores with permanent cores as directed by Owner.
  - 2. Furnish permanent cores to Owner for installation.
- F. Key Control System:
  - 1. Key Control Cabinet: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.
  - 2. Key Lock Boxes: Install where indicated or approved by Engineer to provide controlled access for fire and medical emergency personnel.
  - 3. Key Control System Software: Set up multiple-index system based on final keying schedule.

- G. Boxed Power Supplies: Locate power supplies as indicated or, if not indicated, in equipment room. Verify location with Engineer.
  - 1. Configuration: Provide least number of power supplies required to adequately serve doors with electrified door hardware.
- H. Thresholds: Set thresholds for exterior doors and other doors indicated in full bed of sealant complying with requirements specified in Section 079200 "Joint Sealants."
- I. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they will impede traffic.
- J. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.
  - 1. Do not notch perimeter gasketing to install other surface-applied hardware.
- K. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.
- L. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

### 3.4 FIELD QUALITY CONTROL

- A. Independent Architectural Hardware Consultant: Owner will engage a qualified independent Architectural Hardware Consultant to perform inspections and to prepare inspection reports.
  - 1. Independent Architectural Hardware Consultant will inspect door hardware and state in each report whether installed work complies with or deviates from requirements, including whether door hardware is properly installed and adjusted.

### 3.5 ADJUSTING

- A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.
  - 1. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.
  - 2. Spring Hinges: Adjust to achieve positive latching when door is allowed to close freely from an open position of 70 degrees and so that closing time complies with accessibility requirements of authorities having jurisdiction.
  - 3. Electric Strikes: Adjust horizontal and vertical alignment of keeper to properly engage lock bolt.
- B. Occupancy Adjustment: Approximately six months after date of Substantial Completion, Installer's Architectural Hardware Consultant shall examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors, door hardware, and electrified door hardware.

### 3.6 CLEANING AND PROTECTION

- A. Clean adjacent surfaces soiled by door hardware installation.
- B. Clean operating items as necessary to restore proper function and finish.
- C. Provide final protection and maintain conditions that ensure that door hardware is without damage or deterioration at time of Substantial Completion.

### 3.7 MAINTENANCE SERVICE

- A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.
- B. Maintenance Service: Beginning at Substantial Completion, maintenance service shall include six months' full maintenance by skilled employees of door hardware Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door and door hardware operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

### 3.8 DEMONSTRATION

- A. Engage Installer to train Owner's maintenance personnel to adjust, operate, and maintain door hardware.

### 3.9 DOOR HARDWARE SCHEDULE

- A. Basis-of-Design Product for each Door Hardware Item and finish is provided below or comparable product by one of the manufacturer's listed in the applicable specification section above:
- B. Or Equal Products not accepted for Mortise or Cylindrical Locksets, Exit Devices associated with Security System, Handles and Trim. Client Standard models are listed where applicable.
- C. All door hardware to be coordinated with the access control system manufacturer.
- D. HW 1 (Locked Door with Exit Device)

3	Hinges	BB1199, 4-1/2 x 4-1/2	US32D	Hager
1	Exit Device	ED5200S	US32D	Corbin Russwin
1	Cylinder	ML20606 NAC Series	US26D	Corbin Russwin
1	Closer	281 Series with heavy duty arm	US26D	Sargent
1	Overhead Stop and Holder:	1ADJ-026	US26D	Rixson
1	Kick Plate	K1050, stainless, 8" high 4BE	US32D	Rockwood

	1	Door Bottom	314CN		Pemko
	1	Threshold	2005AT		Pemko
	1	Gasketing	290AV (coordinate head w/closer)		Pemko
E.	HW 2 (Locked Double Door with Exit Device)				
	6	Hinges	BB1199, 4-1/2 x 4-1/2	US32D	Hager
	1	Exit Device	ED5200S	US32D	Corbin Russwin
	1	Flush Bolts (inactive leaf)			
	1	Cylinder	ML20606 NAC Series	US26D	Corbin Russwin
	2	Closer	281 Series with heavy duty arm	US26D	Sargent
	2	Overhead Stop and Holder:	1ADJ-026	US26D	Rixson
	2	Kick Plate	K1050, stainless, 8" high 4BE	US32D	Rockwood
	2	Door Bottom	314CN		Pemko
	1	Threshold	2005AT		Pemko
	1	Gasketing	290AV (coordinate head w/closer)		Pemko
F.	HW 3 (Privacy Toilet Room)				
	3	Hinges	BB1199, 4-1/2 x 4-1/2	US32D	Hager
	1	Lockset	ML2020 function - Bathroom	US32D	Corbin Russwin
	1	Closer	281 Series with heavy duty arm	US26D	Sargent
	1	Overhead Stop and Holder:	1ADJ-026	US26D	Rixson
	1	Kick Plate	K1050, stainless, 8" high 4BE	US32D	Rockwood
G.	HW 4 (Office/Control Room)				
	3	Hinges	BB1199, 4-1/2 x 4-1/2	US32D	Hager
	1	Lockset	ML2003 function – classroom	US32D	Corbin Russwin
	1	Closer	281 Series with heavy duty arm	US26D	Sargent
	2	Overhead Stop and Holder:	1ADJ-026	US26D	Rixson
	1	Kick Plate	K1050, stainless, 8" high 4BE	US32D	Rockwood
H.	HW 5 (Janitor/Storeroom)				
	3	Hinges	BB1199, 4-1/2 x 4-1/2	US32D	Hager
	1	Lockset	ML2049 function – Storeroom	US32D	Corbin Russwin
	1	Closer	281 Series with heavy duty arm	US26D	Sargent
	3	Overhead Stop and Holder:	1ADJ-026	US26D	Rixson

1	Kick Plate	K1050, stainless, 8" high 4BE	US32D	Rockwood
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END OF SECTION 087100

## SECTION 088000 - GLAZING

### 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. Glass for windows and doors.
  - 2. Glazing sealants and accessories.
- B. Related Requirements:
  - 1. Section 081113 "Hollow Metal Doors and Frames."
  - 2. Section 085113 "Aluminum Windows"

#### 1.3 DEFINITIONS

- A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.
- B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C1036.
- C. IBC: International Building Code.
- D. Interspace: Space between lites of an insulating-glass unit.

#### 1.4 COORDINATION

- A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

#### 1.5 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
  - 1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
  - 2. Review temporary protection requirements for glazing during and after installation.

## 1.6 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Glass Samples: For each type of the following products; 12 inches square.
  - 1. Tinted glass.
- C. Glazing Accessory Samples: For sealants and colored spacers, in 12-inch lengths. Install sealant Samples between two strips of material representative in color of the adjoining framing system.
- D. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

## 1.7 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer manufacturers of insulating-glass units with sputter-coated, low-E coatings glass testing agency and sealant testing agency.
- B. Product Certificates: For glass.
- C. Product Test Reports: For tinted glass insulating glass and glazing sealants, for tests performed by a qualified testing agency.
  - 1. For glazing sealants, provide test reports based on testing current sealant formulations within previous 36-month period.
- D. Preconstruction adhesion and compatibility test report.
- E. Sample Warranties: For special warranties.

## 1.8 QUALITY ASSURANCE

- A. Manufacturer Qualifications for Insulating-Glass Units with Sputter-Coated, Low-E Coatings: A qualified insulating-glass manufacturer who is approved and certified by coated-glass manufacturer.
- B. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.
- C. Glass Testing Agency Qualifications: A qualified independent testing agency accredited according to the NFRC CAP 1 Certification Agency Program.
- D. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C1021 to conduct the testing indicated.



## 1.9 PRECONSTRUCTION TESTING

- A. Preconstruction Adhesion and Compatibility Testing: Test each glass product, tape sealant, gasket, glazing accessory, and glass-framing member for adhesion to and compatibility with elastomeric glazing sealants.
  - 1. Testing is not required if data are submitted based on previous testing of current sealant products and glazing materials matching those submitted.
  - 2. Use ASTM C1087 to determine whether priming and other specific joint-preparation techniques are required to obtain rapid, optimum adhesion of glazing sealants to glass, tape sealants, gaskets, and glazing channel substrates.
  - 3. Test no fewer than eight Samples of each type of material, including joint substrates, shims, sealant backings, secondary seals, and miscellaneous materials.
  - 4. Schedule enough time for testing and analyzing results to prevent delaying the Work.
  - 5. For materials failing tests, submit sealant manufacturer's written instructions for corrective measures including the use of specially formulated primers.

## 1.10 DELIVERY, STORAGE, AND HANDLING

- A. Protect glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.
- B. Comply with insulating-glass manufacturer's written instructions for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

## 1.11 FIELD CONDITIONS

- A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.
  - 1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or are below 40 deg F.

## 1.12 WARRANTY

- A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.
  - 1. Warranty Period: 10 years from date of Substantial Completion.
- B. Manufacturer's Special Warranty for Laminated Glass: Manufacturer agrees to replace laminated-glass units that deteriorate within specified warranty period. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass

breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.

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

- C. Manufacturer's Special Warranty for Insulating Glass: Manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.

1. Warranty Period: 10 years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Guardian Glass; SunGuard.
  2. Oldcastle Building Envelope.
  3. Viracon, Inc.
- B. Source Limitations for Glass: Obtain from single source from single manufacturer for each glass type.
1. Obtain tinted glass from single source from single manufacturer.
- C. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer for each product and installation method.

### 2.2 PERFORMANCE REQUIREMENTS

- A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.
- B. Structural Performance: Glazing shall withstand the following design loads within limits and under conditions indicated determined according to the IBC and ASTM E1300.

1. Design Wind Pressures:
    - a. As indicated on Structural Drawings.
  2. Design Snow Loads: As indicated on Structural Drawings.
  3. Differential Shading: Design glass to resist thermal stresses induced by differential shading within individual glass lites.
- C. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.
- D. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:
1. For monolithic-glass lites, properties are based on units with lites 6 mm thick.
  2. For laminated-glass lites, properties are based on products of construction indicated.
  3. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.
  4. U-Factors: Center-of-glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as Btu/sq. ft. x h x deg F.
  5. Solar Heat-Gain Coefficient and Visible Transmittance: Center-of-glazing values, according to NFRC 200 and based on LBL's WINDOW 5.2 computer program.
  6. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

## 2.3 GLASS PRODUCTS, GENERAL

- A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.
1. GANA Publications: "Laminated Glazing Reference Manual" and "Glazing Manual."
  2. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."
- B. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction or manufacturer. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
- C. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.
- D. Thickness: Where glass thickness is indicated, it is a minimum.
1. Minimum Glass Thickness for Exterior Lites: 6 mm.
  2. Thickness of Tinted Glass: Provide same thickness for each tint color indicated throughout Project.

- E. Strength: Where annealed float glass is indicated, provide annealed float glass, heat-strengthened float glass, or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where heat-strengthened float glass is indicated, provide heat-strengthened float glass or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where fully tempered float glass is indicated, provide fully tempered float glass.

## 2.4 GLASS PRODUCTS

- A. Clear Annealed Float Glass: ASTM C1036, Type I, Class 1 (clear), Quality-Q3.
- B. Tinted Annealed Float Glass: ASTM C1036, Type I, Class 2 (tinted), Quality-Q3.
- C. Fully Tempered Float Glass: ASTM C1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.
  - 1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.
- D. Heat-Strengthened Float Glass: ASTM C1048, Kind HS (heat strengthened), Type I, Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.
  - 1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.

## 2.5 LAMINATED GLASS

- A. Laminated Glass: ASTM C1172. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.
  - 1. Construction: Laminate glass with polyvinyl butyral interlayer to comply with interlayer manufacturer's written instructions.
  - 2. Interlayer Thickness: Provide thickness not less than that indicated and as needed to comply with requirements.
  - 3. Interlayer Color: Clear unless otherwise indicated.
- B. Windborne-Debris-Impact-Resistant Laminated Glass: Comply with requirements specified above for laminated glass except laminate glass with the following to comply with interlayer manufacturer's written instructions:
  - 1. Polyvinyl butyral interlayer.

## 2.6 INSULATING GLASS

- A. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E2190.

1. Sealing System: Dual seal, with manufacturer's standard primary and secondary sealants.
2. Perimeter Spacer: Manufacturer's standard spacer material and construction.
  - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - 1) Technoform.
    - 2) Thermix; a brand of Ensinger USA.
3. Desiccant: Molecular sieve or silica gel, or a blend of both.

## 2.7 GLAZING SEALANTS

### A. General:

1. Compatibility: Compatible with one another and with other materials they contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
3. Colors of Exposed Glazing Sealants: As selected by Engineer from manufacturer's full range.

### B. Glazing Sealant:

1. Neutral-curing silicone glazing sealant complying with ASTM C920, Type S, Grade NS, Class 100/50, Use NT.
  - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - 1) Pecora Corporation.
    - 2) Sika Corporation.
    - 3) The Dow Chemical Company.
    - 4) Tremco Incorporated.

## 2.8 GLAZING TAPES

- A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C1281 and AAMA 800 for products indicated below:

1. AAMA 804.3 tape, where indicated.
  2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
  3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.
- B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:
1. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.
  2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

## 2.9 MISCELLANEOUS GLAZING MATERIALS

- A. General: Provide products of material, size, and shape complying with referenced glazing standard, with requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.
- B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
- C. Setting Blocks:
1. EPDM with a Shore A durometer hardness of 85, plus or minus 5.
  2. Type recommended by sealant or glass manufacturer.
- D. Spacers:
1. Neoprene blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
  2. Type recommended by sealant or glass manufacturer.
- E. Edge Blocks:
1. EPDM with a Shore A durometer hardness per manufacturer's written instructions.
  2. Type recommended by sealant or glass manufacturer..
- F. Cylindrical Glazing Sealant Backing: ASTM C1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

## 2.10 FABRICATION OF GLAZING UNITS

- A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.

1. Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.
  - a. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:
  1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
  2. Presence and functioning of weep systems.
  3. Minimum required face and edge clearances.
  4. Effective sealing between joints of glass-framing members.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 PREPARATION

- A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.
- B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that leave visible marks in the completed Work.

#### 3.3 GLAZING, GENERAL

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass includes glass with edge damage or other imperfections that, when installed, could weaken glass, impair performance, or impair appearance.
- C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
- D. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

- F. Provide spacers for glass lites where length plus width is larger than 50 inches.
  - 1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
  - 2. Provide 1/8-inch minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.
- G. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.
- H. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.
- I. Set glass lites with proper orientation so that coatings face exterior or interior as specified.
- J. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.
- K. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

### 3.4 TAPE GLAZING

- A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.
- B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.
- C. Cover vertical framing joints by applying tapes to heads and sills first, then to jambs. Cover horizontal framing joints by applying tapes to jambs, then to heads and sills.
- D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
- E. Do not remove release paper from tape until right before each glazing unit is installed.
- F. Apply heel bead of elastomeric sealant.
- G. Center glass lites in openings on setting blocks, and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.
- H. Apply cap bead of elastomeric sealant over exposed edge of tape.



### 3.5 GASKET GLAZING (DRY)

- A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
- B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.
- C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- E. Install gaskets so they protrude past face of glazing stops.

### 3.6 SEALANT GLAZING (WET)

- A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.
- B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.
- C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

### 3.7 CLEANING AND PROTECTION

- A. Immediately after installation remove nonpermanent labels and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains.
  - 1. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer. Remove and replace glass that cannot be cleaned without damage to coatings.
- C. Remove and replace glass that is damaged during construction period.

- D. Wash glass on both exposed surfaces not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

### 3.8 MONOLITHIC GLASS SCHEDULE

- A. Glass Type: Clear fully tempered float glass.

- 1. Minimum Thickness: 6 mm.
- 2. Safety glazing required.

### 3.9 INSULATING-LAMINATED-GLASS SCHEDULE

- A. Glass Type : Low-E-coated, clear insulating laminated glass.

- 1. Overall Unit Thickness: 1-3/16 inch.
- 2. Minimum Thickness of Outdoor Lite: 6 mm.
- 3. Outdoor Lite: Heat-strengthened float glass.
- 4. Interspace Content: Air.
- 5. Indoor Lite: Clear laminated glass with two plies of heat-strengthened float glass.
  - a. Minimum Thickness of Each Glass Ply: 6 mm.
  - b. Interlayer Thickness: 0.090 inch.
- 6. Low-E Coating: Pyrolytic or sputtered on second or third surface.
- 7. Winter Nighttime U-Factor: 0.28 maximum.
- 8. Summer Daytime U-Factor: 0.26 maximum.
- 9. Visible Light Transmittance: 62 percent minimum.
- 10. Solar Heat Gain Coefficient: 0.27 maximum.
- 11. Safety glazing required.

END OF SECTION 088000

## SECTION 089119 - FIXED 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.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Fixed, extruded-aluminum louvers.

#### 1.3 DEFINITIONS

- A. Louver Terminology: Definitions of terms for metal louvers contained in AMCA 501 apply to this Section unless otherwise defined in this Section or in referenced standards.
- B. Wind-Driven-Rain-Resistant Louver: Louver that provides specified wind-driven rain performance, as determined by testing according to AMCA 500-L.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. For louvers specified to bear AMCA seal, include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals.
- B. Shop Drawings: For louvers and accessories. Include plans, elevations, sections, details, and attachments to other work. Show frame profiles and blade profiles, angles, and spacing.
  - 1. Show weep paths, gaskets, flashing, sealant, and other means of preventing water intrusion.
  - 2. Show mullion profiles and locations.
- C. Samples: For each type of metal finish required.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: Based on evaluation of comprehensive tests performed according to AMCA 500-L by a qualified testing agency or by manufacturer and witnessed by a qualified testing agency, for each type of louver and showing compliance with performance requirements specified.

- B. Windborne-debris-impact-resistance test reports.
- C. Regulatory Approvals: Provide copy of current, valid statewide product approval for product, material or system as shown on the drawings and as specified in this Section, in accordance with Rule 9N-3. Product approval shall be for the specific manufacturer, product type, model or style, and the State Approval Number.

## 1.6 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
  - 1. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum".
  - 2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel".
  - 3. AWS D1.6/D1.6M, "Structural Welding Code - Stainless Steel".

## 1.7 REGULATORY REQUIREMENTS

- A. Provide products, materials and assemblies, including anchorage, proposed for the work of this Section that comply with project specific calculated design pressures and the Florida Building Code, including wind-borne debris region requirements. Provide products designed by the Manufacturer and installed by the Contractor to meet these requirements.
  - 1. Provide products that conform to the project design pressures in the components and cladding table on the structural drawings. Where a conflict occurs between the requirements of this Specification and the Florida Building Code, the more stringent requirement shall apply.
- B. Provide documentation that the Florida Building Code compliance for the products, materials and assemblies, including anchorage specified in this Section have been incorporated into the Work. Demonstrate code compliance with the Florida Building Code, using one of the methods outlined in Chapter 9N-3 of the Florida Administrative Code, Department of Community Affairs, Florida Building Commission, Product Approval documentation.

## 1.8 FIELD CONDITIONS

- A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Source Limitations: Obtain louvers from single source from a single manufacturer where indicated to be of same type, design, or factory-applied color finish.

## 2.2 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Louvers shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of louver components, noise or metal fatigue caused by louver-blade rattle or flutter, or permanent damage to fasteners and anchors. Wind pressures shall be considered to act normal to the face of the building.
  - 1. Wind Loads: Determine loads based on pressures as indicated on Structural Drawings.
- B. Louver Performance Ratings: Provide louvers complying with requirements specified, as demonstrated by testing manufacturer's stock units identical to those provided, except for length and width according to AMCA 500-L.
- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
  - 1. Temperature Change (Range): 120 deg F, ambient; 180 deg F (100 deg C), material surfaces.
- D. SMACNA Standard: Comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" for fabrication, construction details, and installation procedures.

## 2.3 FIXED, EXTRUDED-ALUMINUM LOUVERS

- A. Vertical, Wind-Driven-Rain-Resistant Louver:
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Airolite Company, LLC (The).
    - b. Greenheck Fan Corporation.
    - c. Ruskin Company.
  - 2. Louver Depth: 5 inches.
  - 3. Frame and Blade Nominal Thickness: Not less than 0.060 inch for blades and 0.080 inch for frames.
  - 4. Louver Performance Ratings:
    - a. Free Area: Not less than 8.0 sq. ft. for 48-inch- wide by 48-inch- high louver.
    - b. Air Performance: Not more than 0.10-inch wg static pressure drop at 700-fpm free-area exhaust velocity.
    - c. Wind-Driven Rain Performance: Not less than 99 percent effectiveness when subjected to a rainfall rate of 8 inches per hour and a wind speed of 50 mph at a core-area intake velocity of 600 fpm.
  - 5. AMCA Seal: Mark units with AMCA Certified Ratings Seal.

## 2.4 LOUVER SCREENS

- A. General: Provide screen at each exterior louver.
  - 1. Screen Location for Fixed Louvers: Interior face.
  - 2. Screening Type: Bird screening and Insect screening.
- B. Secure screen frames to louver frames with stainless-steel machine screws, spaced a maximum of 6 inches from each corner and at 12 inches o.c.
- C. Louver Screen Frames: Fabricate with mitered corners to louver sizes indicated.
  - 1. Metal: Same type and form of metal as indicated for louver to which screens are attached. Reinforce extruded-aluminum screen frames at corners with clips.
  - 2. Finish: Mill finish unless otherwise indicated.
  - 3. Type: Rewirable frames with a driven spline or insert.
- D. Louver Screening for Aluminum Louvers:
  - 1. Bird Screening: Flattened, expanded aluminum, 3/4 by 0.050 inch thick.
  - 2. Insect Screening: Aluminum, 18-by-16 mesh, 0.012-inch wire.

## 2.5 MATERIALS

- A. Aluminum Extrusions: ASTM B221, Alloy 6063-T5, T-52, or T6.
- B. Aluminum Sheet: ASTM B209, Alloy 3003 or 5005 with temper as required for forming, or as otherwise recommended by metal producer for required finish.
- C. Fasteners: Use types and sizes to suit unit installation conditions.
  - 1. Use hex-head or Phillips pan-head screws for exposed fasteners unless otherwise indicated.
  - 2. For fastening aluminum, use aluminum or 300 series stainless-steel fasteners.
  - 3. For color-finished louvers, use fasteners with heads that match color of louvers.
- D. Postinstalled Fasteners for Concrete and Masonry: Torque-controlled expansion anchors, made from stainless-steel components, with capability to sustain, without failure, a load equal to 4 times the loads imposed, for concrete, or 6 times the load imposed for masonry, as determined by testing according to ASTM E488/E488M, conducted by a qualified independent testing agency.
- E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

## 2.6 FABRICATION

- A. Factory assemble louvers to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

- B. Maintain equal louver blade spacing, including separation between blades and frames at head and sill, to produce uniform appearance.
- C. Fabricate frames, including integral sills, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.
  - 1. Frame Type: Channel unless otherwise indicated.
- D. Include supports, anchorages, and accessories required for complete assembly.
- E. Provide extended sills for recessed louvers.
- F. Join frame members to each other and to fixed louver blades with fillet welds, threaded fasteners, or both, as standard with louver manufacturer unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.

## 2.7 ALUMINUM FINISHES

- A. Finish louvers after assembly.
- B. High-Performance Organic Finish: Two-coat fluoropolymer finish complying with AAMA 2604 and containing not less than 50 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
  - 1. Color and Gloss: As selected by Engineer from manufacturer's full range.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

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

### 3.2 PREPARATION

- A. Coordinate setting drawings, diagrams, templates, instructions, and directions for installation of anchorages that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to Project site.

### 3.3 INSTALLATION

- A. Locate and place louvers level, plumb, and at indicated alignment with adjacent work.

- B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.
- C. Form closely fitted joints with exposed connections accurately located and secured.
- D. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.
- E. Protect unpainted galvanized and nonferrous-metal surfaces that are in contact with concrete, masonry, or dissimilar metals from corrosion and galvanic action by applying a heavy coating of bituminous paint or by separating surfaces with waterproof gaskets or nonmetallic flashing.
- F. Install concealed gaskets, flashings, joint fillers, and insulation as louver installation progresses, where weathertight louver joints are required. Comply with Section 079200 "Joint Sealants" for sealants applied during louver installation.

### 3.4 ADJUSTING AND CLEANING

- A. Clean exposed louver surfaces that are not protected by temporary covering, to remove fingerprints and soil during construction period. Do not let soil accumulate during construction period.
- B. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Thoroughly rinse surfaces and dry.
- C. Restore louvers damaged during installation and construction so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by Engineer, remove damaged units and replace with new units.
  - 1. Touch up minor abrasions in finishes with air-dried coating that matches color and gloss of, and is compatible with, factory-applied finish coating.

END OF SECTION 089119



## SECTION 092216 - NON-STRUCTURAL METAL FRAMING

### 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. Non-load-bearing steel framing systems for interior partitions.
- B. Related Requirements:
  - 1. Section 054000 "Cold-Formed Metal Framing" for exterior and interior load-bearing and exterior non-load-bearing wall studs; floor joists; and roof rafters and ceiling joists.

#### 1.3 ACTION SUBMITTALS

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

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of code-compliance certification for studs and tracks.
- B. Evaluation Reports: For embossed, high-strength steel studs and tracks, post-installed anchors and power-actuated fasteners, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.

#### 1.5 QUALITY ASSURANCE

- A. Code-Compliance Certification of Studs and Tracks: Provide documentation that framing members are certified according to the product-certification program of the Certified Steel Stud Association the Steel Framing Industry Association or the Steel Stud Manufacturers Association.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated, according to ASTM E119 by an independent testing agency.
- B. Horizontal Deflection: For non-composite wall assemblies, limited to 1/120 of the wall height based on horizontal loading of 5 lbf/sq. ft..

### 2.2 FRAMING SYSTEMS

- A. Framing Members, General: Comply with ASTM C754 for conditions indicated.
  - 1. Steel Sheet Components: Comply with ASTM C645 requirements for metal unless otherwise indicated.
  - 2. Protective Coating: ASTM A653/A653M, G40, hot-dip galvanized unless otherwise indicated.
- B. Studs and Tracks: ASTM C645. Use either conventional steel studs and tracks or embossed, high-strength steel studs and tracks.
  - 1. Steel Studs and Tracks:
    - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      - 1) ClarkDietrich.
      - 2) MarinoWARE.
      - 3) MRI Steel Framing, LLC.
    - b. Minimum Base-Steel Thickness: As required by performance requirements for horizontal deflection.
    - c. Depth: 3-5/8 inches.
- C. Slip-Type Head Joints: Where indicated, provide one of the following:
  - 1. Clip System: Clips designed for use in head-of-wall deflection conditions that provide a positive attachment of studs to tracks while allowing 2-1/2-inch minimum vertical movement.
    - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      - 1) CEMCO; California Expanded Metal Products Co.
      - 2) ClarkDietrich.
      - 3) MarinoWARE.

2. Single Long-Leg Track System: ASTM C645 top track with 2-inch- deep flanges in thickness not less than indicated for studs, installed with studs friction fit into top track and with continuous bridging located within 12 inches of the top of studs to provide lateral bracing.
3. Double-Track System: ASTM C645 top outer tracks, inside track with 2-inch- deep flanges in thickness not less than indicated for studs and fastened to studs, and outer track sized to friction-fit over inner track.
4. Deflection Track: Steel sheet top track manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.
  - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - 1) CEMCO; California Expanded Metal Products Co.
    - 2) ClarkDietrich.
    - 3) MarinoWARE.

D. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. ClarkDietrich.
  - b. MarinoWARE.
  - c. MRI Steel Framing, LLC.
2. Minimum Base-Steel Thickness: 0.0179 inch.

E. Cold-Rolled Channel Bridging: Steel, 0.0538-inch minimum base-steel thickness, with minimum 1/2-inch- wide flanges.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. ClarkDietrich.
  - b. MarinoWARE.
  - c. MRI Steel Framing, LLC.
2. Depth: 1-1/2 inches.
3. Clip Angle: Not less than 1-1/2 by 1-1/2 inches, 0.068-inch- thick, galvanized steel.

## 2.3 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards.

1. Fasteners for Steel Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.
- B. Isolation Strip at Exterior Walls: Provide one of the following:
  1. Asphalt-Saturated Organic Felt: ASTM D226/D226M, Type I (No. 15 asphalt felt), nonperforated.
  2. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8-inch thick, in width to suit steel stud size.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 INSTALLATION, GENERAL

- A. Installation Standard: ASTM C754.
  1. Gypsum Board Assemblies: Also comply with requirements in ASTM C840 that apply to framing installation.
- B. Install framing and accessories plumb, square, and true to line, with connections securely fastened.
- C. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.
- D. Install bracing at terminations in assemblies.
- E. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

#### 3.3 INSTALLING FRAMED ASSEMBLIES

- A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
  1. Single-Layer Application: 16 inches o.c. unless otherwise indicated.
  2. Tile Backing Panels: 16 inches o.c. unless otherwise indicated.
- B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.

- C. Install studs so flanges within framing system point in same direction.
- D. Install tracks at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts that penetrate partitions above ceiling.
  - 1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
  - 2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install track section (for cripple studs) at head and secure to jamb studs.
    - a. Install two studs at each jamb unless otherwise indicated.
    - b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch clearance from jamb stud to allow for installation of control joint in finished assembly.
    - c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.
  - 3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
- E. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.

END OF SECTION 092216

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## SECTION 092900 - GYPSUM BOARD

### 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. Interior gypsum board.

- B. Related Requirements:

- 1. Section 092216 "Non-Structural Metal Framing" for non-structural steel framing and suspension systems that support gypsum board panels.
  - 2. Section 093013 "Ceramic Tiling" for cementitious backer units installed as substrates for ceramic tile.

#### 1.3 ACTION SUBMITTALS

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

- B. Samples: For the following products:

- 1. Trim Accessories: Full-size Sample in 12-inch- long length for each trim accessory indicated.

- C. Samples for Initial Selection: For each type of trim accessory indicated.

#### 1.4 DELIVERY, STORAGE AND HANDLING

- A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

#### 1.5 FIELD CONDITIONS

- A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written instructions, whichever are more stringent.

- B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.

- C. Do not install panels that are wet, moisture damaged, and mold damaged.
  - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
  - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.
- B. 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.

### 2.2 GYPSUM BOARD, GENERAL

- A. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

### 2.3 INTERIOR GYPSUM BOARD

- A. Gypsum Wallboard: ASTM C 1396/C 1396M.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. CertainTeed Gypsum.
    - b. Georgia-Pacific Gypsum LLC.
    - c. National Gypsum Company.
    - d. USG Corporation.
  - 2. Thickness: 1/2 inch.
  - 3. Long Edges: Tapered.
- B. Gypsum Board, Type X: ASTM C 1396/C 1396M.
  - 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. Georgia-Pacific Gypsum LLC.
  - b. National Gypsum Company.
  - c. USG Corporation.
2. Thickness: 5/8 inch
  3. Long Edges: Tapered.

## 2.4 TRIM ACCESSORIES

- A. Interior Trim: ASTM C 1047.
  1. Material: Galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized-steel sheet.
  2. Shapes:
    - a. Cornerbead.
    - b. LC-Bead: J-shaped; exposed long flange receives joint compound.
    - c. L-Bead: L-shaped; exposed long flange receives joint compound.
    - d. U-Bead: J-shaped; exposed short flange does not receive joint compound.

## 2.5 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C 475/C 475M.
- B. Joint Tape:
  1. Interior Gypsum Board: Paper.
- C. Joint Compound for Interior Gypsum Board: For each coat, use formulation that is compatible with other compounds applied on previous or for successive coats.
  1. Prefilling: At open joints and damaged surface areas, use setting-type taping compound.
  2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use drying-type, all-purpose compound.
    - a. Use setting-type compound for installing paper-faced metal trim accessories.
  3. Fill Coat: For second coat, use drying-type, all-purpose compound.
  4. Finish Coat: For third coat, use setting-type, sandable topping compound.

## 2.6 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.
- B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.

- C. 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.
  - 2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.
- D. Sound-Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
- E. Thermal Insulation: As specified in Section 072100 "Thermal Insulation" and 072119 "Foamed in Place Insulation".

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine areas and substrates including welded hollow-metal frames and support framing, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 APPLYING AND FINISHING PANELS, GENERAL

- A. Comply with ASTM C 840.
- B. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch 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. 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. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments. Provide 1/4- to 1/2-inch- wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- G. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.
- H. Install sound attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.

### 3.3 APPLYING INTERIOR GYPSUM BOARD

- A. Install interior gypsum board in the following locations:
  1. Wallboard Type: Vertical surfaces unless otherwise indicated.
  2. Type X: Where required for fire-resistance-rated assembly.
- B. Single-Layer Application:
  1. On partitions/walls, apply gypsum panels horizontally (perpendicular to framing) unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
    - a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
  2. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

### 3.4 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 Engineer for visual effect.
- C. Interior Trim: Install in the following locations:
  1. Cornerbead: Use at outside corners unless otherwise indicated.
  2. LC-Bead: Use at exposed panel edges.
  3. L-Bead: Use where indicated.
  4. U-Bead: Use at exposed panel edges where indicated.

### 3.5 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 and damaged surface areas.
- C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.
- D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:
  - 1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
  - 2. Level 2: Panels that are substrate for tile.
  - 3. Level 3: Where indicated on Drawings.
  - 4. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated.
  - 5. Level 5: Where indicated on Drawings.

### 3.6 PROTECTION

- A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.
- B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- C. Remove and replace panels that are wet, moisture damaged, and mold damaged.
  - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
  - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 092900

## SECTION 093013 - CERAMIC TILING

### 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. Ceramic mosaic tile.
  - 2. Glazed wall tile.
  - 3. Stone thresholds.
  - 4. Tile backing panels.
  - 5. Crack isolation membrane.

- B. Related Requirements:

- 1. Section 079200 "Joint Sealants" for sealing of expansion, contraction, control, and isolation joints in tile surfaces.

#### 1.3 DEFINITIONS

- A. General: Definitions in the ANSI A108 series of tile installation standards and in ANSI A137.1 apply to Work of this Section unless otherwise specified.
- B. ANSI A108 Series: ANSI A108.01, ANSI A108.02, ANSI A108.1A, ANSI A108.1B, ANSI A108.1C, ANSI A108.4, ANSI A108.5, ANSI A108.6, ANSI A108.8, ANSI A108.9, ANSI A108.10, ANSI A108.11, ANSI A108.12, ANSI A108.13, ANSI A108.14, ANSI A108.15, ANSI A108.16, and ANSI A108.17, which are contained in its "Specifications for Installation of Ceramic Tile."
- C. Face Size: Actual tile size, excluding spacer lugs.
- D. Module Size: Actual tile size plus joint width indicated.

#### 1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
  - 1. Review requirements in ANSI A108.01 for substrates and for preparation by other trades.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Show locations of each type of tile and tile pattern. Show widths, details, and locations of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces.
- C. Samples for Initial Selection: For tile, grout, and accessories involving color selection.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Master Grade Certificates: For each shipment, type, and composition of tile, signed by tile manufacturer and Installer.
- C. Product Certificates: For each type of product.
- D. Product Test Reports: For tile-setting and -grouting products.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications:
  - 1. Installer is a Five-Star member of the National Tile Contractors Association or a Trowel of Excellence member of the Tile Contractors' Association of America.
  - 2. Installer's supervisor for Project holds the International Masonry Institute's Foreman Certification.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirements in ANSI A137.1 for labeling tile packages.
- B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.
- C. Store aggregates where grading and other required characteristics can be maintained, and contamination can be avoided.
- D. Store liquid materials in unopened containers and protected from freezing.

1.9 FIELD CONDITIONS

- A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Source Limitations for Tile: Obtain tile of each type and color or finish from single source or producer.
  - 1. Obtain tile of each type and color or finish from same production run and of consistent quality in appearance and physical properties for each contiguous area.
- B. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from single manufacturer and each aggregate from single source or producer.
  - 1. Obtain setting and grouting materials, except for unmodified Portland cement and aggregate, from single manufacturer.
  - 2. Obtain waterproof membrane and crack isolation membrane, except for sheet products, from manufacturer of setting and grouting materials.
- C. Source Limitations for Other Products: Obtain each of the following products specified in this Section from a single manufacturer:
  - 1. Stone thresholds.
  - 2. Crack isolation membrane.
  - 3. Metal edge strips.

### 2.2 PRODUCTS, GENERAL

- A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.
  - 1. Provide tile complying with Standard grade requirements unless otherwise indicated.
- B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCNA installation methods specified in tile installation schedules, and other requirements specified.
- C. Factory Blending: For tile exhibiting color variations within ranges, blend tile in factory and package so tile units taken from one package show same range in colors as those taken from other packages and match approved Samples.

### 2.3 TILE PRODUCTS

- A. Ceramic Tile Type: Factory-mounted unglazed ceramic mosaic tile.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

- a. American Olean; a division of Dal-Tile Corporation.
  - b. Daltile.
2. Composition: Porcelain.
  3. Certification: Porcelain tile certified by the Porcelain Tile Certification Agency.
  4. Module Size: 2 by 2 inches.
  5. Thickness: 1/4 inch.
  6. Face: Plain with cushion edges.
  7. Surface: Slip resistant, with abrasive admixture.
  8. Dynamic Coefficient of Friction: Not less than 0.42.
  9. Finish: Mat, clear glaze.
  10. Tile Color and Pattern: As selected by Engineer from manufacturer's full range.
  11. Grout Color: As selected by Engineer from manufacturer's full range.
  12. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable. Provide shapes as follows, selected from manufacturer's standard shapes:
    - a. Build-up Cove Base: Cove, module size 2 rows of 2 by 2 inch with 1 row of cove base.

B. Ceramic Tile Type: Glazed wall tile.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. American Olean; a division of Dal-Tile Corporation.
  - b. Daltile.
2. Module Size: 6 by 6 inches.
3. Face Size Variation: Rectified.
4. Thickness: 5/16-inch.
5. Face: Plain with modified square edges or cushion edges.
6. Finish: Bright, clear glaze.
7. Tile Color and Pattern: .
  - a. Color A: As selected by Engineer from manufacturer's full range.
  - b. Color B: As selected by Engineer from manufacturer's full range.
8. Grout Color: As selected by Engineer from manufacturer's full range.
9. Mounting: Factory, back mounted.
10. Mounting: PregROUTED sheets of tiles are factory assembled and grouted with manufacturer's standard white silicone rubber.
11. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile. Provide shapes as follows, selected from manufacturer's standard shapes:
  - a. External Corners for Thinset Mortar Installations: Surface bullnose, same size as adjoining flat tile.
  - b. Internal Corners: Field-buttet square corners. For coved base and cap use angle pieces designed to fit with stretcher shapes.



## 2.4 THRESHOLDS

- A. General: Fabricate to sizes and profiles indicated or required to provide transition between adjacent floor finishes.
  - 1. Bevel edges at 1:2 slope, with lower edge of bevel aligned with or up to 1/16 inch above adjacent floor surface. Finish bevel to match top surface of threshold. Limit height of threshold to 1/2 inch or less above adjacent floor surface.
- B. Granite Thresholds: ASTM C615/C615M, with honed finish.
  - 1. Description: Uniform, fine-grained, gray stone without veining.

## 2.5 TILE BACKING PANELS

- A. Cementitious Backer Units: ANSI A118.9 or ASTM C1325, Type A, in maximum lengths available to minimize end-to-end butt joints.
  - 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. Georgia-Pacific Gypsum LLC.
    - b. USG Corporation.
  - 2. Thickness: 1/2 inch.

## 2.6 CRACK ISOLATION MEMBRANE

- A. General: Manufacturer's standard product that complies with ANSI A118.12 for high performance and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.
- B. Fabric-Reinforced, Fluid-Applied Membrane: System consisting of liquid-latex rubber or elastomeric polymer and fabric reinforcement.
  - 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. Bonsal American, an Oldcastle company.
    - b. Bostik, Inc.
    - c. LATICRETE SUPERCAP, LLC.
    - d. MAPEI Corporation.
- C. Fluid-Applied Membrane: Liquid-latex rubber or elastomeric polymer.
  - 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. Bostik, Inc.
- b. LATICRETE SUPERCAP, LLC.
- c. MAPEI Corporation.

## 2.7 SETTING MATERIALS

### A. Standard Dry-Set Mortar (Thinset): ANSI A118.1.

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. Bonsal American, an Oldcastle company.
  - b. Bostik, Inc.
  - c. LATICRETE SUPERCAP, LLC.
  - d. MAPEI Corporation.
2. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to the other requirements in ANSI A118.1.

## 2.8 GROUT MATERIALS

### A. Sand-Portland Cement Grout: ANSI A108.10, consisting of white or gray cement and white or colored aggregate as required to produce color indicated.

### B. Standard Cement Grout: ANSI A118.6.

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. Bonsal American, an Oldcastle company.
  - b. Bostik, Inc.
  - c. LATICRETE SUPERCAP, LLC.
  - d. MAPEI Corporation.

## 2.9 MISCELLANEOUS MATERIALS

- A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.
- B. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.
- C. Floor Sealer: Manufacturer's standard product for sealing grout joints and that does not change color or appearance of grout.

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. Bonsal American, an Oldcastle company.
  - b. Custom Building Products.
  - c. Southern Grouts & Mortars, Inc.

## 2.10 MIXING MORTARS AND GROUT

- A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.
- B. Add materials, water, and additives in accurate proportions.
- C. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
  1. Verify that substrates for setting tile are firm; dry; clean; free of coatings that are incompatible with tile-setting materials, including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.
  2. Verify that concrete substrates for tile floors installed with thinset mortar comply with surface finish requirements in ANSI A108.01 for installations indicated.
    - a. Verify that surfaces that received a steel trowel finish have been mechanically scarified.
    - b. Verify that protrusions, bumps, and ridges have been removed by sanding or grinding.
  3. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed.
  4. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Engineer.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with thinset mortar with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.
- B. Where indicated, prepare substrates to receive waterproof membrane by applying a reinforced mortar bed that complies with ANSI A108.1A and is sloped 1/4 inch per foot toward drains.
- C. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

### 3.3 INSTALLATION OF CERAMIC TILE

- A. Comply with TCNA's "Handbook for Ceramic, Glass, and Stone Tile Installation" for TCNA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 series "Specifications for Installation of Ceramic Tile" that are referenced in TCNA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.
  - 1. For the following installations, follow procedures in the ANSI A108 series of tile installation standards for providing 95 percent mortar coverage:
    - a. Tile floors in wet areas.
- B. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.
- C. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.
- D. Provide manufacturer's standard trim shapes where necessary to eliminate exposed tile edges.
- E. Where accent tile differs in thickness from field tile, vary setting-bed thickness so that tiles are flush.
- F. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.
  - 1. For tile mounted in sheets, make joints between tile sheets same width as joints within tile sheets so joints between sheets are not apparent in finished work.
  - 2. Where adjoining tiles on floor, base, walls, or trim are specified or indicated to be same size, align joints.

3. Where tiles are specified or indicated to be whole integer multiples of adjoining tiles on floor, base, walls, or trim, align joints unless otherwise indicated.
- G. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:
1. Ceramic Mosaic Tile: 1/8 inch.
  2. Glazed Wall Tile: 1/8 inch.
- H. Expansion Joints: Provide expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated. Form joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.
1. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.
- I. Stone Thresholds: Install stone thresholds in same type of setting bed as adjacent floor unless otherwise indicated.
1. Do not extend crack isolation membrane under thresholds set in standard dry-set mortar. Fill joints between such thresholds and adjoining tile set on crack isolation membrane with elastomeric sealant.
- J. Floor Sealer: Apply floor sealer to cementitious grout joints in tile floors according to floor-sealer manufacturer's written instructions. As soon as floor sealer has penetrated grout joints, remove excess sealer and sealer from tile faces by wiping with soft cloth.

### 3.4 INSTALLATION OF TILE BACKING PANEL

- A. Install panels and treat joints according to ANSI A108.11 and manufacturer's written instructions for type of application indicated. Use modified dry-set mortar for bonding material unless otherwise directed in manufacturer's written instructions.

### 3.5 INSTALLATION OF CRACK ISOLATION MEMBRANE

- A. Install crack isolation membrane to comply with ANSI A108.17 and manufacturer's written instructions to produce membrane of uniform thickness that is bonded securely to substrate.
- B. Allow crack isolation membrane to cure before installing tile or setting materials over it.

### 3.6 ADJUSTING AND CLEANING

- A. Remove and replace tile that is damaged or that does not match adjoining tile. Provide new matching units, installed as specified and in a manner to eliminate evidence of replacement.
- B. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.
1. Remove grout residue from tile as soon as possible.

2. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions but no sooner than 10 days after installation. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.

### 3.7 PROTECTION

- A. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear. If recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors.
- B. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.
- C. Before final inspection, remove protective coverings and rinse neutral protective cleaner from tile surfaces.

### 3.8 INTERIOR CERAMIC TILE INSTALLATION SCHEDULE

- A. Interior Floor Installations, Concrete Subfloor:
  1. Ceramic Tile Installation: TCNA F125-Full; thinset mortar on crack isolation membrane.
    - a. Ceramic Tile Type: Mosaic Tile.
    - b. Thinset Mortar: Modified dry-set mortar.
    - c. Grout: High-performance unsanded grout.
- B. Interior Wall Installations, Masonry:
  1. Ceramic Tile Installation: TCNA W202; thinset mortar.
    - a. Ceramic Tile Type: Glazed Ceramic Tile.
    - b. Thinset Mortar: Standard dry-set mortar.
    - c. Grout: High-performance unsanded grout.
- C. Interior Wall Installations, Wood or Metal Studs or Furring:
  1. Ceramic Tile Installation: TCNA W244C or TCNA W244F; thinset mortar on cementitious backer units or fiber-cement backer board.
    - a. Ceramic Tile Type: Glazed Wall Tile.
    - b. Thinset Mortar: Standard dry-set mortar.
    - c. Grout: Sand-portland cement grout.

END OF SECTION 093013

## SECTION 095123 - ACOUSTICAL TILE CEILINGS

### 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. Acoustical tiles for interior ceilings.
  - 2. Fully concealed, direct-hung, suspension systems.
- B. Products furnished, but not installed under this Section, include anchors, clips, and other ceiling attachment devices to be cast in concrete.

#### 1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each exposed product and for each color and texture specified, 6 inches in size.
- C. Samples for Initial Selection: For components with factory-applied finishes.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
  - 1. Ceiling suspension-system members.
  - 2. Structural members to which suspension systems will be attached.
  - 3. Method of attaching hangers to building structure.
    - a. Furnish layouts for cast-in-place anchors, clips, and other ceiling attachment devices whose installation is specified in other Sections.
  - 4. Carrying channels or other supplemental support for hanger-wire attachment where conditions do not permit installation of hanger wires at required spacing.

5. Size and location of initial access modules for acoustical tile.
6. Items penetrating finished ceiling and ceiling-mounted items including the following:
  - a. Lighting fixtures.
  - b. Diffusers.
  - c. Grilles.
  - d. Perimeter moldings.
7. Show operation of hinged and sliding components adjacent to acoustical tiles.
8. Minimum Drawing Scale: 1/4 inch = 1 foot.

- B. Qualification Data: For testing agency.
- C. Product Test Reports: For each acoustical tile ceiling, for tests performed by a qualified testing agency.
- D. Evaluation Reports: For each acoustical tile ceiling suspension system and anchor and fastener type, from ICC-ES.
- E. Field quality-control reports.

#### 1.6 CLOSEOUT SUBMITTALS

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

#### 1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  1. Acoustical Ceiling Units: Full-size tiles equal to 2 percent of quantity installed.
  2. Suspension-System Components: Quantity of each concealed grid and exposed component equal to 2 percent of quantity installed.

#### 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver acoustical tiles, suspension-system components, and accessories to Project site and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.
- B. Before installing acoustical tiles, permit them to reach room temperature and a stabilized moisture content.

#### 1.9 FIELD CONDITIONS

- A. Environmental Limitations: Do not install acoustical tile ceilings until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings is complete, and



ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

#### A. Source Limitations:

1. Suspended Acoustical Tile Ceilings: Obtain each type of acoustical ceiling tile and its suspension system from single source from single manufacturer.

### 2.2 PERFORMANCE REQUIREMENTS

#### A. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: Class A according to ASTM E 1264.
2. Smoke-Developed Index: 50 or less.

#### B. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Indicate design designations from UL or from the listings of another qualified testing agency.

### 2.3 ACOUSTICAL TILES

#### A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Armstrong World Industries, Inc.
2. Or equal not permitted for this item.

#### B. Acoustical Tile Standard: Provide manufacturer's standard tiles of configuration indicated that comply with ASTM E 1264 classifications as designated by type, form, pattern, acoustical rating, and light reflectance unless otherwise indicated.

#### C. Standard ceiling tile shall be square lay-in Cortega ceiling tile.

#### D. Moisture resistant ceiling tile shall be square lay-in Ceramaguard Fine Fissured ceiling tile.

#### E. Classification: Provide tiles as follows:

1. Type and Form: Type III, mineral base with painted finish; Form 2, water felted.

- a. Standard ceiling tile shall be square lay-in Cortega ceiling tile.
  - b. Moisture resistant ceiling tile shall be square lay-in Ceramaguard Fine Fissured ceiling tile.
2. Pattern: CD (perforated, small holes and fissured) for standard and CE (perforated, small holes and lightly textured) for moisture resistant .
- F. Color: White.
- G. Light Reflectance (LR): Not less than 0.82.
- H. Ceiling Attenuation Class (CAC): Not less than 33 for standard and not less than 40 for moisture resistant.
- I. Noise Reduction Coefficient (NRC): Not less than 0.55.
- J. Edge/Joint Detail: Square, kerfed, and rabbeted; tongue and grooved; or butt.
- K. Thickness: 5/8 inch.
- L. Modular Size: 24 by 24 inches.
- M. Antimicrobial Treatment: Manufacturer's standard broad spectrum, antimicrobial formulation that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria and showing no mold, mildew, or bacterial growth when tested according to ASTM D 3273, ASTM D 3274, or ASTM G 21 and evaluated according to ASTM D 3274 or ASTM G 21.

## 2.4 METAL SUSPENSION SYSTEM

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  1. Armstrong World Industries, Inc.
  2. Or equal not permitted for this item.
- B. Metal Suspension-System Standard: Provide manufacturer's standard, direct-hung, fully concealed, metal suspension system and accessories of type, structural classification, and finish indicated that complies with applicable requirements in ASTM C 635/C 635M.
  1. High-Humidity Finish: Where indicated, provide coating tested and classified for "severe environment performance" according to ASTM C 635/C 635M.
- C. Direct-Hung, Double-Web Suspension System: Main and cross runners roll formed from and capped with cold-rolled steel sheet, prepainted, electrolytically zinc coated, or hot-dip galvanized, G30 coating designation.
  1. Structural Classification: Intermediate-duty system.
  2. Access: Upward and end pivoted or side pivoted, with initial access openings of size indicated below and located throughout ceiling within each module formed by main and cross runners, with additional access available by progressively removing remaining acoustical tiles.

- a. Initial Access Opening: In each module, As indicated on Drawings.
- D. Suspension system shall be Prelude XL, 15/16" exposed tee system.

## 2.5 ACCESSORIES

- A. Wire Hangers, Braces, and Ties: Provide wires as follows:
  - 1. Zinc-Coated, Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
  - 2. Size: Wire diameter sufficient for its stress at three times hanger design load (ASTM C 635/C 635M, Table 1, "Direct Hung") will be less than yield stress of wire, but not less than 0.106-inch- diameter wire.
- B. Hanger Rods: Mild steel, zinc coated or protected with rust-inhibitive paint.
- C. Flat Hangers: Mild steel, zinc coated or protected with rust-inhibitive paint.
- D. Angle Hangers: Angles with legs not less than 7/8 inch wide; formed with 0.04-inch- thick, galvanized-steel sheet complying with ASTM A 653/A 653M, G90 coating designation; with bolted connections and 5/16-inch- diameter bolts.

## 2.6 METAL EDGE MOLDINGS AND TRIM

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - 1. Armstrong World Industries, Inc.
  - 2. Or equal not permitted for this item.
- B. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations complying with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for of suspension-system runners.
  - 1. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.
  - 2. Finish: Painted white.
- C. Extruded-Aluminum Edge Moldings and Trim: Where indicated, provide manufacturer's extruded-aluminum edge moldings and trim of profile indicated or referenced by manufacturer's designations, including splice plates, corner pieces, and attachment and other clips, complying with seismic design requirements.
  - 1. Baked-Enamel or Powder-Coat Finish: Minimum dry film thickness of 1.5 mils. Comply with ASTM C 635/C 635M and coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, including structural framing and substrates to which acoustical tile ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine acoustical tiles before installation. Reject acoustical tiles that are wet, moisture damaged, or mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Testing Substrates: Before adhesively bonding tiles to wet-placed substrates such as cast-in-place concrete or plaster, test and verify that moisture level is below tile manufacturer's recommended limits.
- B. Measure each ceiling area and establish layout of acoustical tiles to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width tiles at borders unless otherwise indicated, and comply with layout shown on reflected ceiling plans.
- C. Layout openings for penetrations centered on the penetrating items.

### 3.3 INSTALLATION OF SUSPENDED ACOUSTICAL TILE CEILINGS

- A. Install suspended acoustical tile ceilings according to ASTM C 636/C 636M and manufacturer's written instructions.
- B. Suspend ceiling hangers from building's structural members and as follows:
  - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
  - 2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
  - 3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension-system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
  - 4. Secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns. Connect hangers directly to structure or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
  - 5. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and

- appropriate for both the structure to which hangers are attached and the type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
6. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
  7. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
  8. Do not attach hangers to steel deck tabs.
  9. Do not attach hangers to steel roof deck. Attach hangers to structural members.
  10. Space hangers not more than 48 inches o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 8 inches from ends of each member.
  11. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.
- C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.
- D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical tiles.
1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
  2. Screw attach moldings to substrate at intervals not more than 16 inches o.c. and not more than 3 inches from ends. Miter corners accurately and connect securely.
  3. Do not use exposed fasteners, including pop rivets, on moldings and trim.
- E. Install suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- F. Install acoustical tiles in coordination with suspension system and exposed moldings and trim. Place splines or suspension-system flanges into kerfed edges of tiles so tile-to-tile joints are interlocked.
1. Fit adjoining tiles to form flush, tight joints. Scribe and cut tiles for accurate fit at borders and around penetrations through ceiling.
  2. Hold tile field in compression by inserting leaf-type, spring-steel spacers between tiles and moldings, spaced 12 inches o.c.
  3. Protect lighting fixtures and air ducts according to requirements indicated for fire-resistance-rated assembly.

### 3.4 ERECTION TOLERANCES

- A. Suspended Ceilings: Install main and cross runners level to a tolerance of 1/8 inch in 12 feet, non-cumulative.

- B. Moldings and Trim: Install moldings and trim to substrate and level with ceiling suspension system to a tolerance of 1/8 inch in 12 feet, non-cumulative.

### 3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform the following tests and inspections of completed installations of acoustical tile ceiling hangers and anchors and fasteners in successive stages and when installation of ceiling suspension systems on each floor has reached 20 percent completion, but no tiles have been installed. Do not proceed with installations of acoustical tile ceiling hangers for the next area until test results for previously completed installations of acoustical tile ceiling hangers show compliance with requirements.
  - 1. Within each test area, testing agency will select one of every 10 power-actuated fasteners and postinstalled anchors used to attach hangers to concrete and will test them for 200 lbf of tension; it will also select one of every two postinstalled anchors used to attach bracing wires to concrete and will test them for 440 lbf of tension.
  - 2. When testing discovers fasteners and anchors that do not comply with requirements, testing agency will test those anchors not previously tested until 20 pass consecutively and then will resume initial testing frequency.
- C. Acoustical tile ceiling hangers, anchors, and fasteners will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

### 3.6 ADJUSTING

- A. Clean exposed surfaces of acoustical tile ceilings, including trim and edge moldings. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage.
- B. Remove and replace tiles and other ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 095123

## SECTION 096513 - RESILIENT BASE AND 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.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Vinyl base.
  - 2. Vinyl molding accessories.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each exposed product and for each color and texture specified, not less than 12 inches long.
- C. Samples for Initial Selection: For each type of product indicated.
- D. Product Schedule: For resilient base and accessory products. Use same designations indicated on Drawings.

#### 1.4 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. Furnish not less than 10 linear feet for every 500 linear feet or fraction thereof, of each type, color, pattern, and size of resilient product installed.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F.

## 1.6 FIELD CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive resilient products during the following periods:
  - 1. 48 hours before installation.
  - 2. During installation.
  - 3. 48 hours after installation.
- B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.
- C. Install resilient products after other finishing operations, including painting, have been completed.

## PART 2 - PRODUCTS

### 2.1 VINYL BASE

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - 1. Armstrong World Industries, Inc.
  - 2. Burke Mercer Flooring Products; a division of Burke Industries Inc.
  - 3. Johnsonite; a Tarkett company.
  - 4. Roppe Corporation, USA.
- B. Product Standard: ASTM F 1861, Type TV (vinyl, thermoplastic).
  - 1. Group: I (solid, homogeneous).
  - 2. Style and Location:
    - a. Style B, Cove: Provide in areas with resilient floor coverings and sealed concrete.
- C. Minimum Thickness: 0.125-inch.
- D. Height: 4 inches.
- E. Lengths: Coils in manufacturer's standard length.
- F. Outside Corners: Job formed.
- G. Inside Corners: Job formed.
- H. Colors and Patterns: As selected by Engineer from manufacturer's full range..



## 2.2 VINYL MOLDING ACCESSORY

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - 1. Armstrong World Industries, Inc.
  - 2. Burke Mercer Flooring Products; a division of Burke Industries Inc.
  - 3. Johnsonite; a Tarkett company.
  - 4. Roppe Corporation, USA.
- B. Description: Vinyl reducer strip for resilient floor covering.
- C. Profile and Dimensions: As indicated.
- D. Locations: Provide vinyl molding accessories in areas indicated.
- E. Colors and Patterns: As selected by Engineer from manufacturer's full range.

## 2.3 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-cement-based formulation provided or approved by resilient-product manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by resilient-product manufacturer for resilient products and substrate conditions indicated.
- C. Floor Polish: Provide protective, liquid floor-polish products recommended by resilient stair-tread manufacturer.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
  - 1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
  - 1. Installation of resilient products indicates acceptance of surfaces and conditions.

### 3.2 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.
- B. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- C. Do not install resilient products until materials are the same temperature as space where they are to be installed.
  - 1. At least 48 hours in advance of installation, move resilient products and installation materials into spaces where they will be installed.
- D. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.

### 3.3 RESILIENT BASE INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient base.
- B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
- C. Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.
- D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
- E. Do not stretch resilient base during installation.
- F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.
- G. Preformed Corners: Install preformed corners before installing straight pieces.
- H. Job-Formed Corners:
  - 1. Outside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches in length.
    - a. Form without producing discoloration (whitening) at bends.
  - 2. Inside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches in length.
    - a. Miter corners to minimize open joints.

### 3.4 RESILIENT ACCESSORY INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient accessories.
- B. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of floor covering that would otherwise be exposed.

### 3.5 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.
- B. Perform the following operations immediately after completing resilient-product installation:
  - 1. Remove adhesive and other blemishes from surfaces.
  - 2. Sweep and vacuum horizontal surfaces thoroughly.
  - 3. Damp-mop horizontal surfaces to remove marks and soil.
- C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- D. Floor Polish: Remove soil, adhesive, and blemishes from resilient stair treads before applying liquid floor polish.
  - 1. Apply one coat(s).
- E. Cover resilient products subject to wear and foot traffic until Substantial Completion.

END OF SECTION 096513

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## SECTION 096519 - RESILIENT TILE FLOORING

### 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. Vinyl composition floor tile.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For each type of resilient floor tile.
  - 1. Include floor tile layouts, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.
  - 2. Show details of special patterns.
- C. Samples for Initial Selection: For each type of floor tile indicated.
- D. Product Schedule: For floor tile. Use same designations indicated on Drawings.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of floor tile to include in maintenance manuals.

#### 1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Floor Tile: Furnish one box for every 50 boxes or fraction thereof, of each type, color, and pattern of floor tile installed.

## 1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are competent in techniques required by manufacturer for floor tile installation and seaming method indicated.
  - 1. Engage an installer who employs workers for this Project who are trained or certified by floor tile manufacturer for installation techniques required.

## 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Store floor tile and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F. Store floor tiles on flat surfaces.

## 1.9 FIELD CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive floor tile during the following periods:
  - 1. 48 hours before installation.
  - 2. During installation.
  - 3. 48 hours after installation.
- B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.
- C. Close spaces to traffic during floor tile installation.
- D. Close spaces to traffic for 48 hours after floor tile installation.
- E. Install floor tile after other finishing operations, including painting, have been completed.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: For resilient floor tile, as determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.
  - 1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

### 2.2 VINYL COMPOSITION FLOOR TILE

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Armstrong Flooring, Inc.
  2. Armstrong World Industries, Inc.
  3. Johnsonite; a Tarkett company.
- B. Tile Standard: ASTM F 1066, Class 2, through pattern.
- C. Wearing Surface: Smooth.
- D. Thickness: 0.125 inch.
- E. Size: 12 by 12 inches.
- F. Colors and Patterns: Select from manufacturers full range.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of floor tile.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 PREPARATION

- A. Prepare substrates according to floor tile manufacturer's written instructions to ensure adhesion of resilient products.
- B. Concrete Substrates: Prepare according to ASTM F 710.
1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
  2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by floor tile manufacturer. Do not use solvents.
  3. Alkalinity and Adhesion Testing: Perform tests recommended by floor tile manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 9 pH.
  4. Moisture Testing: Perform tests so that each test area does not exceed 200 sq. ft., and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
    - a. Anhydrous Calcium Chloride Test: ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.

- b. Relative Humidity Test: Using in-situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
- C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- D. Do not install floor tiles until materials are the same temperature as space where they are to be installed.
  - 1. At least 48 hours in advance of installation, move resilient floor tile and installation materials into spaces where they will be installed.
- E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient floor tile.

### 3.3 FLOOR TILE INSTALLATION

- A. Comply with manufacturer's written instructions for installing floor tile.
- B. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.
  - 1. Lay tiles square with room axis.
- C. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.
  - 1. Lay tiles with grain direction alternating in adjacent tiles (basket-weave pattern) in pattern of colors and sizes indicated.
- D. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.
- E. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.
- F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent marking device.
- G. Install floor tiles on covers for telephone and electrical ducts, building expansion-joint covers, and similar items in installation areas. Maintain overall continuity of color and pattern between pieces of tile installed on covers and adjoining tiles. Tightly adhere tile edges to substrates that abut covers and to cover perimeters.
- H. Adhere floor tiles to substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.



### 3.4 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protecting floor tile.
- B. Perform the following operations immediately after completing floor tile installation:
  - 1. Remove adhesive and other blemishes from surfaces.
  - 2. Sweep and vacuum surfaces thoroughly.
  - 3. Damp-mop surfaces to remove marks and soil.
- C. Protect floor tile from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- D. Floor Polish: Remove soil, adhesive, and blemishes from floor tile surfaces before applying liquid floor polish.
  - 1. Apply one coat(s).
- E. Joint Sealant: Apply sealant to resilient terrazzo floor tile perimeter and around columns, at door frames, and at other joints and penetrations.
- F. Sealers and Finish Coats: Remove soil, visible adhesive, and surface blemishes from resilient terrazzo floor tile surfaces before applying liquid cleaners, sealers, and finish products.
  - 1. Sealer: Apply two base coats of liquid sealer.
  - 2. Finish: Apply two coats of liquid floor finish.
- G. Cover floor tile until Substantial Completion.

END OF SECTION 096519

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## SECTION 096723 - RESINOUS FLOORING

### 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. Resinous flooring systems.

#### 1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include manufacturer's technical data, application instructions, and recommendations for each resinous flooring component required.
- B. Samples for Initial Selection: For each type of exposed finish required.
- C. Samples for Verification: For each resinous flooring system required, 6 inches square, applied to a rigid backing by Installer for this Project.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Installer Certificates: Signed by manufacturer certifying that installers comply with specified requirements.
- B. Material Certificates: For each resinous flooring component, from manufacturer.
- C. Material Test Reports: For each resinous flooring system, by a qualified testing agency.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For resinous flooring to include in maintenance manuals.

## 1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.
- B. Engage an installer who is certified in writing by resinous flooring manufacturer as qualified to apply resinous flooring systems indicated.

## 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating brand name and directions for storage and mixing with other components.

## 1.9 FIELD CONDITIONS

- A. Environmental Limitations: Comply with resinous flooring manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting resinous flooring application.
- B. Lighting: Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during resinous flooring application.
- C. Close spaces to traffic during resinous flooring application and for 24 hours after application unless manufacturer recommends a longer period.

# PART 2 - PRODUCTS

## 2.1 PERFORMANCE REQUIREMENTS

- A. Flammability: Self-extinguishing according to ASTM D635.

## 2.2 MANUFACTURERS

- A. Source Limitations: Obtain primary resinous flooring materials, including primers, resins, hardening agents, grouting coats, and topcoats, from single source from single manufacturer. Obtain secondary materials, including patching and fill material, joint sealant, and repair materials, of type and from manufacturer recommended in writing by manufacturer of primary materials.

## 2.3 RESINOUS FLOORING

- A. Resinous Flooring System: Abrasion-, impact-, and chemical-resistant, aggregate-filled, and resin-based monolithic floor surfacing designed to produce a seamless floor and integral cove base.

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. Garland Company, Inc. (The).
  - b. Sauereisen.
  - c. Stonhard, Inc.
  - d. Tnemec Inc.
- B. System Characteristics:
  1. Color and Pattern: As selected by Engineer from manufacturer's full range.
  2. Wearing Surface:
    - a. HSPS Building: Textured for slip resistance
    - b. Chemical Building: Manufacturer's standard wearing surface.
  3. Overall System Thickness:
    - a. HSPS Building: 1/8 inch .
    - b. Chemical Building: 25 mils.
- C. Primer: Type recommended by resinous flooring manufacturer for substrate and resinous flooring system indicated.
  1. Formulation Description: 100 percent solids.
- D. Patching and Fill Material: Resinous product of or approved by resinous flooring manufacturer and recommended by manufacturer for application indicated.
- E. Body Coats:
  1. HSPS Building:
    - a. Resin: Epoxy.
    - b. Formulation Description: 100 percent solids.
    - c. Type: Pigmented.
    - d. Application Method: Troweled or screeded.
    - e. Number of Coats: One.
    - f. Thickness of Coats: 1/16 inch.
    - g. Aggregates: Manufacturer's standard.
  2. Chemical Building:
    - a. Not required.
- F. Topcoats: Sealing or finish coats.
  1. HSPS Building:
    - a. Resin: Epoxy.
    - b. Formulation Description: 100 percent solids.

- c. Type: Pigmented.
  - d. Number of Coats: One.
  - e. Thickness of Coats: 1/16 inch .
  - f. Finish: Standard.
2. Chemical Building:
- a. Resin: Epoxy.
  - b. Formulation Description: 100 percent solids.
  - c. Type: Pigmented.
  - d. Number of Coats: Two.
  - e. Thickness of Coats: 10 mils.
  - f. Finish: Standard.
- G. System Physical Properties: Provide resinous flooring system with the following minimum physical property requirements when tested according to test methods indicated:
1. HSPS Building:
- a. Compressive Strength: 10,000 psi minimum according to ASTM C579.
  - b. Tensile Strength: 1,750 psi minimum according to ASTM C307.
  - c. Flexural Modulus of Elasticity:  $2.0 \times 10^6$  psi minimum according to ASTM C580.
  - d. Water Absorption: 0.2% percent maximum according to ASTM C413.
  - e. Impact Resistance: No chipping, cracking, or delamination and not more than 1/16-inch permanent indentation according to MIL-D-3134J.
  - f. Resistance to Elevated Temperature: No slip or flow of more than 1/16 inch according to MIL-D-3134J.
  - g. Abrasion Resistance: 0.1 gm maximum weight loss according to ASTM D4060.
  - h. Hardness: 85 to 90, Shore D according to ASTM D2240.
  - i. Critical Radiant Flux: 0.45 W/sq. cm or greater according to NFPA 253.
2. Chemical Building:
- a. Tensile Strength: 4,900 psi minimum according to ASTM D-638.
  - b. Flexural Strength: 9,800 psi minimum according to ASTM C-580
  - c. Bond Strength: >400 psi (100% Concrete failure) according to ASTM D-4541.
  - d. Flexural Modulus of Elasticity:  $1.0 \times 10^6$  psi minimum according to ASTM C580.
  - e. Abrasion Resistance: 0.12 gm maximum weight loss according to ASTM D4060.
  - f. Hardness: 85 to 90, Shore D according to ASTM D2240.
  - g. Critical Radiant Flux: 0.45 W/sq. cm or greater according to NFPA 253.
- H. System Chemical Resistance: Test specimens of cured resinous flooring system are unaffected when tested according to ASTM D543, Procedure A, for immersion or ASTM C267 for immersion in the following reagents for no fewer than seven days:
1. HSPS Building: Not Required.
2. Chemical Building: Sodium Hypochlorite.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Prepare and clean substrates according to resinous flooring manufacturer's written instructions for substrate indicated. Provide clean, dry substrate for resinous flooring application.
- B. Concrete Substrates: Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants incompatible with resinous flooring.
  - 1. Roughen concrete substrates as follows:
    - a. Shot-blast surfaces with an apparatus that abrades the concrete surface, contains the dispensed shot within the apparatus, and recirculates the shot by vacuum pickup.
    - b. Comply with NACE No. 6/SSPC-SP13, with a Concrete Surface Profile (CSP) of 3 or greater in accordance with the International Concrete Repair Institute (ICRI) Technical Guideline No. 310.2R, unless manufacturer's written instructions are more stringent.
  - 2. Repair damaged and deteriorated concrete according to resinous flooring manufacturer's written instructions.
  - 3. Verify that concrete substrates are dry and moisture-vapor emissions are within acceptable levels according to manufacturer's written instructions.
    - a. Anhydrous Calcium Chloride Test: ASTM F1869. Proceed with application of resinous flooring only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. of slab area in 24 hours.
    - b. Relative Humidity Test: Use in situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
  - 4. Alkalinity and Adhesion Testing: Verify that concrete substrates have pH within acceptable range. Perform tests recommended by manufacturer. Proceed with application only after substrates pass testing.
- C. Patching and Filling: Use patching and fill material to fill holes and depressions in substrates according to manufacturer's written instructions.
  - 1. Control Joint Treatment: Treat control joints and other nonmoving substrate cracks to prevent cracks from reflecting through resinous flooring according to manufacturer's written instructions.
- D. Resinous Materials: Mix components and prepare materials according to resinous flooring manufacturer's written instructions.

### 3.2 INSTALLATION

- A. Apply components of resinous flooring system according to manufacturer's written instructions to produce a uniform, monolithic wearing surface of thickness indicated.
  - 1. Coordinate application of components to provide optimum adhesion of resinous flooring system to substrate, and optimum intercoat adhesion.
  - 2. Cure resinous flooring components according to manufacturer's written instructions. Prevent contamination during application and curing processes.
  - 3. Expansion and Isolation Joint Treatment: At substrate expansion and isolation joints, comply with resinous flooring manufacturer's written instructions.
- B. Primer: Apply primer over prepared substrate at manufacturer's recommended spreading rate.
- C. Integral Cove Base: Apply cove base mix to wall surfaces before applying flooring. Apply according to manufacturer's written instructions and details, including those for taping, mixing, priming, troweling, sanding, and topcoating of cove base. Round internal and external corners.
  - 1. HSPS Building:
    - a. Integral Cove Base: 8 inches high.
  - 2. Chemical Building:
    - a. Extend coating up full height of vertical containment walls and concrete pad.
- D. Troweled or Screeded Body Coats: Apply troweled or screeded body coats in thickness indicated for flooring system. Hand or power trowel and grout to fill voids. When body coats are cured, remove trowel marks and roughness using method recommended by manufacturer.
- E. Topcoats: Apply topcoats in number indicated for flooring system and at spreading rates recommended in writing by manufacturer and to produce wearing surface indicated.

### 3.3 FIELD QUALITY CONTROL

- A. Material Sampling: Owner may, at any time and any number of times during resinous flooring application, require material samples for testing for compliance with requirements.
  - 1. Owner will engage an independent testing agency to take samples of materials being used. Material samples will be taken, identified, sealed, and certified in presence of Contractor.
  - 2. Testing agency will test samples for compliance with requirements, using applicable referenced testing procedures or, if not referenced, using testing procedures listed in manufacturer's product data.
  - 3. If test results show applied materials do not comply with specified requirements, pay for testing, remove noncomplying materials, prepare surfaces coated with unacceptable materials, and reapply flooring materials to comply with requirements.
- B. Core Sampling: At the direction of Owner and at locations designated by Owner, take one core sample per 1000 sq. ft. of resinous flooring, or portion of, to verify thickness. For each sample



that fails to comply with requirements, take two additional samples. Repair damage caused by coring. Correct deficiencies in installed flooring as indicated by testing.

### 3.4 PROTECTION

- A. Protect resinous flooring from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by resinous flooring manufacturer.

END OF SECTION 096723

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## SECTION 099010 - SHOP PRIMING

### 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 shop primers not included in other sections. Sherwin Williams products are facility standards associated with project.
- B. Related Requirements:
  - 1. Division 09 for field applied painting.
  - 2. Other specifications that reference this specification for primers.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include written statement, or published product data, that the confirms that the shop primer materials are compatible with the finish and field coatings.
- B. Samples: For each exposed product.

#### 1.4 QUALITY ASSURANCE

- A. Compatibility of Coating Systems: Shop priming with primers that are guaranteed, in writing, by the manufacturer to be compatible with field applied and other coatings.

### PART 2 - PRODUCTS

#### 2.1 MATERIALS

- A. Submerged Surfaces: Shop primer for ferrous metals which will be in contact with water being treated, either submerged or which are subject to splash action or which are specified to be considered submerged service:
  - 1. Shop Prime Coat: (Zinc Micaceous Iron Oxide Polyurethane Aromatic Shop Primer):

- a. Sherwin-Williams Company (The): Corothane I Zinc Primer 1K Mio-Zinc.
  - b. Or equal as required for system.
- B. Non-Submerged Surfaces: Shop primer for ferrous metals which will not be in contact with water being treated, not submerged and not subject to splash action:
  - 1. Shop Prime Coat: (Zinc Micaceous Iron Oxide Polyurethane Aromatic Shop Primer):
    - a. Sherwin-Williams Company (The): Corothane I Zinc Primer 1K Mio-Zinc.
    - b. Or equal as required for system.
- C. Submerged Surfaces:
  - 1. Shop Prime Coat for Ductile Iron Pipe: (Epoxy, Polyamidoamine Shop Primer):
    - a. Sherwin-Williams Company (The): Macropoxy 5500.
    - b. Or equal as required for system.
  - 2. Shop Prime Coat for Ferrous Metal Surfaces: (Zinc Micaceous Iron Oxide Polyurethane Aromatic Shop Primer):
    - a. Sherwin-Williams Company (The): Corothane I Zinc Primer 1K Mio-Zinc.
    - b. Or equal as required for system.

### PART 3 - EXECUTION

#### 3.1 PREPARATION

- A. Surface preparation: Comply with the manufacturer's written requirements for the substrate to be primed.

#### 3.2 PROTECTION

- A. Non-Primed Surfaces: Apply a heavy shop coat of grease or other suitable rust-resistant coating to gears, bearings surfaces and other similar surfaces which are not to be field painted.
  - 1. Maintain this coating to prevent corrosion until final acceptance testing of equipment.

END OF SECTION 099010

## SECTION 099100 – PAINTING

### 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 surface preparation and the application of paint systems on the following substrates:
  - 1. Concrete.
  - 2. Concrete masonry units (CMUs).
  - 3. Steel and iron.
  - 4. Galvanized metal.
  - 5. Aluminum (not anodized or otherwise coated).
  - 6. Fiberglass.
  - 7. Gypsum board.
- B. Section includes painting all exposed structural and miscellaneous steel; chemical tanks and systems; mechanical and electrical equipment; sluice gates, operators and posts; conveying systems, pipe, fittings and valves; electrical conduit and appurtenances; new CMU walls; exposed interior ducts; all as specified in the attached painting schedules and all other work obviously required to be painted unless otherwise specified. Minor items not mentioned in the schedule of work shall be included in the work of this Section where they come within the general intent of this Section as stated herein.
- C. Aluminized steel, above roof level, for stacks: Paint with silicone aluminum as specified. Other aluminum-paint only where noted (as is specified).
- D. Paint items noted in "Painting Schedule."
  - 1. Sherwin Williams products are facility standards associated with project.
- E. Provide vinyl film letters and numbers for markings as specified.
- F. Paint items noted in other Specification Sections as having factory finish and other factory finished items are obviously not field painted.
- G. Paint all factory finish painted items replaced, repaired or damaged during construction.
- H. The various Sections are responsible, as stated in each, for preparation and field touch-up of abrasions, welds and damaged primed areas of primed or galvanized components after erection.

I. The following items will not be painted:

1. Concrete except where specified above and scheduled to be painted and seamless flooring.
2. Stainless steel louvers, doors and frames.
3. Finish hardware.
4. Non-ferrous metals and stainless steel, unless specifically noted otherwise.
5. Factory pre-finished architectural components.
6. Packing glands and other adjustable parts and name plates of mechanical equipment.
7. Parts of buildings not exposed to sight, unless specifically noted otherwise.
8. Maintenance equipment
9. Plumbing fixtures.
10. Mechanical, HVAC, Plumbing and Electrical equipment which has been finished painted in the factory as specified in Divisions 22, 23, 26, 41, 42, 43, 44, 46 and 48.

J. Related Requirements:

1. Valve identification is included in Divisions 11, 22, 23, 41, 42, 43, 44, 46 and 48.
2. Shop priming of equipment and piping (except copper piping) are specified in Section 099110 – Shop Priming and included in the respective Section with the item to be primed.
3. Section 055000 "Metal Fabrications" for shop priming metal fabrications.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples for Initial Selection: For each type of topcoat product.
- C. Product List: Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules. Include color designations.

1.4 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. Paint: 5 percent, but not less than 1 gal. of each material and color applied.

## 1.5 QUALITY ASSURANCE

- A. Shop Primers, specified in Section 099100 "Shop Primers," and other Sections are required to be certified by the manufacturer of the field applied painting manufacturer to be compatible with the materials specified in this section.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.
  - 1. Maintain containers in clean condition, free of foreign materials and residue.
  - 2. Remove rags and waste from storage areas daily.

## 1.7 FIELD CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.
- B. Do not apply paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

# PART 2 - PRODUCTS

## 2.1 MANUFACTURERS

- A. Manufacturers: Provide products by one of the following:
  - 1. The Sherwin Williams Company (SW)
  - 2. Or equal product not acceptable unless necessary for application.

## 2.2 MATERIALS

- A. Material Compatibility:
  - 1. Provide materials for use within each coating system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
  - 2. Provide products of same manufacturer for each coat in a coating system.
- B. Use paint materials without adulteration and mixed, thinned and applied in strict accordance with manufacturer's directions for the applicable materials and surface.
- C. Colors: As selected by Engineer from manufacturer's full range.

## 2.3 COLOR CODING FOR PIPES AND EQUIPMENT

- A. The color code establishes, defines and assigns a definite color for each process system. Paint all elements which are an integral part of the system, that is originating from the equipment and/or supplying the equipment, between and up to but not including the fixed flanges nor the flexible conduit connections on the equipment. Paint valves and fittings in the color of the main body of the pipe.
- B. All pipes and equipment shall be painted with final coat color selected by the Engineer and shall be treated as an integral part of the Contract.
- C. All hanger saddles and pipe support floor stands shall be painted the same color and with the same paint as the pipe it supports. Hanger rods and hanger rod connections to building structure shall be painted to match the color of the wall or ceiling to which it is attached.

## 2.4 LETTERING OF TITLES

- A. Indicate the name of the materials in each pipeline and alongside this an arrow indicating the direction of flow of fluids on each pipe system. Locate the titles shall not more than 26 feet apart and directly adjacent to each side of any wall the pipeline breaches, adjacent to each side of the valve regulator, flowcheck, strainer cleanout and all pieces of equipment.
- B. Identify titles by the identity of the contents with complete name at least once in each space through which it passes and thereafter by generally recognized abbreviations, letters or numerals as approved. Place identification title locations in general they shall be placed where the view is unobstructed and on the two lower quarters of pipe or covering where they are overhead. Title to be clearly visible from operating positions and adjacent to all control valves.
- C. Die cut numbers and letters from 3.5 mil vinyl film and pre-space them on carrier tape. Protect adhesive and finish surface with one piece removable liners. Use white or black to provide high contrast to the substrate color.
- D. Letter size shall be as indicated in the following table:

OUTSIDE DIAMETER OF PIPE OR COVERING	SIZE OF LEGEND LETTERS
3/4-in to 1-1/4-in	1/2-in
1-1/2-in to 2-in	3/4-in
2-1/2-in to 6-in	1-1/2-in
8-in to 10-in	2-1/2-in
Over 10-in	3-in

- E. Use Type B ASI/2 by ASI Sign Systems; Architectural Graphics Inc. or equal. Provide Optima Bold, upper case letter type. Use Grid 2 spacing. Match arrow to letter type and size. Follow the instructions of the manufacturer in respect to storage, surface preparation and applications of letters.



## 2.5 TITLES FOR EQUIPMENT

- A. Provide titles consisting of vinyl film as specified above on all equipment using 1-in high Optima Bold upper case, Grid 2 spacing. Use white or black to provide high contrast to the substrate color. Use titles shown on mechanical drawings for bidding purposes. Mount titles at eye level on machines or at the upper most broad vertical surface of low equipment. Where more than one piece of the equipment item to be titled exists, number the items consecutively as indicated on the mechanical drawings or as directed by the Engineer; for example, Pump No. 1, Pump No. 2, etc. Titles shall be composed in more than one line if required and justified on the left-hand side.

## 2.6 TESTING EQUIPMENT

- A. Furnish wet and dry film thickness gauges, electronic moisture meter and all other equipment required by the Engineer for inspection.

# PART 3 - EXECUTION

## 3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.
  - 1. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
    - a. Concrete: 12 percent.
    - b. Masonry (Clay and CMU): 12 percent.
    - c. Gypsum Board: 12 percent.
- B. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
- C. Proceed with coating application only after unsatisfactory conditions have been corrected.
  - 1. Application of coating indicates acceptance of surfaces and conditions.

## 3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
  - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection.

- C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
  - 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.
- D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
- E. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceeds that permitted in manufacturer's written instructions.
- F. Steel Substrates: Remove rust, loose mill scale, and shop primer if any. Clean using methods recommended in writing by paint manufacturer but not less than the following:
  - 1. SSPC-SP 2.
  - 2. SSPC-SP 3.
  - 3. SSPC-SP 7/NACE No. 4.
  - 4. SSPC-SP 11.
- G. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.
- H. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.
- I. Aluminum Substrates: Remove loose surface oxidation.
- J. Plastic Trim Fabrication Substrates: Remove dust, dirt, and other foreign material that might impair bond of paints to substrates.

### 3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual."
  - 1. Use applicators and techniques suited for paint and substrate indicated.
  - 2. Paint surfaces behind movable items same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed items with prime coat only.
  - 3. Paint both sides and edges of exterior doors and entire exposed surface of exterior door frames.
  - 4. Paint entire exposed surface of window frames and sashes.
  - 5. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
  - 6. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.

- B. Tint undercoats same color as topcoat, but tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- E. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:
  - 1. Paint the following work where exposed to view:
    - a. Uninsulated metal piping.
    - b. Uninsulated plastic piping.
    - c. Pipe hangers and supports.
    - d. Metal conduit.
    - e. Plastic conduit.

### 3.4 FIELD QUALITY CONTROL

- A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.
  - 1. Contractor shall touch up and restore painted surfaces damaged by testing.
  - 2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

### 3.5 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Engineer, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

### 3.6 PAINTING SCHEDULE

- A. Dry Film Thickness (DFT) for each paint product is not part of paint schedule. Submit both the Wet Film Thickness (WFT) and DFT for each product as part of submittal process. Apply paint and coating products to comply with manufacturer's DFT thickness and application recommendations in the approved submittal.

### 3.7 The following types of paints by The Sherwin Williams Company (SW),; or equal product not acceptable unless necessary for specified application:

- A. Epoxy:
  - 1. SW: Macropoxy 646, B58 Series.
- B. Waterborne Cementitious Acrylic: Result in pinhole free surface.
  - 1. SW: Cement-Plex 875, B42 Series.
- C. High-Build Acrylic Polyurethane Enamel:
  - 1. SW: Acrolon 218 HS, B65 Series.
- D. High Heat Silicone Aluminum (to 600 degrees F):
  - 1. SW: Heat-Flex Hi-Temp 1000 Aluminum, B59-820 Series.
- E. Tie Coat, Low VOC, Epoxy:
  - 1. SW: Macropoxy 646, B58 Series.
- F. Acrylic Latex Emulsion, Eggshell Finish:
  - 1. SW: DTM Primer/Finish, B66 Series.
- G. Vinyl Acrylic Surface Sealer:
  - 1. SW: Prep-Rite 200 Primer, B28 Series.
- H. The following surfaces shall have the types of paint scheduled below applied at the dry film thickness (DFT) in mils per coat as recommended by manufacturer:
  - 1. Exterior non- submerged ferrous metals (except first coat-hollow metal-pressed metal work):
    - a. First Coat: On properly prepared unprimed metal or for touch-up:
      - 1) SW: Macropoxy 646, B58 Series.
    - b. Second Coat:
      - 1) SW: Macropoxy 646, B58 Series.

- c. Third Coat:
  - 1) SW: Acrolon 218 HS, B65 Series.
- 2. Interior non-submerged concrete scheduled for painting:
  - a. First and Second Coats:
    - 1) SW: Macropoxy 646, B58 Series.
- 3. Interior concrete masonry units:
  - a. First Coat: Result in pinhole free surface.
    - 1) SW: Cement-Plex 875, B42 Series.
  - b. Second and Third Coats:
    - 1) SW: Macropoxy 646, B58 Series.
- 4. Interior non-submerged ferrous metals (except first coat of previously painted metal work), on properly prepared unprimed metal or for touch-up:
  - a. First Coat:
    - 1) SW: Macropoxy 646, B58 Series.
  - b. Second and Third Coats:
    - 1) SW: Macropoxy 646, B58 Series.
- 5. Submerged ferrous metals and ferrous metals subject to submersion or splashing. Surface shall be lightly sanded or abraded before application of first field coat.
  - a. First and Second Coats:
    - 1) SW: Macropoxy 646, B58 Series.
- 6. Plastic piping and, where scheduled to be painted, plastic components:
  - a. First and Second Coats:
    - 1) SW: Macropoxy 646, B58 Series.
- 7. Pipe insulation: (Plastic or metal sheathed insulation-paint as scheduled for appropriate substrate):
  - a. First Coat:
    - 1) SW: Prep-Rite 200, B28 Series.

- b. Second and Third Coats:
  - 1) SW: Macropoxy 646, B58 Series.
- 8. Aluminum Designated to be Painted:
  - a. Mechanically abrade surfaces to comply with SSPC SP 16 "Brush-off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-ferrous Metals".
  - b. First and Second Coats - (Interior):
    - 1) SW: Macropoxy 646, B58 Series.
  - c. First Coat - (Exterior):
    - 1) SW: Macropoxy 646, B58 Series.
  - d. Second Coat - (Exterior):
    - 1) SW: Acrolon 218 HS.
- 9. Copper Piping:
  - a. First and Second Coats:
    - 1) SW: Macropoxy 646, B58 Series.
- 10. Hot Ferrous Metal Surfaces:
  - a. First and Second Coats:
    - 1) SW: Heat-Flex Hi-Temp 1000 Aluminum, B59-820 Series, Aluminum.
- 11. Exterior galvanized steel surfaces:
  - a. Mechanically abrade surfaces to comply with SSPC SP 16 "Brush-off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-ferrous Metals".
  - b. First Coat:
    - 1) SW: Macropoxy 646, B58 Series.
  - c. Second Coat:
    - 1) SW: Acrolon 218 HS.
- 12. Gypsum Work:
  - a. First Coat:
    - 1) SW: PrepRite 200 Primer, B28 Series.

b. Second and Third Coats:

- 1) SW: DTM Primer/Finish, B66 Series
- 2) SW: Pro Industrial Pre-Catalyzed Water Based Epoxy (toilet rooms. Laboratories, high use/abuse locations).

END OF SECTION 099100

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## SECTION 101423.16 - ROOM-IDENTIFICATION PANEL SIGNAGE

### 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 room-identification signs that are directly attached to the building.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For room-identification signs.
  - 1. Include fabrication and installation details and attachments to other work.
  - 2. Show sign mounting heights, locations of supplementary supports to be provided by other installers, and accessories.
  - 3. Show message list, typestyles, graphic elements, including raised characters and Braille, and layout for each sign at least half size.
- C. Samples for Verification: For each type of sign assembly showing all components and with the required finish(es), in manufacturer's standard size unless otherwise indicated and as follows:
  - 1. Room-Identification Signs: Full-size Sample.
  - 2. Full-size Samples, if approved, will be returned to Contractor for use in Project.
- D. Product Schedule: For room-identification signs. Use same designations indicated on Drawings or specified.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and manufacturer.
- B. Sample Warranty: For special warranty.

#### 1.5 CLOSEOUT SUBMITTALS

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

## 1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer of products.

## 1.7 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Deterioration of finishes beyond normal weathering.
    - b. Deterioration of embedded graphic image.
    - c. Separation or delamination of sheet materials and components.
  - 2. Warranty Period: Five years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Accessibility Standard: Comply with applicable provisions in Florida Building Code, Accessibility.

### 2.2 ROOM-IDENTIFICATION SIGNS

- A. Room-Identification Sign: Sign with smooth, uniform surfaces; with message and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:
  - 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. ASI Sign Systems, Inc.
    - b. Seton Identification Products; a Brady Corporation company.
    - c. Signature Signs, Inc.
  - 2. Laminated-Sheet Sign: Photopolymer face sheet with raised graphics laminated to acrylic backing sheet to produce composite sheet.
    - a. Composite-Sheet Thickness: Manufacturer's standard for size of sign.
    - b. Color(s): As selected by Engineer from manufacturer's full range.
  - 3. Sign-Panel Perimeter: Finish edges smooth.
    - a. Edge Condition: Square cut.
    - b. Corner Condition in Elevation: Square.

4. Frame: Entire perimeter.
  - a. Material: Aluminum.
  - b. Profile: Square.
  - c. Corner Condition in Elevation: Square.
  - d. Finish and Color: Clear anodized.
5. Mounting: Manufacturer's standard method for substrates indicated with concealed anchors.
6. Text and Typeface: Accessible raised characters and Braille typeface as selected by Engineer from manufacturer's full range. Finish raised characters to contrast with background color, and finish Braille to match background color.

## 2.3 SIGN MATERIALS

- A. Aluminum Sheet and Plate: ASTM B 209, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.
- B. Aluminum Extrusions: ASTM B 221, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.
- C. Acrylic Sheet: ASTM D 4802, category as standard with manufacturer for each sign, Type UVF (UV filtering).
- D. Paints and Coatings for Sheet Materials: Inks, dyes, and paints that are recommended by manufacturer for optimum adherence to surface and are UV and water resistant for colors and exposure indicated.

## 2.4 ACCESSORIES

- A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signs, noncorrosive and compatible with each material joined, and complying with the following:
  1. Use concealed fasteners and anchors unless indicated to be exposed.
  2. Sign Mounting Fasteners:
    - a. Concealed Studs: Concealed (blind), threaded studs welded or brazed to back of sign material or screwed into back of sign assembly unless otherwise indicated.

## 2.5 FABRICATION

- A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.
  1. Preassemble signs and assemblies in the shop to greatest extent possible. Disassemble signs and assemblies only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation; apply markings in locations concealed from view after final assembly.
  2. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.

3. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
4. Provide rabbets, lugs, and tabs necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match sign finish.

## 2.6 GENERAL FINISH REQUIREMENTS

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

## 2.7 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, Class I, 0.018 mm or thicker.

# PART 3 - EXECUTION

## 3.1 INSTALLATION

- A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.
  1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
  2. Install signs so they do not protrude or obstruct according to the accessibility standard.
  3. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.
- B. Accessibility: Install signs in locations on walls as indicated on Drawings and according to the accessibility standard.
- C. Mounting Methods:
  1. Concealed Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.
    - a. Masonry Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place sign in position and push until flush to surface, embedding studs in holes. Temporarily support sign in position until adhesive fully sets.
    - b. Thin or Hollow Surfaces: Place sign in position and flush to surface, install washers and nuts on studs projecting through opposite side of surface, and tighten.

### 3.2 ADJUSTING AND CLEANING

- A. Remove and replace damaged or deformed signs and signs that do not comply with specified requirements. Replace signs with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.
- B. Remove temporary protective coverings and strippable films as signs are installed.
- C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions and touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect from damage until acceptance by Owner.

### 3.3 SIGNAGE SCHEDULES

- A. Room Identification at HSPS, no room signage Chemical Building

<b>ROOM IDENTIFICATION SIGNAGE SCHEDULE</b>		
<b>Door Number</b>	<b>Signage</b>	<b>Room Side</b>
DA-101	Control Room	Pump Room
DA-102	Toilet	Control Room
DA-103A	Mechanical Room	Control Room
DA-104	Electrical Room	Pump Room
DA-104C	Electrical Room	Control Room

END OF SECTION 101423.16

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## SECTION 102800 - TOILET 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.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Public-use washroom accessories.
  - 2. Under-lavatory guards.
  - 3. Custodial accessories.
- B. Related Requirements:
  - 1. Section 093013 "Ceramic Tiling" for ceramic toilet and bath accessories.

#### 1.3 COORDINATION

- A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.
- B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
  - 2. Include anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
- B. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.
  - 1. Identify accessories using designations indicated.

1.5 INFORMATIONAL SUBMITTALS

- A. Sample Warranty: For manufacturer's special warranty.

1.6 CLOSEOUT SUBMITTALS

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

1.7 WARRANTY

- A. Manufacturer's Special Warranty for Mirrors: Manufacturer agrees to repair or replace mirrors that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, visible silver spoilage defects.
  - 2. Warranty Period: 15 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PUBLIC-USE WASHROOM ACCESSORIES

- A. Source Limitations: Obtain public-use washroom accessories from single source from single manufacturer.
- B. Toilet Tissue (Roll) Dispenser:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. Tork Twin Jumbo Bath Tissue Roll Dispenser.
      - 1) Model: 247549A.
      - 2) Color: Black.
    - b. Or Equal product not acceptable for this item.
- C. Paper Towel (Roll) Dispenser:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. Tork Elevation Matic Hand Towel Roll Dispenser.
      - 1) Model: 5510282.
      - 2) Color: Black.
    - b. Or Equal product not acceptable for this item.



D. Waste Receptacle:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - a. Bobrick Washroom Equipment, Inc.
    - 1) Model: B-2260.
    - 2) Material: Stainless Steel.
  - b. Or Equal Products not acceptable for this item.

E. Liquid-Soap Dispenser:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - a. GOJO Dispenser
    - 1) Model: FMX-12.
    - 2) Color: Black.
  - b. Or Equal Products not acceptable for this item.

F. Grab Bar:

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. Bobrick Washroom Equipment, Inc.
  - b. Bradley Corporation.
2. Mounting: Flanges with concealed fasteners.
3. Material: Stainless steel, 0.05 inch thick.
  - a. Finish: Smooth, No. 4 finish (satin) on ends and slip-resistant texture in grip area.
4. Outside Diameter: 1-1/4 inches.
5. Configuration and Length: As indicated on Drawings.

G. Seat-Cover Dispenser:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - a. Tork Toilet Seat Cover Dispenser.
    - 1) Model: 344080.
    - 2) Color: White.
  - b. Or Equal Products not acceptable for this item.

H. Mirror Unit:

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. Bobrick Washroom Equipment, Inc.
    - 1) Model: B-293.
  - b. Bradley Corporation.
    - 1) Series 740
2. Frame: Stainless steel, fixed tilt.
  - a. Corners: Manufacturer's standard.
3. Hangers: Produce rigid, tamper- and theft-resistant installation, using method indicated below.
  - a. One-piece, galvanized-steel, wall-hanger device with spring-action locking mechanism to hold mirror unit in position with no exposed screws or bolts.
  - b. Wall bracket of galvanized steel, equipped with concealed locking devices requiring a special tool to remove.
4. Size: As indicated on Drawings.

2.2 UNDERLAVATORY GUARDS

A. Underlavatory Guard:

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. Plumberex Specialty Products, Inc.
  - b. Truebro by IPS Corporation.
2. Description: Insulating pipe covering for supply and drain piping assemblies that prevents direct contact with and burns from piping; allow service access without removing coverings.
3. Material and Finish: Antimicrobial, molded plastic, white.

2.3 CUSTODIAL ACCESSORIES

- A. Source Limitations: Obtain custodial accessories from single source from single manufacturer.

B. Utility Shelf:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. American Specialties, Inc.
  - b. Bobrick Washroom Equipment, Inc.
  - c. Bradley Corporation.
2. Description: With exposed edges turned down not less than 1/2 inch and supported by two triangular brackets welded to shelf underside.
3. Size: 16 inches long by 6 inches deep.
4. Material and Finish: Not less than nominal 0.05-inch- thick stainless steel, No. 4 finish (satin).

C. Mop and Broom Holder:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. American Specialties, Inc.
  - b. Bobrick Washroom Equipment, Inc.
  - c. Bradley Corporation.
2. Description: Unit with shelf, hooks, holders, and rod suspended beneath shelf.
3. Length: 36 inches.
4. Hooks: Four.
5. Mop/Broom Holders: Three, spring-loaded, rubber hat, cam type.
6. Material and Finish: Stainless steel, No. 4 finish (satin).
  - a. Shelf: Not less than nominal 0.05-inch- thick stainless steel.
  - b. Rod: Approximately 1/4-inch- diameter stainless steel.

2.4 MATERIALS

- A. Stainless Steel: ASTM A 666, Type 304, 0.031-inch minimum nominal thickness unless otherwise indicated.
- B. Galvanized-Steel Sheet: ASTM A 653/A 653M, with G60 hot-dip zinc coating.
- C. Galvanized-Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.
- D. Fasteners: Screws, bolts, and other devices of same material as accessory unit and tamper-and-theft resistant where exposed, and of galvanized steel where concealed.
- E. Mirrors: ASTM C 1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.
- F. ABS Plastic: Acrylonitrile-butadiene-styrene resin formulation.

## 2.5 FABRICATION

- A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.
- B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.
- B. Grab Bars: Install to withstand a downward load of at least 250 lbf, when tested according to ASTM F 446.

### 3.2 ADJUSTING AND CLEANING

- A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.
- B. Remove temporary labels and protective coatings.
- C. Clean and polish exposed surfaces according to manufacturer's written instructions.

END OF SECTION 102800

## SECTION 104416 - FIRE EXTINGUISHERS

### 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 portable, hand-carried fire extinguishers and mounting brackets for fire extinguishers.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include rating and classification, material descriptions, dimensions of individual components and profiles, and finishes for fire extinguisher and mounting brackets.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Warranty: Sample of special warranty.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fire extinguishers to include in maintenance manuals.

#### 1.6 COORDINATION

- A. Coordinate type and capacity of fire extinguishers with fire-protection cabinets to ensure fit and function.

#### 1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Failure of hydrostatic test according to NFPA 10.
    - b. Faulty operation of valves or release levers.

2. Warranty Period: Six years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."
- B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.
  1. Provide fire extinguishers approved, listed, and labeled by FM Global.

### 2.2 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

- A. Fire Extinguishers: Type, size, and capacity for each mounting bracket indicated.
  1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Amerex Corporation.
    - b. JL Industries, Inc.; a division of the Activar Construction Products Group.
    - c. Larsens Manufacturing Company.
    - d. Potter Roemer LLC; a Division of Morris Group International.
    - e. Pyro-Chem; Tyco Fire Suppression & Building Products.
  2. Valves: Manufacturer's standard.
  3. Handles and Levers: Manufacturer's standard.
  4. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B, and bar coding for documenting fire-extinguisher location, inspections, maintenance, and recharging.
- B. Multipurpose Dry-Chemical Type in Steel Container FE-2: UL-rated 4-A:60-B:C, 10-lb nominal capacity, with monoammonium phosphate-based dry chemical in enameled-steel container.

### 2.3 MOUNTING BRACKETS

- A. Mounting Brackets: Manufacturer's standard galvanized steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or black baked-enamel finish.
  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. Amerex Corporation.
  - b. JL Industries, Inc.; a division of the Activar Construction Products Group.
  - c. Larsens Manufacturing Company.
  - d. Potter Roemer LLC; a Division of Morris Group International.
  - e. Pyro-Chem; Tyco Fire Suppression & Building Products.
- B. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Engineer.
- 1. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.
    - a. Orientation: Vertical.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine fire extinguishers for proper charging and tagging.
  - 1. Remove and replace damaged, defective, or undercharged fire extinguishers.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 INSTALLATION

- A. General: Install fire extinguishers and mounting brackets in locations indicated and in compliance with requirements of authorities having jurisdiction.
  - 1. Mounting Brackets: 54 inches above finished floor to top of fire extinguisher.
- B. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.
- C. Verify that each fire extinguisher is present at Substantial Completion. Replace missing fire extinguishers with new to match specified product.

END OF SECTION 104416

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## SECTION 107316 - EXTRUDED ALUMINUM CANOPY

### 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 SCOPE OF WORK

- A. Furnish all labor, materials, equipment, and incidentals required to design, fabricate, deliver to project site, and erect the extruded aluminum, hanger rod supported canopy shown on the Drawings and as specified herein.
- B. Material furnished shall include the structural framing, connections, anchor bolts, aluminum roofing panels, roof drainage system, trim, flashing, closures, fasteners, expansion joint assemblies, sealant, and all other component parts for a complete canopy as shown on the Drawings.
- C. All materials shall be new, fabricated in a workman like manner, and free of defects.

#### 1.3 SUMMARY

- A. Section Includes:
  - 1. Hanger rod supported, pre-engineered metal canopies including fascia channels, decking, tension rods, and attachment hardware.
- B. Related Requirements:
  - 1. Section 042000 "Unit Masonry".
  - 2. Section 055000 "Metal Fabrications".
  - 3. Section 079200 "Joint Sealants".

#### 1.4 SUBMITTALS

- A. Product Data: For each type of product.
- B. Submit calculation summary, identifying all applied loads, load factors and load combinations and reactions for all connections transferred to the structure. Design in accordance with wind and seismic loads as required by the International Building Code. The calculation summary and reactions shall be signed and sealed by a Professional Engineer registered in the State of Florida.
- C. Shop Drawings: showing configuration consistent with plans and elevation shown. Provide plan, section, and elevation views of each condition. Provide details of all attached components,

Extruded Aluminum Canopy

including roof panels, roof drainage system, and details of interface to buildings. Drawings shall be signed and sealed by a Professional Engineer registered in the State of Florida.

- D. Submit complete details with structural properties (moment of inertia, section modules, modules of elasticity, etc.) for all proposed sections (beams, columns, decking, and other structural members).
- E. Submit the following records:
  - 1. Letter signed and sealed by a Professional Structural Engineer registered in the State of Florida certifying that the structural framing and covering panels proposed meet the design criteria set forth herein and on the Drawings.
  - 2. Two sets of design calculations signed and sealed by a Professional Structural Engineer registered in the State of Florida.
  - 3. One set of reproducible "as-built" erection plans.
  - 4. Signed and sealed plans and design calculations shall be submitted to the Engineer for approval prior to erection.
- F. Submit two each of the following samples for approval of materials, finish, color, and texture.
  - 1. 12-inch width by 12-inch long roofing panels in proposed colors and finish.
  - 2. Each proposed fastener.
  - 3. Closures and flashing in proposed material, color, and finish.
  - 4. Submit manufacturer's standard color charts for initial color selections.
  - 5. Submit pre-engineered canopy manufacturer's welder certifications.
- G. Evidence of compliance with the requirements of Paragraph 1.5.H, Quality Assurance, shall be included with the initial submittal for the products specified.
- H. Regulatory Approvals: Provide copy of current, valid statewide product approval for product, material or system as shown on the drawings and as specified in this section, in accordance with Rule 9N-3. Product approval shall be for the specific manufacturer, product type, model or style, and the State Approval Number.

## 1.5 QUALITY ASSURANCE

- A. Codes and Standards: Comply with provisions of the following, except as otherwise indicated:
  - 1. 2018 International Building Code (IBC).
  - 2. AWS (American Welding Society) standards for structural aluminum welding.
- B. Manufacturer: Obtain structural framing, roof panel system and drainage system components from only one manufacturer.
- C. Installer Qualification: Contractor with not less than 3 years' experience in installation of aluminum canopy of type, quantity and installation methods similar to work of this section.
- D. Manufacturer shall have a minimum of 10 years of experience in manufacturing and installing complete extruded aluminum canopy cover systems.

- E. Field Measurements: Take field measurements prior to preparation of shop drawings and fabrication where possible, to ensure proper fitting of work. However, allow for adjustments within specified toleration wherever taking of field measurements before fabrication might delay work.
- F. Shop Assembly: Preassemble units in shop to greatest extent possible and disassemble as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.
- G. Coordination: Coordinate work of this section with work of other sections that interface with canopy system (concrete steps, adjoining structures, paving etc.).
- H. The products, materials, and assemblies, including anchorage, proposed for the work of this Section shall comply with the International Building Code. Where a conflict occurs between the requirements of the Specification and the Code, the more stringent requirement shall apply.

#### 1.6 WARRANTY

- 1. Manufacturer shall warrant the entire system against defects in labor and materials for a period of 1 year commencing on the date of substantial completion as established in Division 01 of these specifications.
- 2. This warranty requires the manufacturer to do all that is necessary to effectively correct any deficiencies in a timely manner at no expense to the Owner.
- 3. Evidence of defects in labor and material may include, but is not limited to, one or more of the following:
  - a. Moisture leaks.
  - b. Metal failure including excessive deflection.
  - c. Fastener failure.
  - d. Finish failure.
- 4. The warranty specified in this Section shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to and run concurrent with other warranties made by the Contractor under requirements of the Contract Documents.
- 5. Provide the Engineer with 2 copies of warranty to be forwarded to Owner.

#### 1.7 REGULATORY REQUIREMENTS

- A. Provide products, materials and assemblies, including anchorage, proposed for the work of this Section that comply with project specific calculated design pressures and the Florida Building Code, including wind-borne debris region requirements. Provide products designed by the Manufacturer and installed by the Contractor to meet these requirements.
  - 1. Provide products that conform to the project design pressures in the components and cladding table on the structural drawings. Where a conflict occurs between the requirements of this Specification and the Florida Building Code, the more stringent requirement shall apply.

- B. Provide documentation that the Florida Building Code compliance for the products, materials and assemblies, including anchorage specified in this section have been incorporated into the Work. Demonstrate code compliance with the Florida Building Code, using one of the methods outlined in Chapter 9N-3 of the Florida Administrative Code, Department of Community Affairs, Florida Building Commission, Product Approval documentation.

## 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle prefabricated components, sheets, panels, and other manufactured items so they will not be damaged or deformed. Stack materials on platforms or pallets, covered with tarpaulins or other suitable weathertight ventilated covering. Store metal sheets or panels so that water accumulations will drain freely. Do not store sheets or panels in contact with other materials that might cause staining.

## PART 2 - PRODUCTS

### 2.1 GENERAL

- A. Pre-engineered canopy by Ditt-Deck, welded extruded aluminum walkway covers by Dittmer Architectural Aluminum; Mapes Industries, Inc.; or approved equal. Components listed are those manufactured by Dittmer Architectural Aluminum, used as the basis of design. All components provided under this section shall meet or exceed the requirements of the specification.
- B. Aluminum canopy shall consist entirely of extruded aluminum sections (roll-formed are not acceptable). System shall consist of heli-arc welded, one-piece rigid structural components, decking, fascia, hanger rods, accessory items, and hardware to provide a complete system. Manufacturer's design shall provide for adequate roof drainage.
- C. Field verification is required under Section 1.5 herein.
- D. The approved "Design/Construct" and erection drawings, defined under Section 1.4, signed and sealed by a Professional Structural Engineer registered in the State of Florida for identification and assembly of enclosure components, shall be provided onsite during construction.
- E. Field modification shall be in accordance with the best standard procedures and is the responsibility of the canopy constructor/erector.

### 2.2 PERFORMANCE REQUIREMENTS

- A. Provide aluminum canopy system that has been designed, produced, fabricated, and installed to withstand normal temperature changes as well as live loading, dead loading, wind loading, and seismic loading in compliance with the International Building Code requirements for the geographic area in which work is located and as follows:
  - 1. Live load: As indicated on Structural Drawings.

2. Snow load (ground): As indicated on Structural Drawings. Structural design for wind forces: As indicated on Structural Drawings. Basic wind speed: As noted on S-1 indicated on Structural Drawings.
3. Seismic load: As indicated on Structural Drawings. Sizes shown on drawings are to be considered minimum.

## 2.3 MATERIALS

- A. All aluminum extrusions shall be alloy 6063 heat-treated to a T-6 temper.
- B. Finish:
  1. Finish system shall be Kynar 500 PVF by Penwalt Corp., formulated by a licensed formulator to contain 70 percent PVF resin and applied by a licensed applicator. Epoxy prime coat shall be applied to both sides to a dry film thickness of approximately 0.2 mil. One coat of PVF color coating shall be applied to exposed sides to provide a dry film thickness of not less than 0.8 mil, 1.0 mil total coating.
  2. The surface condition of this finish coat shall be 100 percent free of holidays, drip marks, scratches, roll marks, or abrasions that are visible from a distance of 5-ft in good light when in installed position. Surfaces shall be free of checking, crazing, peeling, or loss of adhesion.
  3. Custom colors shall be provided to match other components as selected by the Engineer.
- C. Fasteners:
  1. Deck Screws (rivets not permitted): Type 18-8 non-magnetic stainless steel sealed with a neoprene O-ring beneath 5/8-in outside dimension, conical washer.
  2. Fascia Rivets: Size 3/16-in by 1/2-in grip range aluminum rivets with aluminum mandrel.
  3. Bolts: All bolts, nuts and washers to be 18-8 non -magnetic stainless steel.
  4. Tek Screws: not permitted.

## 2.4 FABRICATION

- A. Comply with indicated profiles, dimensioned requirements, and structural requirements.
- B. Use sections true to details with clean, straight, sharply defined profiles and smooth surfaces of uniform color and texture, free from defects impairing strength and durability.
- C. All welding to be done by heli-arc process.
- D. Mechanical joints shall consist of stainless steel bolts with a minimum of two bolts per fastening. Bolts and nuts shall be installed in a concealed manner utilizing 1/2-in thick by 1-1/2-in aluminum bolt bars welded to structural members. All such mechanical joints must be detailed on shop drawings showing all locations.
- E. Roof Deck: Extruded aluminum shapes, interlocking self-flashing sections. Shop fabricate to lengths and panel widths required for field assembly. Depth of sections to comply with structural requirements. Provide shop induced camber in deck units with spans greater than 16-ft-0-in to offset dead load deflections. Welded dams are to be used at non-draining ends of deck.

- F. Design the structure for thermal expansion and contraction. Provide weathertight expansion joints where shown on the Drawings and as otherwise required.
- G. Exposed rivets used to fasten bottom of fascia to deck to have finish to match fascia.

### PART 3 - EXECUTION

#### 3.1 DELIVERY, STORAGE AND HANDLING

- A. Deliver, store, and handle covered canopy system components as recommended by Manufacturer. Handle and store in a manner to avoid deforming members and to avoid excessive stresses.

#### 3.2 EXAMINATION

- A. Examine adjacent work for conditions that would prevent quality installation of system.
- B. Do not proceed until defects are corrected.

#### 3.3 FIELD DIMENSIONS

- A. Contractor shall field confirm bent locations, dimensions, and elevations shown on shop drawings prior to fabrication.

#### 3.4 INSTALLATION

- A. Install structural support members, roof deck sections, accessories and related flashing in accordance with manufacturer's instructions. Provide roof slope for water drainage without ponding water. Align and anchor roof deck units to structural support frames.
- B. Assemble all components in a neat, workmanlike manner.

#### 3.5 FLASHING

- A. Flashings: Provide approved flashing materials at adjoining structures as indicated in the approved shop drawings.

#### 3.6 CLEANING AND PROTECTION

- A. Damaged Units: Replace roof deck panels and other components of the work that have been damaged or have deteriorated beyond successful minor repair.
- B. Cleaning: Remove protective coverings at time in project construction sequence which will afford greatest protection of work. Clean finished surfaces as recommended by Manufacturer. Maintain in a clean condition during construction.

- C. Protection: Provide protection and surveillance procedures, as required to ensure that work of this section will be without damage or deterioration at time of substantial completion.

END OF SECTION 107316

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## SECTION 122413 - ROLLER WINDOW SHADES

### 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. Manually operated roller shades with single rollers.

- B. Related Requirements:

- 1. Section 061000 "Rough Carpentry" for wood blocking and grounds for mounting roller shades and accessories.
  - 2. Section 079200 "Joint Sealants" for sealing the perimeters of installation accessories for light-blocking shades with a sealant.

#### 1.3 ACTION SUBMITTALS

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

- 1. Include construction details, material descriptions, dimensions of individual components and profiles, features, finishes, and operating instructions for roller shades.

- B. Shop Drawings: Show fabrication and installation details for roller shades, including shadeband materials, their orientation to rollers, and their seam and batten locations.

- C. Samples: For each exposed product and for each color and texture specified, 10 inches long.

- D. Samples for Initial Selection: For each type and color of shadeband material.

- 1. Include Samples of accessories involving color selection.

- E. Product Schedule: For roller shades. Use same designations indicated on Drawings.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.

- B. Product Certificates: For each type of shadeband material.

- C. Product Test Reports: For each type of shadeband material, for tests performed by a qualified testing agency.

## 1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For roller shades to include in maintenance manuals.

## 1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Fabricator of products.

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver roller shades in factory packages, marked with manufacturer, product name, and location of installation using same designations indicated on Drawings.

## 1.8 FIELD CONDITIONS

- A. Environmental Limitations: Do not install roller shades until construction and finish work in spaces, including painting, is complete and dry and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- B. Field Measurements: Where roller shades are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Allow clearances for operating hardware of operable glazed units through entire operating range. Notify Engineer of installation conditions that vary from Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Source Limitations: Obtain roller shades from single source from single manufacturer.

### 2.2 MANUALLY OPERATED SHADES WITH SINGLE ROLLERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - 1. Hunter Douglas Contract.
  - 2. MechoShade Systems, Inc.
- B. Chain-and-Clutch Operating Mechanisms: With continuous-loop bead chain and clutch that stops shade movement when bead chain is released; permanently adjusted and lubricated.

1. Bead Chains: Stainless steel.
    - a. Loop Length: Full length of roller shade.
    - b. Limit Stops: Provide upper and lower ball stops.
    - c. Chain-Retainer Type: Clip, jamb mount.
  2. Spring Lift-Assist Mechanisms: Manufacturer's standard for balancing roller shade weight and for lifting heavy roller shades.
    - a. Provide for shadebands that weigh more than 10 lb or for shades as recommended by manufacturer, whichever criterion is more stringent.
  - C. Mounting Hardware: Brackets or endcaps, corrosion resistant and compatible with roller assembly, operating mechanism, installation accessories, and mounting location and conditions indicated.
  - D. Roller-Coupling Assemblies: Coordinated with operating mechanism and designed to join up to three inline rollers into a multiband shade that is operated by one roller drive-end assembly.
  - E. Shadebands:
    1. Shadeband Material: Light-filtering fabric.
    2. Shadeband Bottom (Hem) Bar: Steel or extruded aluminum.
      - a. Type: Enclosed in sealed pocket of shadeband material.
      - b. Color and Finish: As selected by Engineer from manufacturer's full range.
  - F. Installation Accessories:
    1. Front Fascia: Aluminum extrusion that conceals front and underside of roller and operating mechanism and attaches to roller endcaps without exposed fasteners.
      - a. Shape: L-shaped.
      - b. Height: Manufacturer's standard height required to conceal roller and shadeband assembly when shade is fully open, but not less than 4 inches.
    2. Exposed Headbox: Rectangular, extruded-aluminum enclosure including front fascia, top and back covers, endcaps, and removable bottom closure.
      - a. Height: Manufacturer's standard height required to enclose roller and shadeband assembly when shade is fully open, but not less than 4 inches.
    3. Endcap Covers: To cover exposed endcaps.
    4. Installation Accessories Color and Finish: As selected from manufacturer's full range.
- 2.3 SHADEBAND MATERIALS
- A. Shadeband Material Flame-Resistance Rating: Comply with NFPA 701. Testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - B. Light-Filtering Fabric: Woven fabric, stain and fade resistant.

1. Source: Roller shade manufacturer.
2. Type: PVC-coated polyester.
3. Weave: Mesh.
4. Thickness: .025 inches
5. Weight: 12.64 oz./sq. yd.
6. Roll Width: 72 inches.
7. Orientation on Shadeband: Up the bolt.
8. Openness Factor: 3 percent.
9. Color: As selected by Engineer from manufacturer's full range.

## 2.4 ROLLER SHADE FABRICATION

- A. Product Safety Standard: Fabricate roller shades to comply with WCMA A 100.1, including requirements for flexible, chain-loop devices; lead content of components; and warning labels.
- B. Unit Sizes: Fabricate units in sizes to fill window and other openings as follows, measured at 74 deg F:
  1. Between (Inside) Jamb Installation: Width equal to jamb-to-jamb dimension of opening in which shade is installed less 1/4 inch per side or 1/2-inch total, plus or minus 1/8 inch. Length equal to head-to-sill or -floor dimension of opening in which shade is installed less 1/4 inch, plus or minus 1/8 inch.
  2. Outside of Jamb Installation: Width and length as indicated, with terminations between shades of end-to-end installations at centerlines of mullion or other defined vertical separations between openings.
- C. Shadeband Fabrication: Fabricate shadebands without battens or seams to extent possible, except as follows:
  1. Vertical Shades: Where width-to-length ratio of shadeband is equal to or greater than 1:4, provide battens and seams at uniform spacings along shadeband length to ensure shadeband tracking and alignment through its full range of movement without distortion of the material.
  2. Railroaded Materials: Railroad material where material roll width is less than the required width of shadeband and where indicated. Provide battens and seams as required by railroaded material to produce shadebands with full roll-width panel(s) plus, if required, one partial roll-width panel located at top of shadeband.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

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

### 3.2 ROLLER SHADE INSTALLATION

- A. Install roller shades level, plumb, and aligned with adjacent units according to manufacturer's written instructions.
  - 1. Opaque Shadebands: Located so shadeband is not closer than 2 inches to interior face of glass. Allow clearances for window operation hardware.
- B. Roller Shade Locations: At exterior windows.

### 3.3 ADJUSTING

- A. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

### 3.4 CLEANING AND PROTECTION

- A. Clean roller shade surfaces, after installation, according to manufacturer's written instructions.
- B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that roller shades are without damage or deterioration at time of Substantial Completion.
- C. Replace damaged roller shades that cannot be repaired, in a manner approved by Engineer, before time of Substantial Completion.

### 3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain motor-operated roller shades.

END OF SECTION 122413

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## SECTION 123553.13 - METAL LABORATORY CASEWORK

### 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. Metal laboratory casework.
  - 2. Filler and closure panels.
  - 3. Laboratory countertops.
  - 4. Laboratory sinks.

- B. Related Requirements:

- 1. Section 061000 "Rough Carpentry" for wood blocking for anchoring laboratory casework.
  - 2. Section 092216 "Non-Structural Metal Framing" for reinforcements in metal-framed partitions for anchoring laboratory casework.
  - 3. Section 096513 "Resilient Base and Accessories" for resilient base applied to metal laboratory casework.

#### 1.3 DEFINITIONS

- A. MDF: Medium-density fiberboard.

- B. Hardwood Plywood: A panel product composed of layers, or plies, of veneer, or of veneers in combination with lumber core, hardboard core, MDF core, or particleboard core, joined with adhesive and faced both front and back with hardwood veneers.

#### 1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
- B. Keying Conference: Conduct conference at Project site. Incorporate keying conference decisions into final keying requirements.

## 1.5 COORDINATION

- A. Coordinate layout and installation of framing and reinforcements for support of laboratory casework.

## 1.6 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For laboratory casework. Include plans, elevations, sections, and attachment details.
  - 1. Indicate types and sizes of cabinets.
  - 2. Indicate locations of hardware and keying of locks.
  - 3. Indicate locations of blocking and reinforcements required for installing laboratory casework.
  - 4. Include details of support framing system.
  - 5. Indicate locations of and clearances from adjacent walls, doors, windows, other building components, and other laboratory equipment.
  - 6. Include coordinated dimensions for laboratory equipment specified in other Sections.
- C. Keying Schedule: Include schematic keying diagram and index each key set to unique designations that are coordinated with the Contract Documents.
- D. Samples for Initial Selection: For factory-applied finishes and other materials requiring color selection.

## 1.7 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For manufacturer.
- B. Product Test Reports for Casework: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating compliance of laboratory casework with requirements of specified product standard.
- C. Product Test Reports for Countertop Surface Material: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating compliance of laboratory countertop surface materials with requirements specified for chemical and physical resistance.

## 1.8 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish complete touchup kit for each type and color of metal laboratory casework provided. Include fillers, primers, paints, and other materials necessary to perform permanent repairs to damaged laboratory casework finish.
- B. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.



1. Cabinet Mounting Clips and Related Hardware: Quantity equal to 5 percent of amount installed, but no fewer than 20 of each type.
2. Modular Countertop Units: Two extra units of each length and material installed.

#### 1.9 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer that produces casework of types indicated for this Project that has been tested for compliance with SEFA 8 M.

#### 1.10 DELIVERY, STORAGE, AND HANDLING

- A. Protect finished surfaces during handling and installation with protective covering of polyethylene film or other suitable material.

#### 1.11 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install laboratory casework until building is enclosed, utility roughing-in and wet work are complete and dry, and temporary HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.
- B. Locate concealed framing, blocking, and reinforcements that support casework by field measurements before being enclosed, and indicate measurements on Shop Drawings.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  1. CIF Laboratory Solutions.
  2. Hanson Lab Solutions.
  3. Kewaunee Scientific Corporation.
- B. Source Limitations: Obtain laboratory casework from single source from single manufacturer unless otherwise indicated.
- C. Product Designations: Drawings indicate sizes and configurations of laboratory casework by referencing designated manufacturer's catalog numbers. Other manufacturers' laboratory casework of similar sizes and similar door and drawer configurations and complying with Specifications may be considered. See Section 016000 "Product Requirements."

## 2.2 PERFORMANCE REQUIREMENTS

- A. System Structural Performance: Laboratory casework and support framing system shall withstand the effects of the following gravity loads and stresses without permanent deformation, excessive deflection, or binding of drawers and doors:
1. Support Framing System: 600 lb/ft..
  2. Suspended Base Cabinets (Internal Load): 160 lb/ft..
  3. Work Surfaces (Including Tops of Suspended Base Cabinets): 160 lb/ft..
  4. Wall Cabinets (Upper Cabinets): 160 lb/ft..
  5. Shelves: 40 lb/sq. ft..

## 2.3 CASEWORK, GENERAL

- A. Casework Product Standard: Comply with SEFA 8 M, "Laboratory Grade Metal Casework."

## 2.4 METAL CABINET MATERIALS

- A. Metal: Cold-rolled, commercial steel (CS) sheet, complying with ASTM A 1008/A 1008M; matte finish; suitable for exposed applications.
- B. Nominal Metal Thickness:
1. Sides, Ends, Fixed Backs, Bottoms, Tops, Soffits, and Items Not Otherwise Indicated: 0.048 inch. Except for flammable liquid storage cabinets, bottoms may be 0.036 inch if reinforced.
  2. Back Panels, Doors, Drawer Fronts and Bodies, and Shelves: 0.036 inch except 0.048 inch for back panels and doors of flammable liquid storage cabinets and for unreinforced shelves more than 36 inches long.
  3. Intermediate Horizontal Rails, Table Aprons and Cross Rails, Center Posts, and Top Gussets: 0.060 inch.
  4. Drawer Runners, Sink Supports, and Hinge Reinforcements: 0.075 inch.
  5. Leveling and Corner Gussets: 0.105 inch.

## 2.5 COUNTERTOP AND SINK MATERIALS

- A. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304.

## 2.6 METAL CABINETS

- A. Fabrication: Assemble and finish units at point of manufacture. Use precision dies for interchangeability of like-size drawers, doors, and similar parts. Perform assembly on precision jigs to provide units that are square. Reinforce units with angles, gussets, and channels. Except where otherwise specified, integrally frame and weld cabinet bodies to form dirt- and vermin-resistant enclosures. Where applicable, reinforce base cabinets for sink support. Maintain uniform clearance around door and drawer fronts of 1/16 to 3/32 inch.

- B. Flush Doors: Outer and inner pans that nest into box formation, with full-height channel reinforcements at center of door. Fill doors with noncombustible, sound-deadening material.
- C. Hinged Doors: Mortise for hinges and reinforce with angles welded inside inner pans at hinge edge.
- D. Drawers: Fronts made from outer and inner pans that nest into box formation, with no raw metal edges at top. Sides, back, and bottom fabricated in one piece with rolled or formed top of sides for stiffening and comfortable grasp for drawer removal. Provide drawers with rubber bumpers, polymer roller slides, and positive stops to prevent metal-to-metal contact or accidental removal.
- E. Adjustable Shelves: Front, back, and ends formed down, with edges returned horizontally at front and back to form reinforcing channels.
- F. Toe Space: Fully enclosed, 4 inches high by 3 inches deep, with no open gaps or pockets.
- G. Filler and Closure Panels: Provide where indicated and as needed to close spaces between cabinets and walls, ceilings, and indicated equipment. Fabricate from same material and with same finish as cabinets and with hemmed or flanged edges unless otherwise indicated.

## 2.7 METAL CABINET FINISH

- A. General: Prepare, treat, and finish welded assemblies after assembling. Prepare, treat, and finish components that are to be assembled with mechanical fasteners before assembling. Prepare, treat, and finish concealed surfaces same as exposed surfaces.
- B. Preparation: After assembly, clean surfaces of mill scale, rust, oil, and other contaminants. After cleaning, apply a conversion coating suited to the organic coating to be applied over it.
- C. Chemical-Resistant Finish: Immediately after cleaning and pretreating, apply laboratory casework manufacturer's standard two-coat, chemical-resistant, baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of 2 mils.
  - 1. Chemical and Physical Resistance of Finish System: Finish complies with acceptance levels of cabinet surface finish tests in SEFA 8 M. Acceptance level for chemical spot test shall be no more than four Level 3 conditions.
  - 2. Colors for Metal Laboratory Casework Finish: As selected by Engineer from manufacturer's full range.

## 2.8 HARDWARE

- A. General: Provide laboratory casework manufacturer's standard, commercial-quality, heavy-duty hardware complying with requirements indicated for each type.
- B. Hinges: Stainless-steel, five-knuckle hinges complying with BHMA A156.9, Grade 1, with antifriction bearings and rounded tips. Provide two for doors 48 inches high or less and three for doors more than 48 inches high.

- C. Hinged Door and Drawer Pulls: Solid-aluminum, stainless-steel, or chrome-plated-brass, back-mounted pulls. Provide two pulls for drawers more than 24 inches wide.
  - 1. Design: Wire pulls.
  - 2. Overall Size: 1 by 4-1/2 inches.
- D. Door Catches: Nylon-roller spring catches. Provide two catches on doors more than 48 inches high.
- E. Drawer Slides: Side mounted, epoxy-coated steel, self-closing; designed to prevent rebound when drawers are closed; complying with BHMA A156.9, Type B05091.
  - 1. Heavy Duty (Grade 1HD-100 and Grade 1HD-200): Full-extension, ball-bearing type.
- F. Label Holders: Stainless steel, aluminum, or chrome plated; sized to receive standard label cards approximately 1 by 2 inches, attached with screws or rivets. Provide on all drawers.
- G. Locks: Cam or half-mortise type with five-pin tumbler, brass with chrome-plated finish; complying with BHMA A156.11, Type E07281, Type E07111, or Type E07021.
  - 1. Provide a minimum of two keys per lock and two master keys.
  - 2. Provide on all drawers and doors.
  - 3. Keying: Key locks alike within each room; key each room separately.
  - 4. Master Key System: Key all locks to be operable by master key.

## 2.9 COUNTERTOPS AND SINKS

- A. Countertops, General: Provide units with smooth surfaces in uniform plane, free of defects. Make exposed edges and corners straight and uniformly beveled. Provide front and end overhang of 1 inch, with continuous drip groove on underside 1/2 inch from edge.
- B. Sinks, General: Provide sizes indicated or laboratory casework manufacturer's closest standard size of equal or greater volume, as approved by Engineer.
  - 1. Outlets: Provide with strainers and tailpieces, NPS 1-1/2, unless otherwise indicated.
  - 2. Overflows: Where indicated, provide overflow of standard beehive or open-top design with separate strainer. Height 2 inches less than sink depth. Provide in same material as strainer.
- C. Stainless-Steel Countertops: Made from stainless-steel sheet, not less than 0.062-inch nominal thickness, with No. 4 satin finish.
  - 1. Extend top down 1 inch at edges with a 1/2-inch return flange under frame. Apply heavy coating of heat-resistant, sound-deadening mastic to undersurface.
  - 2. Form backsplash coved to and integral with top surface.
  - 3. Provide raised (marine) edge around perimeter of countertops containing sinks.
  - 4. Pitch countertops containing sinks two ways to sink without channeling or grooving.
  - 5. Factory punch holes for service fittings.
  - 6. Reinforce underside of countertop with channels or use thicker metal sheet where necessary to ensure rigidity without deflection.

7. Weld shop-made joints.
  8. Where field-made joints are required, provide hairline butt joints mechanically bolted through continuous channels welded to underside at edges of joined ends. Keep field jointing to a minimum.
  9. Where stainless-steel sinks or cup sinks occur in stainless-steel countertops, factory weld into one integral unit.
  10. After fabricating and welding, grind surfaces smooth, and polish as needed to produce uniform, directionally textured finish with no cross scratches or evidence of welds. Passivate and rinse surfaces; remove embedded foreign matter and leave surfaces clean.
- D. Stainless-Steel Sinks: Made from stainless-steel sheet, not less than 0.050-inch nominal thickness. Fabricate with corners rounded and coved to at least 5/8-inch radius. Slope sink bottoms to outlet. Provide double-wall construction for sink partitions, with top edge rounded to at least 1/2-inch diameter. Provide continuous butt-welded joints. After fabricating and welding, grind surfaces smooth, and polish as needed to produce uniform finish with no cross scratches or evidence of welds. Passivate and rinse surfaces; remove embedded foreign matter and leave surfaces clean.
1. Factory punch holes for fittings.
  2. Provide with stainless-steel strainers and tailpieces.
  3. Provide with integral rims except where located in stainless-steel countertops.
  4. Apply 1/8-inch- thick coating of heat-resistant, sound-deadening mastic to undersink surfaces.

## 2.10 LABORATORY ACCESSORIES

- A. Pegboards: Stainless-steel pegboards with removable polypropylene pegs and stainless-steel drip troughs with drain outlet.

## 2.11 WATER AND LABORATORY GAS SERVICE FITTINGS

- A. Service Fittings: Provide units that comply with SEFA 7, "Laboratory and Hospital Fixtures - Recommended Practices." Provide fittings complete with washers, locknuts, nipples, and other installation accessories. Include wall and deck flanges, escutcheons, handle extension rods, and similar items.
1. Provide units that comply with "Vandal-Resistant Faucets and Fixtures" recommendations in SEFA 7.
- B. Materials: Fabricated from cast or forged red brass unless otherwise indicated.
1. Reagent-Grade Water Service Fittings: Polypropylene, PVC, or PVDF for parts in contact with water.
- C. Finish: Chromium plated.
1. Provide chemical-resistant powder coating in laboratory casework manufacturer's standard metallic brown, aluminum, white, or other color as approved by Engineer.

- D. Water Valves and Faucets: Provide units complying with ASME A112.18.1, with renewable seats, designed for working pressure up to 80 psig.
  - 1. Aerators: Provide aerators on water fittings that do not have serrated outlets.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

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

#### 3.2 INSTALLATION OF CABINETS

- A. Comply with installation requirements in SEFA 2.3. Install level, plumb, and true; shim as required, using concealed shims. Where laboratory casework abuts other finished work, apply filler strips and scribe for accurate fit, with fasteners concealed where practical. Do not exceed the following tolerances:
  - 1. Variation of Tops of Base Cabinets from Level: 1/16 inch in 10 feet.
  - 2. Variation of Bottoms of Upper Cabinets from Level: 1/8 inch in 10 feet.
  - 3. Variation of Faces of Cabinets from a True Plane: 1/8 inch in 10 feet.
  - 4. Variation of Adjacent Surfaces from a True Plane (Lippage): 1/32 inch.
  - 5. Variation in Alignment of Adjacent Door and Drawer Edges: 1/16 inch.
- B. Base Cabinets: Fasten cabinets to utility-space framing, partition framing, wood blocking, or reinforcements in partitions, with fasteners spaced not more than 16 inches o.c. Bolt adjacent cabinets together with joints flush, tight, and uniform.
  - 1. Where base cabinets are installed away from walls, fasten to floor at toe space at not more than 24 inches o.c. and at sides of cabinets with not less than two fasteners per side.
- C. Wall Cabinets: Fasten to hanging strips, masonry, partition framing, blocking, or reinforcements in partitions. Fasten each cabinet through back, near top, at not less than 16 inches o.c.
- D. Install hardware uniformly and precisely. Set hinges snug and flat in mortises.
- E. Adjust laboratory casework and hardware so doors and drawers align and operate smoothly without warp or bind and contact points meet accurately. Lubricate operating hardware as recommended by manufacturer.

#### 3.3 INSTALLATION OF COUNTERTOPS

- A. Comply with installation requirements in SEFA 2.3. Abut top and edge surfaces in one true plane with flush hairline joints and with internal supports placed to prevent deflection. Locate joints only where indicated on Shop Drawings.

- B. Field Jointing: Where possible, make in same manner as shop-made joints, using dowels, splines, fasteners, adhesives, and sealants recommended by manufacturer. Shop prepare edges for field-made joints.
  - 1. Use concealed clamping devices for field-made joints in plastic-laminate countertops. Locate clamping devices within 6 inches of front and back edges and at intervals not exceeding 24 inches. Tighten according to manufacturer's written instructions to exert a uniform heavy pressure at joints.
- C. Fastening:
  - 1. Secure countertops, except for epoxy countertops, to cabinets with Z-type fasteners or equivalent, using two or more fasteners at each cabinet front, end, and back.
  - 2. Where necessary to penetrate countertops with fasteners, countersink heads approximately 1/8 inch, and plug hole flush with material equal to countertop in chemical resistance, hardness, and appearance.
- D. Provide required holes and cutouts for service fittings.
- E. Provide scribe moldings for closures at junctures of countertop, curb, and splash with walls as recommended by manufacturer for materials involved. Match materials and finish to adjacent laboratory casework. Use chemical-resistant, permanently elastic sealing compound where recommended by manufacturer.
- F. Carefully dress joints smooth, remove surface scratches, and clean entire surface.

### 3.4 INSTALLATION OF SINKS

- A. Comply with installation requirements in SEFA 2.3.
- B. Semiflush Installation of Stainless-Steel Sinks: Before setting, apply sink and countertop manufacturers' recommended sealant under rim lip and along top. Remove excess sealant while still wet and finish joint for neat appearance.

### 3.5 INSTALLATION OF LABORATORY ACCESSORIES

- A. Install accessories according to Shop Drawings, installation requirements in SEFA 2.3, and manufacturer's written instructions.
- B. Securely fasten adjustable shelving supports, stainless-steel shelves, and pegboards to partition framing, wood blocking, or reinforcements in partitions.
- C. Install shelf standards plumb and at heights to align shelf brackets for level shelves. Install shelving level and straight, closely fitted to other work where indicated.
- D. Securely fasten pegboards to partition framing, wood blocking, or reinforcements in partitions.

### 3.6 INSTALLATION OF SERVICE FITTINGS

- A. Comply with requirements in other Sections for installing water service fittings.
- B. Install fittings according to Shop Drawings, installation requirements in SEFA 2.3, and manufacturer's written instructions. Set bases and flanges of sink- and countertop-mounted fittings in sealant recommended by manufacturer of sink or countertop material. Securely anchor fittings to laboratory casework unless otherwise indicated.

### 3.7 CLEANING AND PROTECTING

- A. Clean finished surfaces, touch up as required, and remove or refinish damaged or soiled areas to match original factory finish, as approved by Engineer.
- B. Protect countertop surfaces during construction with 6-mil plastic or other suitable water-resistant covering. Tape to underside of countertop at a minimum of 48 inches o.c.

### 3.8 SERVICE-FITTING SCHEDULE

- A. Water Service Fitting, Type WF:
  - 1. Fitting Type: Swing-spout mixing faucet.
  - 2. Outlet: Aerator.
  - 3. Mounting: Deck mounted.

END OF SECTION 123553.13



## SECTION 124843.33 - RUBBER INSULATING FLOOR MATS

### 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: Rubber insulating floor mats for electrical resistance, for non-adhesive installation.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product construction details, material descriptions, dimensions, profiles, and finishes.
- B. Product Schedule: Show locations and sizes of floor mats in relation to each piece of electrical equipment. Use same designations indicated on Drawings.
- C. Samples: 3 inches square sample of rubber insulating floor mats.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For rubber insulating matting to include in maintenance manuals.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Reject floor mats that are damaged.
- B. Store mats without distortion, out of direct sun light or sources of ozone, and at a temperature not to exceed 95 degrees F.

#### 1.6 WARRANTY

- A. Special Warranty: Submit manufacturer's standard written warranty agreeing to repair or replace rubber insulating floor mats that fail in materials or workmanship under normal usage conditions within specified warranty period.
  - 1. Warranty Period: Five years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to the following or equal:
1. American Floor Products Company, Inc.: A.S.T.M. Switchboard.
  2. Musson Rubber Company: Switchboard Runner Matting.
  3. Wearwell, LLC: Corrugated Switchboard.

### 2.2 MATERIALS

- A. Rubber: Comply with ASTM D178 and the following:
1. Type I, consisting of vulcanized elastomer or combination of elastomer compounds.
  2. Class and Thickness: 2 - 0.25 inch.
  3. Width: 3 feet minimum..
  4. Length: One continuous full-length piece in front of each motor control center, power center, switchgear, and board and control panel.

### 2.3 FABRICATION

- A. Fabricate rubber insulating floor mats as surface-type units for use as a floor covering for protection of workers from electrical hazards.
1. Front Surface: Consist of a corrugated design.
  2. Back Surface: Consist of fabric or may have one or more fabric inserts.
    - a. Back of floor mats may be finished with cloth imprint or other slip-resistant material with no adverse effect to dielectric characteristics of the mat.
- B. Clearly and permanently mark each floor mat at a maximum interval of 3 feet with the name of manufacturer or supplier, ASTM D178, Type, and Class.
- C. Shop fabricate units to greatest extent possible in sizes indicated. Do not exceed manufacturer's recommended maximum sizes for units that are removeable for maintenance and cleaning.
- D. Bevel edges of mats or attach electric insulating rubber reducing strips as approved to provide a non-trip perimeter.
- E. Miter corner joints in framing elements with hairline joints or provide prefabricated corner units without joints.
- F. Where necessary to butt floor mats, space symmetrically and away from normal traffic lanes.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, for compliance with requirements for installation tolerances,, and other conditions affecting performance of the Work.
- B. Examine rubber insulating floor mats before installation. Reject damaged mats.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Install mats according to manufacturer's installation instructions and where located on approved Shop Drawings.
- B. Install mats in one continuous piece.
  - 1. Where equipment faces each other and is less than six feet apart, provide one width of mat.
- C. Install floor mats loosely laid allowing for mat removal for cleaning and temporary relocation when moving electrical equipment.
- D. Delay setting mats until construction traffic has ended and to prevent accumulation of dirt, dust, deleterious films, and other physical damage.

### 3.3 PROTECTION

- A. Protect floor mats as required to prevent damage and so that mats are clean at Substantial Completion.

END OF SECTION 124843.33

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## SECTION 210517 - SLEEVES AND SLEEVE SEALS FOR FIRE-SUPPRESSION PIPING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:

1. Sleeves.
2. Stack-sleeve fittings.
3. Sleeve-seal systems.
4. Sleeve-seal fittings.
5. Grout.
6. Silicone sealants.

#### 1.3 ACTION SUBMITTALS

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

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

### PART 2 - PRODUCTS

#### 2.1 SLEEVES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Advance Products & Systems, Inc.
  2. CALPICO, Inc.
  3. GPT; an EnPro Industries company.
  4. Or equal.
- B. Cast-Iron Pipe Sleeves: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop.

- C. Steel Pipe Sleeves: ASTM A53/A53M, Type E, Grade B, Schedule 40, anticorrosion coated or galvanized, with plain ends and integral welded waterstop collar.
- D. Galvanized-Steel Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

## 2.2 STACK-SLEEVE FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Jay R. Smith Mfg. Co.
  - 2. Zurn Industries, LLC.
  - 3. Or equal.
- B. Description: Manufactured, Dura-coated or Duco-coated galvanized cast-iron sleeve with integral clamping flange for use in waterproof floors and roofs. Include clamping ring, bolts, and nuts for membrane flashing.
  - 1. Underdeck Clamp: Clamping ring with setscrews.

## 2.3 SLEEVE-SEAL SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Advance Products & Systems, Inc.
  - 2. CALPICO, Inc.
  - 3. GPT; an EnPro Industries company.
  - 4. Or equal.
- B. Description:
  - 1. Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
  - 2. Designed to form a hydrostatic seal of 20 psig minimum.
  - 3. Sealing Elements: EPDM-rubber High-temperature-silicone Nitrile (Buna N) interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size.
  - 4. Pressure Plates: Stainless steel, Type 316.
  - 5. Connecting Bolts and Nuts: Stainless steel, Type 316, of length required to secure pressure plates to sealing elements.

## 2.4 SLEEVE-SEAL FITTINGS

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

1. Advance Products & Systems, Inc.
  2. CALPICO, Inc.
  3. GPT; an EnPro Industries company.
  4. Or equal.
- B. Description: Manufactured plastic, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall.
- C. Plastic or rubber waterstop collar with center opening to match piping OD.

## 2.5 GROUT

- A. Description: Nonshrink, 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.

## 2.6 SILICONE SEALANTS

- A. Silicone, S, NS, 25, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant, ASTM C 920, Type S, Grade NS, Class 25, Use NT.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Dow Corning Corporation.
    - b. GE Construction Sealants; Momentive Performance Materials Inc.
    - c. Sherwin-Williams Company (The).
    - d. Or equal.
- B. Silicone, S, P, 25, T, NT: Single-component, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade P, Class 25, Uses T and NT. Grade P Pourable (self-leveling) formulation is for opening in floors and other horizontal surfaces that are not fire rated.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. May National Associates, Inc.; a subsidiary of Sika Corporation.
    - b. Or equal.
- C. Silicone Foam: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - a. Smooth-On.
  - b. Or equal.

## PART 3 - EXECUTION

### 3.1 SLEEVE INSTALLATION

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
- B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.
  1. Sleeves are not required for core-drilled holes.
- C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
  1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
  2. 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.
  3. Using grout or silicone sealant, seal space outside of sleeves in slabs and walls without sleeve-seal system.
- D. Install sleeves for pipes passing through interior partitions.
  1. Cut sleeves to length for mounting flush with both surfaces.
  2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
  3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint.
- E. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke Barrier Penetrations: Maintain indicated fire or smoke rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping and fill materials specified in Section 078413 "Penetration Firestopping."



### 3.2 STACK-SLEEVE-FITTING INSTALLATION

- A. Install stack-sleeve fittings in new slabs as slabs are constructed.
  - 1. Install fittings that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
  - 2. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Section 076200 "Sheet Metal Flashing and Trim."
  - 3. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level.
  - 4. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
  - 5. Use silicone sealant to seal around the outside of stack-sleeve fittings.
- B. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke Barrier Penetrations: Maintain indicated fire or smoke rating of floors at pipe penetrations. Seal pipe penetrations with fire- or smoke-stop materials. Comply with requirements for firestopping specified in Section 078413 "Penetration Firestopping."

### 3.3 SLEEVE-SEAL-SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.
- B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

### 3.4 SLEEVE-SEAL-FITTING INSTALLATION

- A. Install sleeve-seal fittings in new walls and slabs as they are constructed.
- B. 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.
- C. Secure nailing flanges to concrete forms.
- D. Use grout or silicone sealant, to seal the space around outside of sleeve-seal fittings.

### 3.5 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
  - 1. Leak Test: After allowing for a full cure, test sleeves and sleeve seals for leaks. Repair leaks and retest until no leaks exist.

- B. Sleeves and sleeve seals will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

### 3.6 SLEEVE AND SLEEVE-SEAL SCHEDULE

- A. Use sleeves and sleeve seals for the following piping-penetration applications:
  - 1. Exterior Concrete Walls above Grade:
    - a. Piping Smaller Than NPS 6: Cast-iron pipe sleeves Steel pipe sleeves.
    - b. Piping NPS 6 and Larger: Steel pipe sleeves.
  - 2. Exterior Concrete Walls below Grade:
    - a. Piping Smaller Than NPS 6: Steel pipe sleeves with sleeve-seal system.
      - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
    - b. Piping NPS 6 and Larger: Steel pipe sleeves with sleeve-seal system.
      - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
  - 3. Concrete Slabs-on-Grade:
    - a. Piping Smaller Than NPS 6: Steel pipe sleeves with sleeve-seal system.
      - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
    - b. Piping NPS 6 and Larger: Steel pipe sleeves with sleeve-seal system.
      - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
  - 4. Concrete Slabs above Grade:
    - a. Piping Smaller Than NPS 6: Steel pipe sleeves.
    - b. Piping NPS 6 and Larger: Steel pipe sleeves.

END OF SECTION 210517

## SECTION 210523 - GENERAL-DUTY VALVES FOR FIRE PROTECTION 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. Check valves.
  - 2. Bronze OS&Y gate valves.
  - 3. Indicator posts.
  - 4. Trim and drain valves.

#### 1.3 DEFINITIONS

- A. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
- B. NRS: Nonrising stem.
- C. OS&Y: Outside screw and yoke.
- D. SBR: Styrene-butadiene rubber.

#### 1.4 ACTION SUBMITTALS

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

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
  - 1. Protect internal parts against rust and corrosion.
  - 2. Protect threads, flange faces, and weld ends.
  - 3. Set valves open to minimize exposure of functional surfaces.
- 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 operating handles or stems as lifting or rigging points.
- D. Protect flanges and specialties from moisture and dirt.

## PART 2 - PRODUCTS

### 2.1 GENERAL REQUIREMENTS FOR VALVES

- A. UL Listed: Valves shall be listed in UL's "Online Certifications Directory" under the headings listed below and shall bear UL mark:
  - 1. Main Level: HAMV - Fire Main Equipment.
    - a. Level 1: HCBZ - Indicator Posts, Gate Valve.
    - b. Level 1: HLOT - Valves.
      - 1) Level 3: HLUG - Ball Valves, System Control.
      - 2) Level 3: HLXS - Butterfly Valves.
      - 3) Level 3: HMER - Check Valves.
      - 4) Level 3: HMRZ - Gate Valves.
  - 2. Main Level: VDGT - Sprinkler System & Water Spray System Devices.
    - a. Level 1: VQGU - Valves, Trim and Drain.
- B. FM Global Approved: Valves shall be listed in its "Approval Guide," under the headings listed below:
  - 1. Automated Sprinkler Systems:
    - a. Indicator posts.
    - b. Valves.
      - 1) Gate valves.
      - 2) Check valves.
        - a) Single check valves.
      - 3) Miscellaneous valves.
- C. Source Limitations for Valves: Obtain valves for each valve type from single manufacturer.
- D. ASME Compliance:
  - 1. ASME B16.1 for flanges on iron valves.
  - 2. ASME B1.20.1 for threads for threaded-end valves.
  - 3. ASME B31.9 for building services piping valves.
- E. AWWA Compliance: Comply with AWWA C606 for grooved-end connections.

- F. NFPA Compliance: Comply with NFPA 24 for valves.
- G. Valve Pressure Ratings: Not less than the minimum pressure rating indicated or higher as required by system pressures.
- H. Valve Sizes: Same as upstream piping unless otherwise indicated.
- I. Valve Actuator Types:
  - 1. Worm-gear actuator with handwheel for quarter-turn valves, except for trim and drain valves.
  - 2. Handwheel: For other than quarter-turn trim and drain valves.
  - 3. Handlever: For quarter-turn trim and drain valves NPS 2 and smaller.

## 2.2 CHECK VALVES

- A. Description:
  - 1. Standard: UL 312 and FM Global standard for swing check valves, Class Number 1210.
  - 2. Minimum Pressure Rating: 175 psig.
  - 3. Type: Single swing check.
  - 4. Body Material: Cast iron, ductile iron, or bronze.
  - 5. Clapper: Bronze, ductile iron, or stainless steel with elastomeric seal.
  - 6. Clapper Seat: Brass, bronze, or stainless steel.
  - 7. Hinge Shaft: Bronze or stainless steel.
  - 8. Hinge Spring: Stainless steel.
  - 9. End Connections: Flanged, grooved, or threaded.

## 2.3 BRONZE OS&Y GATE VALVES

- A. Description:
  - 1. Standard: UL 262 and FM Global standard for fire-service water control valves (OS&Y- and NRS-type gate valves).
  - 2. Minimum Pressure Rating: 175 psig.
  - 3. Body and Bonnet Material: Bronze or brass.
  - 4. Wedge: One-piece bronze or brass.
  - 5. Wedge Seat: Bronze.
  - 6. Stem: Bronze or brass.
  - 7. Packing: Non-asbestos PTFE.
  - 8. Supervisory Switch: External.
  - 9. End Connections: Threaded.

## 2.4 INDICATOR POSTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. American Cast Iron Pipe Company.
  2. Mueller Co.
  3. NIBCO INC.
  4. Or equal.
- B. Description:
1. Standard: UL 789 and FM Global standard for indicator posts.
  2. Type: Underground.
  3. Base Barrel Material: Cast or ductile iron.
  4. Extension Barrel: Cast or ductile iron.
  5. Cap: Cast or ductile iron.
  6. Operation: Wrench Handwheel.

## 2.5 TRIM AND DRAIN VALVES

- A. Ball Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. NIBCO INC.
    - b. Potter Roemer LLC.
    - c. WATTS.
    - d. Or equal.
  2. Description:
    - a. Pressure Rating: 175 psig.
    - b. Body Design: Two piece.
    - c. Body Material: Forged brass or bronze.
    - d. Port size: Full or standard.
    - e. Seats: PTFE.
    - f. Stem: Bronze or stainless steel.
    - g. Ball: Chrome-plated brass.
    - h. Actuator: Handlever.
    - i. End Connections for Valves NPS 1 through NPS 2-1/2: Threaded ends.
    - j. End Connections for Valves NPS 1-1/4 and NPS 2-1/2: Grooved ends.
- B. Angle Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Fire Protection Products, Inc.
    - b. NIBCO INC.
    - c. United Brass Works, Inc.
    - d. Or equal.
  - 2. Description:
    - a. Pressure Rating: 175 psig.
    - b. Body Material: Brass or bronze.
    - c. Ends: Threaded.
    - d. Stem: Bronze.
    - e. Disc: Bronze.
    - f. Packing: Asbestos free.
    - g. Handwheel: Malleable iron, bronze, or aluminum.
- C. Globe Valves:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. NIBCO INC.
    - b. United Brass Works, Inc.
    - c. Or equal.
  - 2. Description:
    - a. Pressure Rating: 175 psig.
    - b. Body Material: Bronze with integral seat and screw-in bonnet.
    - c. Ends: Threaded.
    - d. Stem: Bronze.
    - e. Disc Holder and Nut: Bronze.
    - f. Disc Seat: Nitrile.
    - g. Packing: Asbestos free.
    - h. Handwheel: Malleable iron, bronze, or aluminum.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.

- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Do not attempt to repair defective valves; replace with new valves.

### 3.2 GENERAL REQUIREMENTS FOR VALVE INSTALLATION

- A. Comply with requirements in the following Sections for specific valve installation requirements and applications:
  - 1. Section 211100 "Facility Fire-Suppression Water Service Piping" for application of valves in fire-suppression water-service piping outside the building.
  - 2. Section 211313 "Wet-Pipe Sprinkler Systems" for application of valves in wet-pipe, fire-suppression sprinkler systems.
- B. Install listed fire-protection shutoff valves supervised-open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.
- C. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.
- D. Install valves having threaded connections with unions at each piece of equipment arranged to allow easy access, service, maintenance, and equipment removal without system shutdown. Provide separate support where necessary.
- E. Install valves in horizontal piping with stem at or above the pipe center.
- F. Install valves in position to allow full stem movement.
- G. Install valve tags. Comply with the NFPA standard applying to the piping system in which valves are installed. Install permanent identification signs indicating the portion of system controlled by each valve.
- H. Install listed fire-protection shutoff valves supervised-open, located to control sources of water supply except from fire-department connections.
- I. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.

END OF SECTION 210523



## SECTION 210529 - HANGERS AND SUPPORTS FOR FIRE SUPPRESSION 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. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Metal framing systems.
4. Thermal hanger-shield inserts.
5. Fastener systems.
6. Equipment supports.

- B. Related Requirements:

1. Section 055000 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Section 210548 "Vibration and Seismic Controls for Fire-Suppression Piping and Equipment" for vibration isolation devices and seismic restraints.

#### 1.3 ACTION SUBMITTALS

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

- B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following:

1. Trapeze pipe hangers.
2. Metal framing systems.
3. Equipment supports.

- C. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Detail fabrication and assembly of trapeze hangers.
2. Include design calculations for designing trapeze hangers.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

#### 1.5 QUALITY ASSURANCE

- A. Structural-Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M.
- B. Pipe Welding Qualifications: Qualify procedures and operators according to 2015 ASME Boiler and Pressure Vessel Code, Section IX.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design trapeze pipe hangers and equipment supports.
- B. Structural Performance: Hangers and supports for fire-suppression piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
  - 1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
  - 2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
  - 3. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.
- C. NFPA Compliance: Comply with NFPA 13.
- D. UL Compliance: Comply with UL 203.

#### 2.2 METAL PIPE HANGERS AND SUPPORTS

- A. Carbon-Steel Pipe Hangers and Supports:
  - 1. Description: Factory-fabricated components, NFPA approved, UL listed, or FM approved for fire-suppression piping support.
  - 2. Galvanized Metallic Coatings: Pre-galvanized or hot-dip galvanized.
  - 3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.
- B. Copper Pipe and Tube Hangers:
  - 1. Description: Copper-coated-steel, factory-fabricated components, NFPA approved, UL listed, or FM approved for fire-suppression piping support.
  - 2. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

## 2.3 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-58, Type 59, shop- or field-fabricated pipe-support assembly, made from structural-carbon-steel shapes, with NFPA-approved, UL-listed, or FM-approved carbon-steel hanger rods, nuts, saddles, and U-bolts.

## 2.4 METAL FRAMING SYSTEMS

### A. MFMA Manufacturer Metal Framing Systems:

1. Description: Shop- or field-fabricated pipe-support assembly, made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
2. Standard: Comply with MFMA-4, factory-fabricated components for field assembly.
3. Channels: Continuous slotted carbon-steel channel with inturned lips.
4. Channel Width: Selected for applicable load criteria.
5. Channel Nuts: Formed or stamped nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
7. Metallic Coating: Hot-dip galvanized.
8. Paint Coating: Green epoxy, acrylic, or urethane.

### B. Non-MFMA Manufacturer Metal Framing Systems:

1. Description: Shop- or field-fabricated pipe-support assembly, made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
2. Standard: Comply with MFMA-4, factory-fabricated components for field assembly.
3. Channels: Continuous slotted carbon-steel channel with inturned lips.
4. Channel Width: Select for applicable load criteria.
5. Channel Nuts: Formed or stamped nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
7. Metallic Coating: Hot-dip galvanized.
8. Paint Coating: Green epoxy, acrylic, or urethane.

## 2.5 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: NFPA-approved, UL-listed, or FM-approved threaded-steel stud, for use in hardened portland cement concrete, with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
- B. Mechanical-Expansion Anchors: NFPA-approved, UL-listed, or FM-approved, insert-wedge-type anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
  1. Indoor Applications: Stainless-steel.
  2. Outdoor Applications: Stainless-steel.

## 2.6 EQUIPMENT SUPPORTS

- A. Description: NFPA-approved, UL-listed, or FM-approved, welded, shop- or field-fabricated equipment support, made from structural-carbon-steel shapes.

## 2.7 MATERIALS

- A. Aluminum: ASTM B221.
- B. Carbon Steel: ASTM A1011/A1011M.
- C. Structural Steel: ASTM A36/A36M, carbon-steel plates, shapes, and bars; black and galvanized.
- D. Stainless Steel: ASTM A240/A240M.
- E. Grout: ASTM C1107/C1107M, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout, suitable for interior and exterior applications.
  - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
  - 2. Design Mix: 5000-psi, 28-day compressive strength.

## PART 3 - EXECUTION

### 3.1 APPLICATION

- A. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation, for penetrations through fire-rated walls, ceilings, and assemblies.
- B. Strength of Support Assemblies: Where not indicated, select sizes of components, so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

### 3.2 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with installation requirements of approvals and listings. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-58. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
  - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller-diameter pipes as specified for individual pipe hangers.
  - 2. Field fabricate from ASTM A 36/A 36M carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
- C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal strut 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. Install in accordance with approvals and listings.
  - 2. Install mechanical-expansion anchors in concrete, after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions. Install in accordance with approvals and listings.
- F. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- G. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- H. 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.
- I. Install lateral bracing with pipe hangers and supports to prevent swaying.
- J. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- K. Load Distribution: Install hangers and supports, so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- L. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- M. Insulated Piping:
  - 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 allowed by ASME B31.9 for building services piping.
  - 2. Install MSS SP-58, Type 39 protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
    - a. Option: Thermal hanger-shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

3. Install MSS SP-58, Type 40 protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
  - a. Option: Thermal hanger-shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
4. Shield Dimensions for Pipe: Not less than the following:
  - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
  - b. NPS 4: 12 inches long and 0.06 inch thick.
  - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
  - d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
  - e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
5. Pipes NPS 8 and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
6. Thermal Hanger Shields: Install with insulation of 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 bearing surface smooth.
- 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/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
  1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  2. Obtain fusion without undercut or overlap.
  3. Remove welding flux immediately.
  4. Finish welds at exposed connections, so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

### 3.5 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. Touchup: Clean field welds and abraded, shop-painted areas. Paint exposed areas immediately after erecting hangers and supports. Use same materials as those used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
  - 1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.
- B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded, shop-painted areas on miscellaneous metal are specified in Section 099100 "Painting."
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas, and apply galvanizing-repair paint to comply with ASTM A 780/A 780M.

### 3.7 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with NFPA requirements 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 finishes.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use stainless-steel pipe hangers and stainless-steel or corrosion-resistant attachments for hostile environment applications (Chlorine Building).
- F. Use copper-plated pipe hangers and stainless-steel attachments for copper piping and tubing.
- G. Use thermal hanger-shield inserts for insulated piping and tubing.
- H. Horizontal-Piping Hangers and Supports: Comply with NFPA requirements. Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
  - 2. Steel Pipe Clamps (MSS Type 4): For suspension of NPS 1/2 to NPS 24 if little or no insulation is required.
  - 3. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
  - 4. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
  - 5. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
  - 6. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.

7. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
  8. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
  9. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
- I. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
  2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.
- J. Hanger-Rod Attachments: Comply with NFPA requirements.
- K. Building Attachments: Comply with NFPA requirements. 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. C-Clamps (MSS Type 23): For structural shapes.
  3. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
- L. Saddles and Shields: Comply with NFPA requirements. 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.
- M. Comply with NFPA requirements for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- N. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.
- O. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION 210529



## SECTION 211100 - FACILITY FIRE-SUPPRESSION WATER-SERVICE 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 fire-suppression water-service piping and related components outside the building and service entrance piping through floor into the building and the following:
  - 1. Pipes, fittings, and specialties.
  - 2. Fire-suppression specialty valves.
  - 3. Concrete vaults.
  - 4. Protective enclosures.
  - 5. Alarm devices.
- B. Utility-furnished products include water meters that are furnished to the site, ready for installation.
- C. Related Requirements:
  - 1. Section 211119 "Fire-Department Connections" for exposed-, flush-, and yard-type, fire-department connections.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings:
  - 1. Detail precast concrete vault assemblies and indicate dimensions, method of field assembly, and components.
  - 2. Include diagrams for power, signal, and control wiring.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: For piping and specialties including relation to other services in same area, drawn to scale. Show piping and specialty sizes and valves, meter and specialty locations, and elevations.
- B. Field quality-control reports.

## 1.5 QUALITY ASSURANCE

### A. Regulatory Requirements:

1. Comply with requirements of utility company supplying the 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, by a qualified testing agency, and marked for intended location and application.

### D. Comply with FM Global's "Approval Guide" and UL's "Fire Protection Equipment Directory" for fire-service-main products.

### E. NFPA Compliance: Comply with NFPA 24 for materials, installations, tests, flushing, and valve and hydrant supervision for fire-suppression water-service piping.

## 1.6 DELIVERY, STORAGE, AND HANDLING

### A. Preparation for Transport: Prepare valves, including fire hydrants, according to the following:

1. Ensure that valves are dry and internally protected against rust and corrosion.
2. Protect valves against damage to threaded ends and flange faces.
3. Set valves in best position for handling. Set valves closed to prevent rattling.

### B. During Storage: Use precautions for valves, 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.

## 1.7 PROJECT CONDITIONS

- A. Interruption of Existing Fire-Suppression Water-Service Piping: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water-distribution service according to requirements indicated:
1. Notify Engineer and Owner no fewer than two days in advance of proposed interruption of service.
  2. Do not proceed with interruption of service without Engineer's or Owner's written permission.

## PART 2 - PRODUCTS

### 2.1 BACKFLOW PREVENTERS

- A. Reduced-Pressure-Principle Backflow Preventers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. FEBCO; A WATTS Brand.
    - b. WATTS.
    - c. Zurn Industries, LLC.
    - d. Or equal.
  2. Standard: ASSE 1013 or AWWA C511.
  3. Operation: Continuous-pressure applications.
  4. Pressure Loss: 12 psig maximum, through middle one-third of flow range.
  5. Size: NPS 6.
  6. Pressure Loss at Design Flow Rate: 9 psig for NPS 2 and smaller; 9 psig for NPS 2-1/2 and larger.
  7. Body Material: Bronze for NPS 2 and smaller; stainless steel for NPS 2-1/2 and larger.
  8. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
  9. Configuration: Designed for horizontal, straight through flow.
  10. Accessories:
    - a. Valves: Ball type with threaded ends on inlet and outlet of NPS 2 and smaller; OS&Y gate type with flanged ends on inlet and outlet of NPS 2-1/2 and larger.
    - b. Air-Gap Fitting: ASME A112.1.2, matching backflow preventer connection.
- B. Backflow Preventer Test Kits:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. FEBCO; A WATTS Brand.
    - b. WATTS.

- c. Zurn Industries, LLC.
  - d. Or equal.
2. Description: Factory calibrated, with gages, fittings, hoses, and carrying case with test-procedure instructions.

### PART 3 - EXECUTION

#### 3.1 EARTHWORK

- A. Comply with excavating requirements in Section 312000 "Earthwork" and trenching and backfilling in Section 312333 "Trenching and Backfilling."

#### 3.2 PIPING INSTALLATION

- A. Water-Main Connection: Arrange with water utility company for tap of size and in location indicated in water main.
- B. Water-Main Connection: Tap water main according to requirements of water utility company and of size and in location indicated.
- C. Make connections larger than NPS 2 with tapping machine according to the following:
- 1. Install tapping sleeve and tapping valve according to MSS SP-60.
  - 2. Install tapping sleeve on pipe to be tapped. Position flanged outlet for gate valve.
  - 3. Use tapping machine compatible with valve and tapping sleeve; cut hole in main. Remove tapping machine and connect water-service piping.
  - 4. Install gate valve onto tapping sleeve. Comply with MSS SP-60. Install valve with stem pointing up and with valve box.
- D. Make connections NPS 2 and smaller with drilling machine according to the following:
- 1. Install service-saddle assemblies and corporation valves in size, quantity, and arrangement required by utility company's standards.
  - 2. Install service-saddle assemblies on water-service pipe to be tapped. Position outlets for corporation valves.
  - 3. Use drilling machine compatible with service-saddle assemblies and corporation valves. Drill hole in main. Remove drilling machine and connect water-service piping.
  - 4. Install corporation valves into service-saddle assemblies.
  - 5. Install manifold for multiple taps in water main.
  - 6. Install curb valve in water-service piping with head pointing up and with service box.
- E. Comply with NFPA 24 for fire-service-main piping materials and installation.
- F. Install copper tube and fittings according to CDA's "Copper Tube Handbook."
- 1. Install encasement for tubing according to ASTM A674 or AWWA C105.

- G. Install ductile-iron, water-service piping according to AWWA C600 and AWWA M41.
  - 1. Install encasement for piping according to ASTM A674 or AWWA C105.
- H. Install PE pipe according to ASTM D2774 and ASTM F645.
- I. Install PVC, AWWA pipe according to ASTM F645 and AWWA M23.
- J. Install fiberglass AWWA pipe according to AWWA M45.
- K. Bury piping with depth of cover over top at least 30 inches, with top at least 12 inches below level of maximum frost penetration, and according to the following:
  - 1. Under Driveways: With at least 36 inches of cover over top.
- L. Install piping by tunneling or jacking, or combination of both, under streets and other obstructions that cannot be disturbed.
- M. Extend fire-suppression water-service piping and connect to water-supply source and building fire-suppression water-service piping systems at locations and pipe sizes indicated.
  - 1. Terminate fire-suppression water-service piping within the building at the floor slab until building-water-piping systems are installed. Terminate piping with caps, plugs, or flanges as required for piping material. Make connections to building's fire-suppression water-service piping systems when those systems are installed.
- N. 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.
- O. Comply with requirements for fire-suppression water-service piping inside the building in the following Sections:
  - 1. Section 211313 "Wet-Pipe Sprinkler Systems."
- P. Comply with requirements in Section 221116 "Domestic Water Piping" for potable-water piping inside the building.
- Q. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 210517 "Sleeves and Sleeve Seals for Fire-Suppression Piping."
- R. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 210517 "Sleeves and Sleeve Seals for Fire-Suppression Piping."

### 3.3 JOINT CONSTRUCTION

- A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure rating same as or higher than systems pressure rating for aboveground applications unless otherwise indicated.
- B. Install unions adjacent to each valve in tubing NPS 2 and smaller.

- C. Install flanges, flange adaptors, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.
- D. Ream ends of tubes and remove burrs.
- E. Remove scale, slag, dirt, and debris from outside and inside of pipes, tubes, and fittings before assembly.
- F. Copper-Tubing, Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Brazed Joints" Chapter.
- G. Copper-Tubing, Pressure-Sealed Joints: Use proprietary crimping tool and procedure recommended by copper, pressure-seal-fitting manufacturer.
- H. Ductile-Iron Piping, Gasketed Joints for Fire-Service-Main Piping: UL 194.
- I. Ductile-Iron Piping, Grooved Joints: Cut-groove pipe. Assemble joints with grooved-end, ductile-iron-piping couplings, gaskets, lubricant, and bolts.
- J. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with bolts according to ASME B31.9.
- K. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D2657.
- L. 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.
- M. Fiberglass Piping Bonded Joints: Use adhesive and procedure recommended by piping manufacturer.
- N. Dissimilar Materials Piping Joints: Use adapters compatible with both piping materials, with OD, and with system working pressure.
- O. Do not use flanges or unions for underground piping.

### 3.4 ANCHORAGE INSTALLATION

- A. Anchorage, General: Install water-distribution piping with restrained joints. Anchorages and restrained-joint types that may be used include the following:
  - 1. Concrete thrust blocks.
  - 2. Locking mechanical joints.
  - 3. Set-screw mechanical retainer glands.
  - 4. Bolted flanged joints.
  - 5. Heat-fused joints.
  - 6. Pipe clamps and tie rods.
- B. Install anchorages for tees, plugs and caps, bends, crosses, valves, and hydrant branches in fire-suppression water-service piping according to NFPA 24 and the following:

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.
- C. Apply full coat of asphalt or other acceptable corrosion-resistant material to surfaces of installed ferrous anchorage devices.

### 3.5 VALVE INSTALLATION

- A. AWWA Gate Valves: Comply with AWWA C600 and AWWA M44. Install each underground valve with stem pointing up and with valve box.
- B. AWWA Valves Other Than Gate Valves: Comply with AWWA C600 and AWWA M44.
- C. UL-Listed and FM Global-Approved 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-Listed and FM Global-Approved 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. Support valves and piping, not direct buried, on concrete piers. Comply with requirements for concrete piers in Section 033000 "Cast-in-Place Concrete."

### 3.6 BACKFLOW PREVENTER INSTALLATION

- A. Install backflow preventers of type, size, and capacity indicated. Include valves and test cocks. Install according to requirements of plumbing and health department and authorities having jurisdiction.
- B. Do not install backflow preventers that have relief drain in vault or in other spaces subject to flooding.
- C. Do not install bypass piping around backflow preventers.
- D. Support NPS 2-1/2 and larger backflow preventers and piping on concrete piers. Comply with requirements for concrete piers in Section 033000 "Cast-in-Place Concrete."

### 3.7 PROTECTIVE ENCLOSURE INSTALLATION

- A. Install concrete base level and with top approximately 2 inches above grade.
- B. Install protective enclosure over valves and equipment.

- C. Anchor protective enclosure to concrete base.

### 3.8 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 freestanding fire-department connection. Pipe bollards are specified in Section 055000 "Metal Fabrications."

### 3.9 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. Supervisory Switches: Supervise valves in open position.
  - 1. Valves: Grind away portion of exposed valve stem. Bolt switch, with plunger in stem depression, to OS&Y gate-valve yoke.
  - 2. Indicator Posts: Drill and thread hole in upper-barrel section at target plate. Install switch, with toggle against target plate, on barrel of indicator post.
- C. Locking and Sealing: Secure unsupervised valves as follows:
  - 1. Valves: Install chain and padlock on open OS&Y gate valve.
  - 2. Post Indicators: Install padlock on wrench on indicator post.
- D. Pressure Switches: Drill and thread hole in exposed barrel of fire hydrant. Install switch.
- E. Water-Flow Indicators: Install in water-service piping in vault. Select indicator with saddle and vane matching pipe size. Drill hole in pipe, insert vane, and bolt saddle to pipe.
- F. Connect alarm devices to building's fire-alarm system. Wiring and fire-alarm devices are specified in Section 284621.11 "Addressable Fire-Alarm Systems."

### 3.10 CONNECTIONS

- A. Connect fire-suppression water-service piping to utility water main existing water main. Use tapping sleeve and tapping valve service clamp and corporation valve.
- B. Connect fire-suppression water-service piping to interior fire-suppression piping.

### 3.11 FIELD QUALITY CONTROL

- A. Use test procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described below.



- B. Piping Tests: Conduct piping tests before joints are covered and after concrete thrust blocks have hardened sufficiently. Fill pipeline 24 hours before testing and apply test pressure to stabilize system. Use only potable water.
- C. Hydrostatic Tests: Test at not less than one-and-one-half times the working pressure for two hours.
  - 1. Increase pressure in 50-psig increments and inspect each joint between increments. Hold at test pressure for one hour; decrease to zero psig. Slowly increase again to test pressure and hold for one more hour. Maximum allowable leakage is 2 quarts per hour per 100 joints. Remake leaking joints with new materials and repeat test until leakage is within allowed limits.
- D. Prepare test and inspection reports.

### 3.12 IDENTIFICATION

- A. Install continuous underground detectable warning tape during backfilling of trench for underground fire-suppression water-service piping. Locate below finished grade, directly over piping. Underground warning tapes are specified in various Division 31 Sections.
- B. Permanently attach equipment nameplate or marker indicating plastic fire-suppression water-service piping or fire-suppression water-service piping with electrically insulated fittings, on main electrical meter panel. Comply with requirements for identifying devices in Section 220553 "Identification for Plumbing Piping and Equipment."

### 3.13 CLEANING

- A. Clean and disinfect fire-suppression water-service piping as follows:
  - 1. Purge new piping systems and parts of existing systems that have been altered, extended, or repaired before use.
  - 2. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in NFPA 24 for flushing of piping. Flush piping system with clean, potable water until dirty water does not appear at points of outlet. Flush all underground piping, including lead-ins, in accordance with FM Global Property Loss Prevention Data Sheet 3-10 Installation/Maintenance of Fire Service Mains. Water mains should be flushed for a minimum of 5 minutes after water flows clear and free of visible obstructions. Water supply control valves installed during this project should be in the full open position during flushing procedures. Flowing 2 in. drains is not an acceptable method of flushing lead-ins.
  - 3. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in AWWA C651 or do as follows:
    - a. Fill system or part of system with water/chlorine solution containing at least 50 ppm of chlorine; isolate and allow it to stand for 24 hours.

- b. Drain system or part of system of previous solution and refill with water/chlorine solution containing at least 200 ppm of chlorine; isolate and allow it to stand for three hours.
  - c. After standing time, flush system with clean, potable water until no chlorine remains in water coming from system.
  - d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedure if biological examination shows evidence of contamination.
- B. Prepare reports of purging and disinfecting activities.

### 3.14 VALVE SCHEDULE

- A. Provide nonrising-stem gate valves.
- B. Indicator-post underground fire-suppression water-service valves NPS 3 and larger shall be 175-psig, UL-listed and FM Global-approved, iron, nonrising-stem gate valves with indicator-post flange.
- C. Fire-suppression water-service check valves NPS 3 and larger shall be one of the following:
  - 1. AWWA or UL-listed and FM Global-approved check valves.
  - 2. UL-listed and FM Global-approved detector check valves.

END OF SECTION 211100

## SECTION 211313 - WET-PIPE SPRINKLER SYSTEMS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:

1. Pipes, fittings, and specialties.
2. Cover system for sprinkler piping.
3. Specialty valves.
4. Sprinklers.
5. Alarm devices.
6. Pressure gages.
7. Flush-type fire-department connections.
8. Yard-type fire-department connections.

- B. Related Requirements:

1. Section 210523 "General-Duty Valves for Fire Protection Piping" for ball, butterfly, check, gate, post-indicator, and trim and drain valves.

#### 1.3 DEFINITIONS

- A. Standard-Pressure Sprinkler Piping: Wet-pipe sprinkler system piping designed to operate at working pressure of 175-psig maximum.

#### 1.4 ACTION SUBMITTALS

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

1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

- B. Shop Drawings: For wet-pipe sprinkler systems.

1. Include plans, elevations, sections, and attachment details.
2. Include diagrams for power, signal, and control wiring.

- C. Delegated-Design Submittal: For wet-pipe sprinkler 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.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Sprinkler systems, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
  - 1. Domestic water piping.
  - 2. Compressed air piping.
  - 3. HVAC hydronic piping.
  - 4. Items penetrating finished ceiling include the following:
    - a. Lighting fixtures.
    - b. Air outlets and inlets.
- B. Qualification Data: For qualified Installer and professional engineer.
- C. Design Data:
  - 1. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.
- D. Welding certificates.
- E. Field Test Reports:
  - 1. Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."
  - 2. Fire-hydrant flow test report.
- F. Field quality-control reports.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For wet-pipe sprinkler systems and specialties to include in emergency, operation, and maintenance manuals.

#### 1.7 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. Sprinkler Cabinets: Finished, wall-mounted, steel cabinet with hinged cover, and with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of

sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler used on Project.

## 1.8 QUALITY ASSURANCE

### A. Installer Qualifications:

1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.

### B. Welding Qualifications: Qualify procedures and operators according to 2010 ASME Boiler and Pressure Vessel Code.

## 1.9 FIELD CONDITIONS

### A. Interruption of Existing Sprinkler Service: Do not interrupt sprinkler service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary sprinkler service according to requirements indicated:

1. Notify Engineer, Construction Manager, and Owner no fewer than two days in advance of proposed interruption of sprinkler service.
2. Do not proceed with interruption of sprinkler service without Engineer's and Owner's written permission.

## PART 2 - PRODUCTS

## 2.1 PERFORMANCE REQUIREMENTS

### A. Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:

1. NFPA 13.

### B. Standard-Pressure Piping System Component: Listed for 175-psig minimum working pressure.

### C. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design wet-pipe sprinkler systems.

1. Refer to the Drawings for the fire-hydrant flow test record conditions.
2. Sprinkler system design shall be approved by authorities having jurisdiction.
  - a. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.
  - b. Sprinkler Occupancy Hazard Classifications:
    - 1) Ordinary Hazard, Group 2.

3. Minimum Density for Automatic-Sprinkler Piping Design:
    - a. Ordinary-Hazard, Group 2 Occupancy: 0.20 gpm over 1500-sq. ft. area.
  4. Maximum Protection Area per Sprinkler: According to UL listing.
  5. Maximum Protection Area per Sprinkler:
    - a. Storage Areas: 130 sq. ft.
- D. Seismic Performance: Sprinkler piping shall withstand the effects of earthquake motions determined according to NFPA 13 and ASCE/SEI 7.

## 2.2 STEEL PIPE AND FITTINGS

- A. Standard-Weight, Black Steel Pipe: ASTM A53/A53M, Type E Pipe ends may be factory or field formed to match joining method.
- B. Black-Steel Pipe Nipples: ASTM A733, made of ASTM A53/A53M, standard-weight, seamless steel pipe with threaded ends.
- C. Galvanized Steel Couplings: ASTM A865/A865M, threaded.
- D. Galvanized, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.
- E. Malleable- or Ductile-Iron Unions: UL 860.
- F. Cast-Iron Flanges: ASME 16.1, Class 125.
- G. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.
  1. Pipe-Flange Gasket Materials: EPDM rubber gasket.
    - a. Class 125 and Class 250, Cast-Iron, Flat-Face Flanges: Full-face gaskets.
    - b. Class 150 and Class 300, Ductile-Iron or -Steel, Raised-Face Flanges: Ring-type gaskets.
  2. Metal, Pipe-Flange Bolts and Nuts: Carbon steel unless otherwise indicated.
- H. Steel Welding Fittings: ASTM A234/A 234M and ASME B16.9.
  1. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- I. Grooved-Joint, Steel-Pipe Appurtenances:
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Anvil International.
    - b. Tyco by Johnson Controls Company.

- c. Victaulic Company.
  - d. Or equal.
- 2. Pressure Rating: 175-psig minimum.
  - 3. Galvanized Grooved-End Fittings for Steel Piping: ASTM A47/A47M, malleable-iron casting or ASTM A536, ductile-iron casting, with dimensions matching steel pipe.
  - 4. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213 rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

## 2.3 SPECIALTY VALVES

- A. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
- B. Pressure Rating:
  - 1. Standard-Pressure Piping Specialty Valves: 175-psig minimum.
  - 2. High-Pressure Piping Specialty Valves: 250-psig minimum.
- C. Body Material: Cast or ductile iron.
- D. Size: Same as connected piping.
- E. End Connections: Flanged or grooved.
- F. Alarm Valves:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Globe Fire Sprinkler Corporation.
    - b. Reliable Automatic Sprinkler Co., Inc. (The).
    - c. Viking Corporation.
    - d. Or equal.
  - 2. Standard: UL 193.
  - 3. Design: For horizontal or vertical installation.
  - 4. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gages, retarding chamber, and fill-line attachment with strainer.
  - 5. Drip Cup Assembly: Pipe drain without valves and separate from main drain piping.
  - 6. Drip Cup Assembly: Pipe drain with check valve to main drain piping.
  - 7. 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.
- G. Automatic (Ball Drip) Drain Valves:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Reliable Automatic Sprinkler Co., Inc. (The).
  - b. Tyco by Johnson Controls Company.
  - c. Or equal.
2. Standard: UL 1726.
3. Pressure Rating: 175-psig minimum.
4. Type: Automatic draining, ball check.
5. Size: NPS 3/4.
6. End Connections: Threaded.

## 2.4 SPRINKLER PIPING SPECIALTIES

### A. Branch Outlet Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Anvil International.
  - b. Tyco by Johnson Controls Company.
  - c. Victaulic Company.
  - d. Or equal.
2. Standard: UL 213.
3. Pressure Rating: 175-psig minimum.
4. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.
5. Type: Mechanical-tee and -cross fittings.
6. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.
7. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
8. Branch Outlets: Grooved, plain-end pipe, or threaded.

### B. Flow Detection and Test Assemblies:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Reliable Automatic Sprinkler Co., Inc. (The).
  - b. Tyco by Johnson Controls Company.
  - c. Victaulic Company.
  - d. Or equal.
2. Standard: UL's "Fire Protection Equipment Directory" and FM Global's "Approval Guide."
3. Pressure Rating: 175-psig minimum
4. Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test valve.
5. Size: Same as connected piping.
6. Inlet and Outlet: Threaded or grooved.



C. Branch Line Testers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Elkhart Brass Mfg. Co., Inc.
  - b. Fire-End & Croker Corporation.
  - c. Potter Roemer LLC.
  - d. Or equal.
2. Standard: UL 199.
3. Pressure Rating: 175 psig.
4. Body Material: Brass.
5. Size: Same as connected piping.
6. Inlet: Threaded.
7. Drain Outlet: Threaded and capped.
8. Branch Outlet: Threaded, for sprinkler.

D. Sprinkler Inspector's Test Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Tyco by Johnson Controls Company.
  - b. Victaulic Company.
  - c. Viking Corporation.
  - d. Or equal.
2. Standard: UL's "Fire Protection Equipment Directory" and FM Global's "Approval Guide."
3. Pressure Rating: 175-psig minimum.
4. Body Material: Cast- or ductile-iron housing with sight glass.
5. Size: Same as connected piping.
6. Inlet and Outlet: Threaded.

2.5 SPRINKLERS

- A. Listed in UL's "Fire Protection Equipment Directory" and FM Global's "Approval Guide."
- B. Pressure Rating for Automatic Sprinklers: 175-psig minimum.
- C. Automatic Sprinklers with Heat-Responsive Element:
  1. Nonresidential Applications: UL 199.
  2. Characteristics: Use nominally rated 165°F FM Approved, quick-response, non-storage sprinklers having a K-factor of 8.0.

- D. Sprinkler Finishes: painted.
- E. Special Coatings: Wax and corrosion-resistant paint.

## 2.6 ALARM DEVICES

- A. Alarm-device types shall match piping and equipment connections.
- B. Water-Motor-Operated Alarm:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Tyco by Johnson Controls Company.
    - b. Victaulic Company.
    - c. Viking Corporation.
    - d. Or equal.
  - 2. Standard: UL 753.
  - 3. Type: Mechanically operated, with Pelton wheel.
  - 4. Alarm Gong: Cast aluminum with red-enamel factory finish.
  - 5. Size: 8-1/2-inches diameter.
  - 6. Components: Shaft length, bearings, and sleeve to suit wall construction.
  - 7. Inlet: NPS 3/4.
  - 8. Outlet: NPS 1 drain connection.
- C. Electrically Operated Alarm Bell:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Notifier.
    - b. Potter Electric Signal Company, LLC.
    - c. Or equal.
  - 2. Standard: UL 464.
  - 3. Type: Vibrating, metal alarm bell.
  - 4. Size: 8-inch minimum-diameter.
  - 5. Finish: Red-enamel factory finish, suitable for outdoor use.
  - 6. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Water-Flow Indicators:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Potter Electric Signal Company, LLC.
  - b. System Sensor.
  - c. Or equal.
2. Standard: UL 346.
3. Water-Flow Detector: Electrically supervised.
4. Components: Two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.
5. Type: Paddle operated.
6. Pressure Rating: 250 psig.
7. Design Installation: Horizontal or vertical.

E. Pressure Switches:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Potter Electric Signal Company, LLC.
  - b. System Sensor.
  - c. Tyco by Johnson Controls Company.
  - d. Viking Corporation.
  - e. Or equal.
2. Standard: UL 346.
3. Type: Electrically supervised water-flow switch with retard feature.
4. Components: Single-pole, double-throw switch with normally closed contacts.
5. Design Operation: Rising pressure signals water flow.

F. Valve Supervisory Switches:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Fire-Lite Alarms, Inc.; a Honeywell International company.
  - b. Kennedy Valve Company; a division of McWane, Inc.
  - c. Potter Electric Signal Company, LLC.
  - d. System Sensor.
  - e. Or equal.
2. Standard: UL 346.
3. Type: Electrically supervised.
4. Components: Single-pole, double-throw switch with normally closed contacts.
5. Design: Signals that controlled valve is in other than fully open position.
6. 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.

## 2.7 PRESSURE GAGES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Ashcroft Inc.
  - 2. Brecco Corporation.
  - 3. WIKA Instrument Corporation.
  - 4. Or equal.
- B. Standard: UL 393.
- C. Dial Size: 3-1/2- to 4-1/2-inch diameter.
- D. Pressure Gage Range: 0- to 250-psig minimum.
- E. Label: Include "WATER" label on dial face.

## 2.8 YARD-TYPE FIRE-DEPARTMENT CONNECTION

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Elkhart Brass Mfg. Co., Inc.
  - 2. Fire-End & Croker Corporation.
  - 3. Potter Roemer LLC.
  - 4. Or equal.
- B. Standard: UL 405.
- C. Type: Exposed, freestanding.
- D. Pressure Rating: 175 psig minimum.
- E. Body Material: Corrosion-resistant metal.
- F. Inlets: Brass with threads according to NFPA 1963 and matching local fire-department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.
- G. Caps: Brass, lugged type, with gasket and chain.
- H. Escutcheon Plate: Round, brass, floor type.
- I. Outlet: Bottom, with pipe threads.
- J. Number of Inlets: Two.
- K. Sleeve: Brass.
- L. Sleeve Height: 18 inches.

- M. Escutcheon Plate Marking: Similar to "AUTO SPKR & STANDPIPE."
- N. Finish, Including Sleeve: Rough brass or bronze.
- O. Outlet Size: NPS 4.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Article.
- B. Report test results promptly and in writing.

### 3.2 SERVICE-ENTRANCE PIPING

- A. Connect sprinkler piping to water-service piping for service entrance to building. Comply with requirements for exterior piping in Section 211100 "Facility Fire-Suppression Water-Service Piping" for exterior piping.
- B. Install shutoff valve, backflow preventer, pressure gage, drain, and other accessories indicated at connection to water-service piping. Comply with requirements for backflow preventers in Section 211100 "Facility Fire-Suppression Water Service Piping."
- C. Install shutoff valve, check valve, pressure gage, and drain at connection to water service.

### 3.3 WATER-SUPPLY CONNECTIONS

- A. Connect sprinkler piping to building's interior water-distribution piping. Comply with requirements for interior piping in Section 211100 "Facility Fire-Suppression Water-Service Piping."
- B. Install shutoff valve, backflow preventer, pressure gage, drain, and other accessories indicated at connection to water-distribution piping. Comply with requirements for backflow preventers in Section 221119 "Domestic Water Piping Specialties."
- C. Install shutoff valve, check valve, pressure gage, and drain at connection to water supply.

### 3.4 PIPING INSTALLATION

- A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated on approved working plans.
  - 1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Engineer before deviating from approved working plans.

2. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.
- B. Piping Standard: Comply with NFPA 13 requirements for installation of sprinkler piping.
  - C. Install seismic restraints on piping. Comply with NFPA 13 requirements for seismic-restraint device materials and installation.
  - D. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
  - E. Install unions adjacent to each valve in pipes NPS 2 and smaller.
  - F. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.
  - G. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.
  - H. Install sprinkler piping with drains for complete system drainage.
  - I. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.
  - J. Install automatic (ball drip) drain valve at each check valve for fire-department connection, to drain piping between fire-department connection and check valve. Install drain piping to and spill over floor drain or to outside building.
  - K. Install alarm devices in piping systems.
  - L. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements for hanger materials in NFPA 13.
  - M. Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 and with soft-metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal and install where they are not subject to freezing.
  - N. Fill sprinkler system piping with water.
  - O. Install electric heating cables and pipe insulation on sprinkler piping in areas subject to freezing.
  - P. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 210517 "Sleeves and Sleeve Seals for Fire-Suppression Piping."
  - Q. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 210517 "Sleeves and Sleeve Seals for Fire-Suppression Piping."
  - R. Install escutcheons for piping penetrations of walls, ceilings, and floors.

### 3.5 JOINT CONSTRUCTION

- A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.
- B. Install unions adjacent to each valve in pipes NPS 2 and smaller.
- C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.
- D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.
- G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
  - 1. Apply appropriate tape or thread compound to external pipe threads.
  - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- H. Twist-Locked Joints: Insert plain end of steel pipe into plain-end-pipe fitting. Rotate retainer lugs one-quarter turn or tighten retainer pin.
- I. Steel-Piping, Pressure-Sealed Joints: Join lightwall steel pipe and steel pressure-seal fittings with tools recommended by fitting manufacturer.
- J. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.
  - 1. Shop weld pipe joints where welded piping is indicated. Do not use welded joints for galvanized-steel pipe.
- K. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.
- L. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.
- M. Steel-Piping, Pressure-Sealed Joints: Join Schedule 5 steel pipe and steel pressure-seal fittings with tools recommended by fitting manufacturer.
- N. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Brazed Joints" Chapter.

- O. Copper-Tubing Grooved Joints: Roll rounded-edge groove in end of tube according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join copper tube and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.
- P. Copper-Tubing, Pressure-Sealed Joints: Join copper tube and copper pressure-seal fittings with tools recommended by fitting manufacturer.
- Q. Extruded-Tee Connections: Form tee in copper tube according to ASTM F2014. Use tool designed for copper tube; drill pilot hole, form collar for outlet, dimple tube to form seating stop, and braze branch tube into collar.
- R. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

### 3.6 INSTALLATION OF COVER SYSTEM FOR SPRINKLER PIPING

- A. Install cover system, brackets, and cover components for sprinkler piping according to manufacturer's "Installation Manual" and NFPA 13 or NFPA 13R for supports.

### 3.7 VALVE AND SPECIALTIES INSTALLATION

- A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.
- B. Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.
- C. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.
- D. Specialty Valves:
  - 1. Install valves in vertical position for proper direction of flow, in main supply to system.
  - 2. Install alarm valves with bypass check valve and retarding chamber drain-line connection.
  - 3. Install deluge valves in vertical position, in proper direction of flow, and in main supply to deluge system. Install trim sets for drain, priming level, alarm connections, ball drip valves, pressure gages, priming chamber attachment, and fill-line attachment.

### 3.8 SPRINKLER INSTALLATION

- A. Install sprinklers with water supply from heated space. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing.
- B. Install sprinklers into flexible, sprinkler hose fittings, and install hose into bracket on ceiling grid.



### 3.9 IDENTIFICATION

- A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.
- B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

### 3.10 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
  - 1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
  - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
  - 3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
  - 4. Energize circuits to electrical equipment and devices.
  - 5. Coordinate with fire-alarm tests. Operate as required.
  - 6. Coordinate with fire-pump tests. Operate as required.
  - 7. Verify that equipment hose threads are same as local fire department equipment.
- B. Sprinkler piping system will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

### 3.11 CLEANING

- A. Clean dirt and debris from sprinklers.
- B. Only sprinklers with their original factory finish are acceptable. Remove and replace any sprinklers that are painted or have any other finish than their original factory finish.

### 3.12 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain specialty valves.

### 3.13 PIPING SCHEDULE

- A. Piping between Fire Department Connections and Check Valves: Galvanized, standard-weight steel pipe with threaded ends, cast-iron threaded fittings, and threaded or grooved ends, grooved-end fittings, grooved-end-pipe couplings, and grooved joints.
- B. Sprinkler specialty fittings may be used, downstream of control valves, instead of specified fittings.
- C. Standard-pressure, wet-pipe sprinkler system, NPS 2 and smaller, shall be one of the following:

1. Standard-weight, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
- D. Standard-pressure, wet-pipe sprinkler system, NPS 2-1/2 to NPS 4, shall be one of the following:
  1. Standard-weight, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
- E. Standard-pressure, wet-pipe sprinkler system, NPS 5 and larger, shall be one of the following:
  1. Standard-weight, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.

### 3.14 SPRINKLER SCHEDULE

- A. Use sprinkler types in subparagraphs below for the following applications:
  1. Rooms without Ceilings: Upright sprinklers.
- B. Provide sprinkler types in subparagraphs below with finishes indicated.
  1. Upright Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; wax coated where exposed to acids, chemicals, or other corrosive fumes.

END OF SECTION 211313

## SECTION 220517 - SLEEVES AND SLEEVE SEALS 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. Sleeves.
  - 2. Stack-sleeve fittings.
  - 3. Sleeve-seal systems.
  - 4. Sleeve-seal fittings.
  - 5. Grout.
  - 6. Silicone sealants.

#### 1.3 ACTION SUBMITTALS

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

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

### PART 2 - PRODUCTS

#### 2.1 SLEEVES

- A. Cast-Iron Pipe Sleeves: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop collar.
- B. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, anticorrosion coated, with plain ends and integral welded waterstop collar.
- C. Galvanized-Steel Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- D. PVC Pipe Sleeves: ASTM D 1785, Schedule 40.
- E. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.

- F. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

## 2.2 GROUT

- A. Description: Nonshrink, 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.

## 2.3 SILICONE SEALANTS

- A. Silicone, S, NS, 25, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant, ASTM C 920, Type S, Grade NS, Class 25, Use NT.
- B. Silicone, S, P, 25, T, NT: Single-component, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade P, Class 25, Uses T and NT. Grade P Pourable (self-leveling) formulation is for opening in floors and other horizontal surfaces that are not fire rated.
- C. Silicone Foam: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

# PART 3 - EXECUTION

## 3.1 SLEEVE INSTALLATION

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
- B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.
  - 1. Sleeves are not required for core-drilled holes.
- C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
  - 1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
  - 2. 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.
- 3. Using grout or silicone sealant, seal the space outside of sleeves in slabs and walls without sleeve-seal system.
- D. Install sleeves for pipes passing through interior partitions.
  - 1. Cut sleeves to length for mounting flush with both surfaces.
  - 2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
  - 3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint.
- E. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke Barrier Penetrations: Maintain indicated fire or smoke rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping and fill materials specified in Section 078413 "Penetration Firestopping."

### 3.2 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
  - 1. Leak Test: After allowing for a full cure, test sleeves and sleeve seals for leaks. Repair leaks and retest until no leaks exist.
- B. Sleeves and sleeve seals will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

### 3.3 SLEEVE AND SLEEVE-SEAL SCHEDULE

- A. Use sleeves and sleeve seals for the following piping-penetration applications:
  - 1. Exterior Concrete Walls above Grade:
    - a. Piping Smaller Than NPS 6: Steel pipe sleeves.
  - 2. Exterior Concrete Walls below Grade:
    - a. Piping Smaller Than NPS 6: Steel pipe sleeves with sleeve-seal system.
      - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
  - 3. Concrete Slabs-on-Grade:
    - a. Piping Smaller Than NPS 6: Steel pipe sleeves with sleeve-seal system.

- 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
4. Concrete Slabs above Grade:
  - a. Piping Smaller Than NPS 6: PVC pipe sleeves.
5. Interior Partitions:
  - a. Piping Smaller Than NPS 6: PVC pipe sleeves.

END OF SECTION 220517

## SECTION 220518 - ESCUTCHEONS 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. Escutcheons.
  - 2. Floor plates.

#### 1.3 DEFINITIONS

- A. Existing Piping to Remain: Existing piping that is not to be removed and that is not otherwise indicated to be removed and salvaged, or removed and reinstalled.

#### 1.4 ACTION SUBMITTALS

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

### PART 2 - PRODUCTS

#### 2.1 ESCUTCHEONS

- A. One-Piece, Steel Type: With polished, chrome-plated finish and setscrew fastener.
- B. One-Piece, Stainless-Steel Type: With polished stainless-steel finish.
- C. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.
- D. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped steel with polished, chrome-plated finish and spring-clip fasteners.
- E. One-Piece, Stamped-Steel Type: With polished, chrome-plated finish and spring-clip fasteners.
- F. Split-Plate, Stamped-Steel Type: With polished, chrome-plated finish; concealed and exposed-rivet hinge; and spring-clip fasteners.

## 2.2 FLOOR PLATES

- A. Split Floor Plates: Cast brass with concealed hinge.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.
- B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of insulated piping and with OD that completely covers opening.
  - 1. Escutcheons for New Piping:
    - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep pattern.
    - b. Chrome-Plated Piping: One-piece steel with polished, chrome-plated finish.
    - c. Insulated Piping: One-piece steel with polished, chrome-plated finish.
    - d. Insulated Piping: One-piece stainless steel with polished stainless-steel finish.
    - e. Insulated Piping: One-piece cast brass with polished, chrome-plated finish.
    - f. Insulated Piping: One-piece stamped steel or split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.
    - g. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece steel with polished, chrome-plated finish.
    - h. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece stainless steel with polished stainless-steel finish.
    - i. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece cast brass with polished, chrome-plated finish.
    - j. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece stamped steel or split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.
    - k. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece steel with polished, chrome-plated finish.
    - l. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece stainless steel with polished stainless-steel finish.
    - m. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece cast brass with polished, chrome-plated finish.
    - n. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece stamped steel or split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.
    - o. Bare Piping in Unfinished Service Spaces: One-piece steel with polished, chrome-plated finish.
    - p. Bare Piping in Unfinished Service Spaces: One-piece cast brass with polished, chrome-plated finish.
    - q. Bare Piping in Unfinished Service Spaces: One-piece stamped steel or split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.
    - r. Bare Piping in Equipment Rooms: One-piece steel with polished, chrome-plated finish.
    - s. Bare Piping in Equipment Rooms: One-piece cast brass with polished, chrome-plated finish.



- t. Bare Piping in Equipment Rooms: One-piece stamped steel or split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.
- C. Install floor plates for piping penetrations of equipment-room floors.
- D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
  - 1. New Piping: One-piece, floor plate.
  - 2. Existing Piping: Split floor plate.

### 3.2 FIELD QUALITY CONTROL

- A. Using new materials, replace broken and damaged escutcheons and floor plates.

END OF SECTION 220518

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## SECTION 220523.12 - BALL 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. Section Includes:
  - 1. Bronze ball valves.

#### 1.3 DEFINITIONS

- A. CWP: Cold working pressure.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of valve.
  - 1. Certification that products comply with NSF 61 Annex G and NSF 372.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
  - 1. Protect internal parts against rust and corrosion.
  - 2. Protect threads, flange faces, and soldered ends.
  - 3. Set ball valves open to minimize exposure of functional surfaces.
- 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 operating handles or stems as lifting or rigging points.

## PART 2 - PRODUCTS

### 2.1 GENERAL REQUIREMENTS FOR VALVES

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance:
  - 1. ASME B1.20.1 for threads for threaded end valves.
  - 2. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
  - 3. ASME B16.18 for solder-joint connections.
  - 4. ASME B31.9 for building services piping valves.
- C. NSF Compliance: NSF 61 Annex G and NSF 372 for valve materials for potable-water service.
- D. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.
- E. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- F. Valve Sizes: Same as upstream piping unless otherwise indicated.
- G. Valve Actuator Types:
  - 1. Handlever: For quarter-turn valves smaller than NPS 4.
- H. Valves in Insulated Piping:
  - 1. Include 2-inch stem extensions.
  - 2. Extended operating handles of nonthermal-conductive material and protective sleeves that allow operation of valves without breaking vapor seals or disturbing insulation.
  - 3. Memory stops that are fully adjustable after insulation is applied.

### 2.2 BRONZE BALL VALVES

- A. Bronze Ball Valves, One-Piece with Stainless-Steel Trim:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Apollo Flow Controls; Conbraco Industries, Inc.
    - b. NIBCO INC.
    - c. WATTS.
  - 2. Description:
    - a. Standard: MSS SP-110.
    - b. CWP Rating: 600 psig.

- c. Body Design: One piece.
- d. Body Material: Bronze.
- e. Ends: Threaded.
- f. Seats: PTFE.
- g. Stem: Stainless steel.
- h. Ball: Stainless steel, vented.
- i. Port: full.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Do not attempt to repair defective valves; replace with new valves.

#### 3.2 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.
- E. Install valve tags. Comply with requirements in Section 220553 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

#### 3.3 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valves with specified CWP ratings are unavailable, the same types of valves with higher CWP ratings may be substituted.
- B. Select valves with the following end connections:

1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.

### 3.4 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE

#### A. Pipe NPS 2 and Smaller:

1. Bronze ball valve, one piece with stainless steel trim.

END OF SECTION 220523.12

## 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. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Metal framing systems.
4. Thermal hanger-shield inserts.
5. Fastener systems.
6. Pipe stands.
7. Pipe-positioning systems.
8. Equipment supports.

- B. Related Requirements:

1. Section 055000 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment" for vibration isolation devices.

#### 1.3 ACTION SUBMITTALS

- A. Shop Drawings: Show fabrication and installation details and include calculations for the following:

1. Trapeze pipe hangers.
2. Metal framing systems.
3. Pipe stands.
4. Equipment supports.

- B. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Detail fabrication and assembly of trapeze hangers.
2. Include design calculations for designing trapeze hangers.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

#### 1.5 QUALITY ASSURANCE

- A. Structural-Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M.
- B. Pipe Welding Qualifications: Qualify procedures and operators according to 2015 ASME Boiler and Pressure Vessel Code, Section IX.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design trapeze pipe hangers and equipment supports.

#### 2.2 METAL PIPE HANGERS AND SUPPORTS

- A. Carbon-Steel Pipe Hangers and Supports:
  - 1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
  - 2. Galvanized Metallic Coatings: Pregalvanized, hot-dip galvanized, or electro-galvanized.
  - 3. Nonmetallic Coatings: Plastic coated or epoxy powder coated.
  - 4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
  - 5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
- B. Stainless-Steel Pipe Hangers and Supports:
  - 1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
  - 2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
  - 3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

#### 2.3 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
- B. Mechanical-Expansion Anchors: Insert-wedge-type anchors, for use in hardened portland cement concrete, with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.



1. Indoor Applications: Zinc-coated or stainless steel.
2. Outdoor Applications: Stainless steel.

## 2.4 PIPE-POSITIONING SYSTEMS

- A. Description: IAPMO PS 42 positioning system composed of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.

## 2.5 EQUIPMENT SUPPORTS

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

## 2.6 MATERIALS

- A. Aluminum: ASTM B221.
- B. Carbon Steel: ASTM A1011/A1011M.
- C. Structural Steel: ASTM A36/A36M carbon-steel plates, shapes, and bars; black and galvanized.
- D. Stainless Steel: ASTM A240/A240M.
- E. Grout: ASTM C1107/C1107M, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
  1. Properties: Nonstaining, noncorrosive, and nongaseous.
  2. Design Mix: 5000-psi, 28-day compressive strength.

# PART 3 - EXECUTION

## 3.1 APPLICATION

- A. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation, for penetrations through fire-rated walls, ceilings, and assemblies.
- B. Strength of Support Assemblies: Where not indicated, select sizes of components, so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

## 3.2 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-58. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.

- B. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.
- C. Thermal Hanger-Shield Installation: Install in pipe hanger or shield for insulated piping.
- D. 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.
- E. Pipe-Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture.
- F. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- G. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- H. 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.
- I. Install lateral bracing with pipe hangers and supports to prevent swaying.
- J. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms, and install reinforcing bars through openings at top of inserts.
- K. Load Distribution: Install hangers and supports, so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- L. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- M. Insulated Piping:
  - 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 allowed by ASME B31.9 for building services piping.

2. Install MSS SP-58, Type 39 protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
  - a. Option: Thermal hanger-shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
3. Install MSS SP-58, Type 40 protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
  - a. Option: Thermal hanger-shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
4. Shield Dimensions for Pipe: Not less than the following:
  - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
  - b. NPS 4: 12 inches long and 0.06 inch thick.
  - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
  - d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
  - e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
5. Pipes NPS 8 and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
6. Thermal Hanger Shields: Install with insulation of 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 bearing surface smooth.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

### 3.4 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
  1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  2. Obtain fusion without undercut or overlap.
  3. Remove welding flux immediately.
  4. Finish welds at exposed connections, so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

### 3.5 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. Touchup: Clean field welds and abraded, shop-painted areas. Paint exposed areas immediately after erecting hangers and supports. Use same materials as those used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
  - 1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.
- B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded, shop-painted areas on miscellaneous metal are specified in Section 099100 "Painting."
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas, and apply galvanizing-repair paint to comply with ASTM A780/A780M.

### 3.7 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-58 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 finishes.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use carbon-steel pipe hangers and supports and metal framing systems and attachments for general service applications (electrical room and control room).
- F. Use stainless-steel pipe hangers and stainless-steel attachments for hostile environment applications (Pump Room, Chemical Building).
- G. Use padded hangers for piping that is subject to scratching.
- H. Use thermal hanger-shield inserts for insulated piping and tubing.
- I. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.

2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F pipes NPS 4 to NPS 24, 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 36, 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 if little or no insulation is required.
5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
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, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, 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 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, from two rods if longitudinal movement caused by expansion and contraction occurs.
18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction occurs.
19. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction occurs but vertical adjustment is unnecessary.
20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 if small horizontal movement caused by expansion and contraction occurs and vertical adjustment is unnecessary.
21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 if vertical and lateral adjustment during installation, in addition to expansion and contraction, is required.

J. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.

2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.
- K. 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 of up to 6 inches for heavy loads.
  2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
  3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11 split pipe rings.
  4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
  5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
- L. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable-Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
  2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
  3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
  4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
  5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
  6. C-Clamps (MSS Type 23): For structural shapes.
  7. 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.
- M. 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.
- N. 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 allow 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 allow 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 allow 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.
- O. Comply with MSS SP-58 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- P. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.
- Q. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.
- R. Use pipe-positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION 220529

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## SECTION 220548.13 - VIBRATION CONTROLS 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. Elastomeric isolation pads.
  - 2. Elastomeric hangers.
  - 3. Spring hangers.

- B. Related Requirements:

- 1. Section 230548.13 "Vibration Controls for HVAC" for devices for HVAC equipment and systems.

#### 1.3 ACTION SUBMITTALS

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

- 1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
  - 2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of vibration isolation device type required.

- B. Shop Drawings:

- 1. Detail fabrication and assembly of equipment bases. Detail fabrication including anchorages and attachments to structure and to supported equipment.

- C. Delegated-Design Submittal: For each vibration isolation device.

- 1. Include design calculations for selecting vibration isolators.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Show coordination of vibration isolation device installation for plumbing piping and equipment with other systems and equipment in the vicinity, including other supports and restraints, if any.

- B. Qualification Data: For testing agency.
- C. Welding certificates.
- D. Air-Mounting System Performance Certification: Include natural frequency, load, and damping test data.

## 1.5 QUALITY ASSURANCE

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

## PART 2 - PRODUCTS

### 2.1 ELASTOMERIC ISOLATION PADS

- A. Elastomeric Isolation Pads: .
  - 1. Fabrication: Single or multiple layers of sufficient durometer stiffness for uniform loading over pad area.
  - 2. Size: Factory or field cut to match requirements of supported equipment.
  - 3. Pad Material: Oil and water resistant with elastomeric properties.
  - 4. Surface Pattern: Smooth or Waffle pattern.
  - 5. Infused nonwoven cotton or synthetic fibers.
  - 6. Load-bearing metal plates adhered to pads.
  - 7. Sandwich-Core Material: Resilient and elastomeric.
    - a. Surface Pattern: Smooth or Waffle pattern.
    - b. Infused nonwoven cotton or synthetic fibers.

### 2.2 ELASTOMERIC HANGERS

- A. Elastomeric Mount in a Steel Frame with Upper and Lower Steel Hanger Rods: .
  - 1. Frame: Steel, fabricated with a connection for an upper threaded hanger rod and an opening on the underside to allow for a maximum of 30 degrees of angular lower hanger-rod misalignment without binding or reducing isolation efficiency.
  - 2. Dampening Element: Molded, oil-resistant rubber, neoprene, or other elastomeric material with a projecting bushing for the underside opening preventing steel to steel contact.

### 2.3 SPRING HANGERS

- A. 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. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
8. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- 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. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 033000 "Cast-in-Place Concrete."
- B. Installation of vibration isolators must not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.

END OF SECTION 220548.13

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## SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Equipment labels.
  - 2. Warning signs and labels.
  - 3. Pipe labels.
  - 4. Stencils.
  - 5. Valve tags.
  - 6. Warning tags.

#### 1.3 ACTION 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.

### PART 2 - PRODUCTS

#### 2.1 EQUIPMENT LABELS

- A. Metal Labels for Equipment:
  - 1. Material and Thickness: aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
  - 2. Letter Color: White .
  - 3. Background Color: Blue.

4. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
  5. 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-quarters the size of principal lettering.
  6. Fasteners: Stainless-steel rivets or self-tapping screws.
  7. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.
- C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number, and identify Drawing numbers where equipment is indicated (plans, details, and schedules) and 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: White.
- C. Background Color: Red.
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
- G. Fasteners: Stainless-steel rivets or self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Label Content: Include caution and warning information plus emergency notification instructions.

## 2.3 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

- B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings; also include 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: Size letters according to ASME A13.1 for piping.

## 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: aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
  - 2. Fasteners: Brass wire-link chain or S-hook.
- B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
  - 1. Valve-tag schedule shall be included in operation and maintenance data.

## 2.5 WARNING TAGS

- A. Description: Preprinted or partially preprinted accident-prevention tags of plasticized card stock with matte finish suitable for writing.
  - 1. Size: 3 by 5-1/4 inches minimum.
  - 2. Fasteners: Brass grommet and wire.
  - 3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
  - 4. Color: Safety yellow background with black lettering.

# PART 3 - EXECUTION

## 3.1 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

### 3.2 GENERAL INSTALLATION REQUIREMENTS

- 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.

### 3.3 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

### 3.4 PIPE LABEL INSTALLATION

- A. Piping Color Coding: Painting of piping is specified in Section 099123 "Painting."
- B. Stenciled Pipe Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels, complying with ASME A13.1, on each piping system.
  - 1. Identification Paint: Use for contrasting background.
  - 2. Stencil Paint: Use for pipe marking.
- C. Pipe Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
  - 1. Near each valve and control device.
  - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
  - 3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
  - 4. At access doors, manholes, and similar access points that permit view of concealed piping.
  - 5. Near major equipment items and other points of origination and termination.
  - 6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
  - 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
- D. Directional Flow Arrows: Arrows shall be used to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.
- E. Pipe Label Color Schedule:
  - 1. Domestic Water Piping:
    - a. Background: Safety green.
    - b. Letter Colors: White.



2. Sanitary Waste Piping:
  - a. Background Color: Safety black.
  - b. Letter Color: White.
3. Protected Water Piping:
  - a. Background: Safety green.
  - b. Letter Colors: White.

### 3.5 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems, except check valves, valves within factory-fabricated equipment units, shutoff valves, faucets, convenience and lawn-watering hose connections, and 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: 1-1/2 inches, round.
    - b. Hot Water: 1-1/2 inches, round.
    - c. Protected Water: 1-1/2 inches, round.
  2. Valve-Tag Colors:
    - a. Cold Water: Natural.
    - b. Hot Water: Natural.
    - c. Protected Water: Natural.
  3. Letter Colors:
    - a. Cold Water: White.
    - b. Hot Water: White.
    - c. Protected Water: White.

### 3.6 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 220553

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## SECTION 220719 - PLUMBING PIPING 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 insulating the following plumbing piping services:
  - 1. Domestic cold-water piping.
  - 2. Domestic hot-water piping.
  - 3. Roof drains and rainwater leaders.
  - 4. Supplies and drains for handicap-accessible lavatories and sinks.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied if any).
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
  - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
  - 2. Detail attachment and covering of heat tracing inside insulation.
  - 3. Detail insulation application at pipe expansion joints for each type of insulation.
  - 4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
  - 5. Detail removable insulation at piping specialties, equipment connections, and access panels.
  - 6. Detail application of field-applied jackets.
  - 7. Detail application at linkages of control devices.
- C. Samples: For each type of insulation and jacket indicated. Identify each Sample, describing product and intended use. Sample sizes are as follows:
  - 1. Preformed Pipe Insulation Materials: 12 inches long by NPS 2.
  - 2. Jacket Materials for Pipe: 12 inches long by NPS 2.
  - 3. Sheet Jacket Materials: 12 inches square.
  - 4. Manufacturer's Color Charts: For products where color is specified, show the full range of colors available for each type of finish material.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.
- C. Field quality-control reports.

#### 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84 by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
  - 1. Insulation Installed Indoors: Flame-spread index of 25 or less and smoke-developed index of 50 or less.
  - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less and smoke-developed index of 150 or less.
- C. Comply with the following applicable standards and other requirements specified for miscellaneous components:
  - 1. Supply and Drain Protective Shielding Guards: ICC A117.1.

#### 1.6 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.

#### 1.7 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping 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.

## 1.8 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 "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come into contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested in accordance with ASTM C871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable in accordance with ASTM C795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Comply with ASTM C552.
  - 1. Not typically used
  - 2. Pittsburgh Corning Foamglas.
  - 3. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. Pittsburgh Corning Corporation.
  - 4. Block Insulation: ASTM C 552, Type I.
  - 5. Preformed Pipe Insulation: Type II, Class 1, without jacket.
  - 6. Preformed Pipe Insulation: Type II, Class 2, with factory-applied ASJ-SSL jacket.
  - 7. Factory fabricate shapes in accordance with ASTM C450 and ASTM C585.
  - 8. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- G. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C534/C534M, Type I for tubular materials.
- H. Armacell AP Armaflex

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

1. Aeroflex USA.
2. Armacell LLC.
3. K-Flex USA.

## 2.2 INSULATING CEMENTS

- A. Mineral-Fiber Insulating Cement: Comply with ASTM C195.
- B. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C196.
- C. Mineral-Fiber, Hydraulic-

## 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. Cellular-Glass Adhesive: Two-component, thermosetting urethane adhesive containing no flammable solvents, with a service temperature range of minus 100 to plus 200 deg F.
- C. Flexible Elastomeric and Polyolefin Adhesive: Solvent-based adhesive.
1. Flame-spread index shall be 25 or less and smoke-developed index shall be 50 or less as tested in accordance with ASTM E84.
  2. Wet Flash Point: Below 0 deg F40 to 200 deg F color: Black
- D. ASJ Adhesive and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A, for bonding insulation jacket lap seams and joints.

## 2.4 MASTICS AND COATINGS

- A. Materials shall be compatible with insulation materials, jackets, and substrates.
- B. Vapor-Barrier Mastic, Water Based: Suitable for indoor use on below-ambient services.
1. Water-Vapor Permeance: Comply with ASTM E96/E96M or ASTM F1249.
  2. Service Temperature Range: 0 to plus 180 deg F.
  3. Comply with MIL-PRF-19565C, Type II, for permeance requirements.
  4. Color: White.
- C. Vapor-Retarder Mastic, Solvent Based, Indoor Use: Suitable for indoor use on below-ambient services.
1. Water-Vapor Permeance: Comply with ASTM E96/E96M or ASTM F1249.
  2. Service Temperature Range: 0 to 180 deg F.
  3. Color: White.

- D. Vapor-Retarder Mastic, Solvent Based, Outdoor Use: Suitable for outdoor use on below-ambient services.
  - 1. Water-Vapor Permeance: Comply with ASTM E96/E96M or ASTM F1249.
  - 2. Service Temperature Range: Minus 50 to plus 220 deg F.
  - 3. Color: White.
- E. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.
  - 1. Water-Vapor Permeance: ASTM E96/E96M, greater than 1.0 perm at manufacturer's recommended dry film thickness.
  - 2. Service Temperature Range: 0 to plus 180 deg F.
  - 3. Color: White.

## 2.5 LAGGING ADHESIVES

- A. Adhesives shall comply with MIL-A-3316C, Class I, Grade A, and shall be compatible with insulation materials, jackets, and substrates.
  - 1. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over pipe insulation.
  - 2. Service Temperature Range: 0 to plus 180 deg F.
  - 3. Color: White.

## 2.6 SEALANTS

- A. Materials shall be as recommended by the insulation manufacturer and shall be compatible with insulation materials, jackets, and substrates.
- B. Joint Sealants:
  - 1. Permanently flexible, elastomeric sealant.
  - 2. Service Temperature Range: Minus 58 to plus 176 deg F Minus 100 to plus 300 deg F.
  - 3. Color: White or gray.

## 2.7 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 C1136, Type I.
  - 2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C1136, Type I.
  - 3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C1136, Type II.

2.8 FIELD-APPLIED FABRIC-REINFORCING MESH

- A. Woven Glass-Fiber Fabric: Approximately 2 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in. for covering pipe and pipe fittings.

2.9 FIELD-APPLIED CLOTHS

- A. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz./sq. yd..

2.10 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C1136, Type I, unless otherwise indicated.
- B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.
- C. Metal Jacket:
  - 1. Aluminum Jacket: Comply with ASTM B209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.
    - a. Sheet and roll stock ready for shop or field sizing.
    - b. Finish and thickness are indicated in field-applied jacket schedules.
    - c. Moisture Barrier for Indoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper.
    - d. Moisture Barrier for Outdoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper.
    - e. Factory-Fabricated Fitting Covers:
      - 1) Same material, finish, and thickness as jacket.
      - 2) Preformed two-piece or gore, 45- and 90-degree, short- and long-radius elbows.
      - 3) Tee covers.
      - 4) Flange and union covers.
      - 5) End caps.
      - 6) Beveled collars.
      - 7) Valve covers.
      - 8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

2.11 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C1136.
  - 1. Width: 3 inches.
  - 2. Thickness: 11.5 mils.
  - 3. Adhesion: 90 ounces force/inch in width.
  - 4. Elongation: 2 percent.



5. Tensile Strength: 40 lbf/inch in width.
  6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C1136.
1. Width: 3 inches.
  2. Thickness: 6.5 mils.
  3. Adhesion: 90 ounces force/inch in width.
  4. Elongation: 2 percent.
  5. Tensile Strength: 40 lbf/inch in width.
  6. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- C. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
1. Width: 2 inches.
  2. Thickness: 3.7 mils.
  3. Adhesion: 100 ounces force/inch in width.
  4. Elongation: 5 percent.
  5. Tensile Strength: 34 lbf/inch in width.

## 2.12 SECUREMENTS

- A. Bands:
1. Stainless Steel: ASTM A240/A240M, Type 316; 0.015 inch thick, 1/2 inch wide with wing seal.
- B. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.
- C. Wire: 0.062-inch soft-annealed, stainless steel.

## 2.13 PROTECTIVE SHIELDING GUARDS

- A. Protective Shielding Pipe Covers:
1. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.
- B. Protective Shielding Piping Enclosures:
1. Description: Manufactured plastic enclosure for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with ADA requirements.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
  - 1. Verify that systems to be insulated have been tested and are free of defects.
  - 2. Verify that surfaces to be insulated are clean and dry.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:
  - 1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils thick and an epoxy finish 5 mils thick if operating in a temperature range of between 140 and 300 deg F. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
  - 2. Carbon Steel: Coat carbon steel operating at a service temperature of between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
- C. Coordinate insulation installation with the tradesman installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless steel surfaces, use demineralized water.

### 3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and of thicknesses required for each item of 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 storage, application, and finishing. Replace insulation materials that get wet.
- 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 attached to structure with vapor-barrier mastic.
  - 3. Install insert materials and insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
  - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
  - 1. Draw jacket tight and smooth.
  - 2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward-clinching staples along both edges of strip, spaced 4 inches o.c.
  - 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward-clinching staples along edge at 4 inches o.c.
    - a. For below-ambient services, apply vapor-barrier mastic over staples.
  - 4. Cover joints and seams with tape, in accordance with insulation material manufacturer's written instructions, to maintain vapor seal.
  - 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 25 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 in similar fashion 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. Cleanouts.

### 3.4 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
  - 1. Seal penetrations with flashing sealant.
  - 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  - 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches 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 Section 078413 "Penetration Firestopping" for 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 Section 078413 "Penetration Firestopping."

3.5 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, Mechanical Couplings, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, mechanical couplings, 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 that of 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 that 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 that used for adjacent pipe. Overlap adjoining pipe insulation by not less than 2 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 2 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, mechanical couplings, and unions, using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Stencil or label the outside insulation jacket of each union with the word "union" matching size and color of pipe labels.
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.

- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
  - 1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as that of adjoining pipe insulation.
  - 2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union at least 2 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.

### 3.6 INSTALLATION OF CELLULAR-GLASS INSULATION

#### A. Insulation Installation on Straight Pipes and Tubes:

- 1. Secure each layer of 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 services, secure laps with outward-clinched staples at 6 inches o.c.
- 4. For insulation with factory-applied jackets on below-ambient services, do not staple longitudinal tabs. Instead, 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 cut sections of cellular-glass block insulation of same thickness as that of pipe 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 that of straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of cellular-glass insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

### 3.7 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install 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 cut sections of sheet insulation of same thickness as that of pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as that of pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

4. Secure insulation to valves and specialties, and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

### 3.8 FIELD-APPLIED JACKET INSTALLATION

- A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.
  1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
  2. Embed glass cloth between two 0.062-inch- thick coats of lagging adhesive.
  3. Completely encapsulate insulation with coating, leaving no exposed insulation.
- B. Where FSK jackets are indicated, install as follows:
  1. Draw jacket material smooth and tight.
  2. Install lap or joint strips with same material as jacket.
  3. Secure jacket to insulation with manufacturer's recommended adhesive.
  4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch- wide joint strips at end joints.
  5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.
- C. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.
  1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
- D. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless steel bands 12 inches o.c. and at end joints.

### 3.9 FINISHES

- A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
  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 Engineer. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless steel jackets.

### 3.10 FIELD QUALITY CONTROL

- A. Owner will engage a qualified testing agency to perform tests and inspections.
- B. Engage a qualified testing agency to perform tests and inspections.
- C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- D. Perform tests and inspections.
- E. Tests and Inspections: Inspect pipe, fittings, strainers, and valves, randomly selected by Engineer, 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.
- F. All insulation applications will be considered defective if they do not pass tests and inspections.
- G. Prepare test and inspection reports.

### 3.11 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.

### 3.12 INDOOR PIPING INSULATION SCHEDULE

- A. Domestic Cold Water:
  - 1. NPS 1 and Smaller: Insulation shall be one of the following:
    - a. Cellular Glass: 1-1/2 inches thick.
    - b. Flexible Elastomeric: 3/4 inch thick.

2. NPS 1-1/4 and Larger: Insulation shall be one of the following:

- a. Cellular Glass: 1-1/2 inches thick.
- b. Flexible Elastomeric: 1 inch thick.

B. Domestic Hot and Recirculated Hot Water:

1. NPS 1-1/4 and Smaller: Insulation shall be one of the following:

- a. Cellular Glass: 2 inches thick.
- b. Flexible Elastomeric: 2 inch thick.

2. NPS 1-1/2 and Larger: Insulation shall be one of the following:

- a. Cellular Glass: 2 inches thick.
- b. Flexible Elastomeric: 2 inch thick.

C. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities:

1. All Pipe Sizes: Insulation shall be one of the following:

- a. Flexible Elastomeric: 1/2 inch thick.
- b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.

### 3.13 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Piping, Concealed:

1. None.

D. Piping, Exposed:

1. Aluminum, Smooth: 0.016 inch thick.

END OF SECTION 220719

## SECTION 221116 - DOMESTIC WATER PIPING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. CPVC piping.
  - 2. Piping joining materials.
  - 3. Encasement for piping.
  - 4. Transition fittings.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For transition fittings and dielectric fittings.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. System purging and disinfecting activities report.
- B. Field quality-control reports.

#### 1.5 FIELD CONDITIONS

- A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:
  - 1. Notify Construction Manager no fewer than two days in advance of proposed interruption of water service.
  - 2. Do not interrupt water service without Construction Manager's written permission.

## PART 2 - PRODUCTS

### 2.1 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.
- B. Potable-water piping and components shall comply with NSF 14 and NSF 61 Annex G. Plastic piping components shall be marked with "NSF-pw."
- C. Comply with NSF 372 for low lead.

### 2.2 CPVC PIPING

- A. CPVC Pipe: ASTM F441/F441M, Schedule 80.
  - 1. CPVC Socket Fittings: ASTM F439 for Schedule 80.
  - 2. CPVC Threaded Fittings: ASTM F437, Schedule 80.
- B. CPVC Piping System: ASTM D2846/D2846M, SDR 11, pipe and socket fittings.
- C. CPVC Tubing System: ASTM D2846/D2846M, SDR 11, tube and socket fittings.

### 2.3 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials:
  - 1. AWWA C110/A21.10, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free unless otherwise indicated.
  - 2. Full-face or ring type unless otherwise indicated.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- C. Solder Filler Metals: ASTM B32, lead-free alloys.
- D. Flux: ASTM B813, water flushable.
- E. Brazing Filler Metals: AWS A5.8M/A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.
- F. Solvent Cements for Joining CPVC Piping and Tubing: ASTM F493.

### 2.4 TRANSITION FITTINGS

- A. General Requirements:
  - 1. Same size as pipes to be joined.
  - 2. Pressure rating at least equal to pipes to be joined.

3. End connections compatible with pipes to be joined.
- B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
- C. Sleeve-Type Transition Coupling: AWWA C219.
- D. Plastic-to-Metal Transition Fittings:
  1. Description:
    - a. CPVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions.
    - b. One end with threaded brass insert and one solvent-cement-socket or threaded end.
- E. Plastic-to-Metal Transition Unions:
  1. Description:
    - a. CPVC four-part union.
    - b. Brass or stainless-steel threaded end.
    - c. Solvent-cement-joint or threaded plastic end.
    - d. Rubber O-ring.
    - e. Union nut.

## PART 3 - EXECUTION

### 3.1 EARTHWORK

- A. Comply with requirements in Section 312000 "Earthwork" for excavating, trenching, and backfilling.

### 3.2 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."
- C. Install ductile-iron piping under building slab with restrained joints according to AWWA C600 and AWWA M41.
- D. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve inside the building at each domestic water-service entrance. Comply with requirements for pressure gages in Section 220519 "Meters and Gages for Plumbing Piping" and with requirements for drain valves and strainers in Section 221119 "Domestic Water Piping Specialties."
- E. Install shutoff valve immediately upstream of each dielectric fitting.

- F. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements for pressure-reducing valves in Section 221119 "Domestic Water Piping Specialties."
- G. Install domestic water piping level with 0.25 percent slope downward toward drain and plumb.
- H. Rough-in domestic water piping for water-meter installation according to utility company's requirements.
- I. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- J. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- K. 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.
- L. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- M. Install piping to permit valve servicing.
- N. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.
- O. Install piping free of sags and bends.
- P. Install fittings for changes in direction and branch connections.
- Q. Install PEX tubing with loop at each change of direction of more than 90 degrees.
- R. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
- S. Install pressure gages on suction and discharge piping for each plumbing pump and packaged booster pump.
- T. Install thermostats in hot-water circulation piping.
- U. Install thermometers on outlet piping from each water heater.
- V. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- W. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- X. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

### 3.3 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
  - 1. Apply appropriate tape or thread compound to external pipe threads.
  - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- D. Brazed Joints for Copper Tubing: Comply with CDA's "Copper Tube Handbook," "Brazed Joints" chapter.
- E. Soldered Joints for Copper Tubing: Apply ASTM B813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B828 or CDA's "Copper Tube Handbook."
- F. Pressure-Sealed Joints for Copper Tubing: Join copper tube and pressure-seal fittings with tools recommended by fitting manufacturer.
- G. Push-on Joints for Copper Tubing: Clean end of tube. Measure insertion depth with manufacturer's depth gage. Join copper tube and push-on-joint fittings by inserting tube to measured depth.
- H. Extruded-Tee Connections: Form tee in copper tube according to ASTM F2014. Use tool designed for copper tube; drill pilot hole, form collar for outlet, dimple tube to form seating stop, and braze branch tube into collar.
- I. Joint Construction for Grooved-End Copper Tubing: Make joints according to AWWA C606. Roll groove ends of tubes. Lubricate and install gasket over ends of tubes or tube and fitting. Install coupling housing sections over gasket with keys seated in tubing grooves. Install and tighten housing bolts.
- J. Joint Construction for Grooved-End, Ductile-Iron Piping: Make joints according to AWWA C606. Cut round-bottom grooves in ends of pipe at gasket-seat dimension required for specified (flexible or rigid) joint. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections over gasket with keys seated in piping grooves. Install and tighten housing bolts.
- K. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.
- L. Joint Construction for Solvent-Cemented Plastic Piping: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F402 for safe-handling practice of cleaners, primers, and solvent cements. Apply primer.
  2. CPVC Piping: Join according to ASTM D2846/D2846M Appendix.
  3. PVC Piping: Join according to ASTM D2855.
- M. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

### 3.4 TRANSITION FITTING INSTALLATION

- A. Install transition couplings at joints of dissimilar piping.
- B. Transition Fittings in Underground Domestic Water Piping:
1. Fittings for NPS 1-1/2 and Smaller: Fitting-type coupling.
  2. Fittings for NPS 2 and Larger: Sleeve-type coupling.
- C. Transition Fittings in Aboveground Domestic Water Piping NPS 2 and Smaller: Plastic-to-metal transition fittings or unions.

### 3.5 INSTALLATION OF HANGERS AND SUPPORTS

- A. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- B. Comply with requirements for pipe hangers, supports, and anchor devices in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
1. Vertical Piping: MSS Type 8 or 42, clamps.
  2. Individual, Straight, Horizontal Piping Runs:
    - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
    - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
    - c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.
  3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
  4. Base of Vertical Piping: MSS Type 52, spring hangers.
- C. Install vinyl-coated hangers for CPVC piping, with maximum horizontal spacing and minimum rod diameters, to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- D. Install vinyl-coated hangers for PEX tubing, with maximum horizontal spacing and minimum rod diameters, to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- E. Support horizontal piping within 12 inches of each fitting.



- F. Support vertical runs of CPVC piping to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- G. Support vertical runs of PEX tubing to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

### 3.6 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. When installing piping adjacent to equipment and machines, allow space for service and maintenance.
- C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.
- D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:
  - 1. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
  - 2. Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller than that required by plumbing code.
  - 3. Equipment: Cold- and hot-water-supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

### 3.7 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification materials and installation in Section 220553 "Identification for Plumbing Piping and Equipment."
- B. Label pressure piping with system operating pressure.

### 3.8 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
  - 1. Piping Inspections:
    - a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
    - b. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
      - 1) Roughing-in Inspection: Arrange for inspection of piping before concealing or closing in after roughing in and before setting fixtures.

- 2) Final Inspection: Arrange for authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.
  - c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
  - d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
2. Piping Tests:
- a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
  - b. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
  - c. 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.
  - d. 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 it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
  - e. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
  - f. Prepare reports for tests and for corrective action required.
- B. Domestic water piping will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

### 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 hot-water flow in each branch.
    - b. Adjust calibrated balancing valves to flows indicated.
  5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
  6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
  7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
  8. Check plumbing specialties and verify proper settings, adjustments, and operation.

### 3.10 CLEANING

A. Clean and disinfect potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
  - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
  - b. Fill and isolate system according to either of the following:
    - 1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
    - 2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.
  - c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
  - d. Repeat procedures if biological examination shows contamination.
  - e. Submit water samples in sterile bottles to authorities having jurisdiction.

B. Clean non-potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging procedures prescribed by authorities having jurisdiction or; if methods are not prescribed, follow procedures described below:
  - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
  - b. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

C. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.

D. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

### 3.11 PIPING SCHEDULE

- A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
- B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.
- C. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.

- D. Aboveground domestic water piping, NPS 2 and smaller, shall be the following:
  - 1. CPVC, Schedule 80; socket fittings; and solvent-cemented joints.
  - 2. CPVC, Schedule 80 pipe; CPVC, Schedule 80 threaded fittings; and threaded joints.
- E. Aboveground domestic water piping, NPS 2-1/2 to NPS 4, shall be the following:
  - 1. CPVC, Schedule 80; socket fittings; and solvent-cemented joints.
  - 2. CPVC, Schedule 80 pipe; CPVC, Schedule 80 threaded fittings; and threaded joints.

### 3.12 VALVE SCHEDULE

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
  - 1. Shutoff Duty: Use ball valves for piping NPS 2 and smaller.
  - 2. Drain Duty: Hose-end drain valves.
- B. Use check valves to maintain correct direction of domestic water flow to and from equipment.

END OF SECTION 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.
- B. JEA Water, Wastewater, and Reclaimed Water Design Guidelines.
- C. JEA Water and Wastewater Standards Manual.
- D. JEA Facilities Manual.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Vacuum breakers.
  - 2. Backflow preventers.
  - 3. Water pressure-reducing valves.
  - 4. Temperature-actuated, water mixing valves.
  - 5. Strainers.
  - 6. Hose stations.
  - 7. Hose bibbs.
  - 8. Wall hydrants
  - 9. Water-hammer arresters.
  - 10. Trap-seal primer valves.
  - 11. Specialty valves.
  - 12. Flexible connectors.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For domestic water piping specialties.
  - 1. Include diagrams for power, signal, and control wiring.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

## 1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

## PART 2 - PRODUCTS

### 2.1 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES

- A. Potable-water piping and components shall comply with NSF 61 Annex G and NSF 14. Mark "NSF-pw" on plastic piping components.

### 2.2 PERFORMANCE REQUIREMENTS

- A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig unless otherwise indicated.

### 2.3 VACUUM BREAKERS

- A. Hose-Connection Vacuum Breakers:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Apollo Flow Controls; Conbraco Industries, Inc.
    - b. WATTS.
    - c. Zurn Industries, LLC.
  - 2. Standard: ASSE 1011.
  - 3. Body: Bronze, nonremovable, with manual drain.
  - 4. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
  - 5. Finish: Chrome or nickel plated.

### 2.4 BACKFLOW PREVENTERS

- A. Reduced-Pressure-Principle Backflow Preventers:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Apollo Flow Controls; Conbraco Industries, Inc.
    - b. WATTS.
    - c. Wilkins.
  - 2. Standard: ASSE 1013.
  - 3. Operation: Continuous-pressure applications.
  - 4. Pressure Loss: 12 psig maximum, through middle third of flow range.
  - 5. Body: Bronze for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.

6. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
7. Configuration: Designed for horizontal, straight-through flow.
8. Accessories:
  - a. Valves NPS 2 and Smaller: Ball type with threaded ends on inlet and outlet.
  - b. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.

## 2.5 WATER PRESSURE-REDUCING VALVES

### A. Water Regulators:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Apollo Flow Controls; Conbraco Industries, Inc.
  - b. WATTS.
  - c. Zurn Industries, LLC.
2. Standard: ASSE 1003.
3. Pressure Rating: Initial working pressure of 150 psig.
4. Size: refer to drawings
5. Design Inlet Pressure: 90 psig
6. Design Outlet Pressure Setting: 60 psig
7. Body: Bronze with chrome-plated finish for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved for NPS 2-1/2 and NPS 3.
8. Valves for Booster Heater Water Supply: Include integral bypass.
9. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and NPS 3.

## 2.6 WATER MIXING VALVES

### A. Water-Temperature Limiting Devices

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Leonard Valve Company.
  - b. WATTS.
  - c. Zurn Industries, LLC.
2. Standard: ASSE 1017.
3. Pressure Rating: 125 psig.
4. Type: Thermostatically controlled, water mixing valve.
5. Material: Bronze body with corrosion-resistant interior components.
6. Connections: Threaded or union inlets and outlet.
7. Accessories: Check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
8. Tempered-Water Setting: 104 deg F.
9. Tempered-Water Design Flow Rate: 0.5 gpm.
10. Valve Finish: Rough bronze.

## 2.7 HOSE STATIONS

### A. Single-Temperature-Water Hose Stations:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Leonard Valve Company.
  - b. T&S Brass and Bronze Works, Inc.
2. Standard: ASME A112.18.1.
3. Cabinet: Stainless-steel enclosure with exposed valve handle, hose connection, and hose rack. Include thermometer in front.
4. Hose-Rack Material: Stainless steel.
5. Body Material: Bronze with stainless-steel wetted parts.
6. Body Finish: Rough bronze.
7. Mounting: Wall, with reinforcement.
8. Supply Fittings: NPS 3/4 globe, or ball valve and check valve and NPS 3/4 copper, water tubing. Omit check valve if check stop is included with fitting.
9. Hose: Manufacturer's standard, for service fluid, temperature, and pressure; 50 feet long.
10. Nozzle: With hand-squeeze, on-off control.
11. Vacuum Breaker:
  - a. Integral or factory-installed, nonremovable, manual-drain-type, hose-connection vacuum breaker complying with ASSE 1011 or backflow preventer complying with ASSE 1052.
  - b. Garden-hose thread complying with ASME B1.20.7 on outlet.

## 2.8 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 threaded or solder-joint inlet.
5. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
6. Pressure Rating: 125 psig.
7. Vacuum Breaker: Integral nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
8. Finish for Equipment Rooms: Rough bronze, or chrome or nickel plated.
9. Finish for Service Areas: Chrome or nickel plated.
10. Finish for Finished Rooms: Chrome or nickel plated.
11. Operation for Equipment Rooms: Wheel handle or operating key.
12. Operation for Service Areas: Wheel handle.
13. Operation for Finished Rooms: Wheel handle.
14. Include operating key with each operating-key hose bibb.
15. Include integral wall flange with each chrome- or nickel-plated hose bibb.



## 2.9 WALL HYDRANTS

### A. Nonfreeze Wall Hydrants:

1. Standard: ASME A112.21.3M for concealed-outlet, self-draining wall hydrants.
2. Pressure Rating: 125 psig.
3. Operation: Loose key.
4. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
5. Inlet: NPS 3/4 or NPS 1.
6. Outlet: Concealed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
7. Box: Deep, flush mounted with cover.
8. Box and Cover Finish: Polished nickel bronze.
9. Outlet: Exposed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
10. Nozzle and Wall-Plate Finish: Polished nickel bronze.
11. Operating Keys(s): Two with each wall hydrant.

## 2.10 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. WATTS.
  - c. Zurn Industries, LLC.
2. Standard: ASSE 1010 or PDI-WH 201.
3. Type: Metal bellows.
4. Size: ASSE 1010, Sizes AA and A through F, or PDI-WH 201, Sizes A through F.

## 2.11 TRAP-SEAL PRIMER DEVICE

### A. Supply-Type, Trap-Seal Primer Device:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Precision Plumbing Products.
  - b. WATTS.
2. Standard: ASSE 1018.
3. Pressure Rating: 125 psig minimum.
4. Body: Bronze.
5. Inlet and Outlet Connections: NPS 1/2 threaded, union, or solder joint.
6. Gravity Drain Outlet Connection: NPS 1/2 threaded or solder joint.

7. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

B. Drainage-Type, Trap-Seal Primer Device:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Jay R. Smith Mfg Co; a division of Morris Group International or equal.
2. Standard: ASSE 1044, lavatory P-trap with NPS 3/8 minimum, trap makeup connection.
3. Size: NPS 1-1/4 minimum.
4. Material: Chrome-plated, cast brass.

2.12 SPECIALTY VALVES

A. Comply with requirements for general-duty metal valves in Section 220523.12 "Ball Valves for Plumbing Piping."

B. CPVC Union Ball Valves:

1. Description:
  - a. Standard: MSS SP-122.
  - b. Pressure Rating and Temperature: 125 psig at 73 deg F.
  - c. Body Material: CPVC.
  - d. Body Design: Union type.
  - e. End Connections for Valves NPS 2 and Smaller: Detachable, socket or threaded.
  - f. End Connections for Valves NPS 2-1/2 to NPS 4: Detachable, socket or threaded or flanged.
  - g. Ball: CPVC; full port.
  - h. Seals: PTFE or EPDM-rubber O-rings.
  - i. Handle: Tee shaped.

C. CPVC Non-Union Ball Valves:

1. Description:
  - a. Standard: MSS SP-122.
  - b. Pressure Rating and Temperature: 125 psig at 73 deg F.
  - c. Body Material: CPVC.
  - d. Body Design: Non-union type.
  - e. End Connections: Socket or threaded.
  - f. Ball: CPVC; full or reduced port.
  - g. Seals: PTFE or EPDM-rubber O-rings.
  - h. Handle: Tee shaped.

## 2.13 FLEXIBLE CONNECTORS

- A. Bronze-Hose Flexible Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.
  - 1. Working-Pressure Rating: Minimum 200 psig.
  - 2. End Connections NPS 2 and Smaller: Threaded copper pipe or plain-end copper tube.
  - 3. End Connections NPS 2-1/2 and Larger: Flanged copper alloy.
- B. Stainless-Steel-Hose Flexible Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.
  - 1. Working-Pressure Rating: Minimum 200 psig.
  - 2. End Connections NPS 2 and Smaller: Threaded steel-pipe nipple.
  - 3. End Connections NPS 2-1/2 and Larger: Flanged steel nipple.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.
  - 1. Locate backflow preventers in same room as connected equipment or system.
  - 2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe-to-floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are unacceptable for this application.
  - 3. Do not install bypass piping around backflow preventers.
- B. Install water regulators with inlet and outlet shutoff valves. Install pressure gages on inlet and outlet.
- C. Install water-control valves with inlet and outlet shutoff valves. Install pressure gages on inlet and outlet.
- D. Install balancing valves in locations where they can easily be adjusted.
- E. Install temperature-actuated, water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.
  - 1. 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 water pressure-reducing valve.
- G. Install outlet boxes recessed in wall or surface mounted on wall. Install 2-by-4-inch fire-retardant-treated-wood blocking, wall reinforcement between studs. Comply with requirements for fire-retardant-treated-wood blocking in Section 061000 "Rough Carpentry."

- H. Install hose stations with check stops or shutoff valves on inlets and with thermometer on outlet.
  - 1. 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. Comply with requirements for fire-retardant-treated-wood blocking in Section 061000 "Rough Carpentry."
- I. Install water-hammer arresters in water piping according to PDI-WH 201.
- J. 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.
- K. Install drainage-type, trap-seal primer valves as lavatory trap with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting.
- L. Install trap-seal primer systems with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust system for proper flow.

### 3.2 CONNECTIONS

- A. Comply with requirements for ground equipment in Section 260526 "Grounding and Bonding for Electrical Systems."
- B. Fire-retardant-treated-wood blocking is specified in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for electrical connections.

### 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. Pressure vacuum breakers.
  - 2. Reduced-pressure-principle backflow preventers.
  - 3. Water pressure-reducing valves.
  - 4. Primary, thermostatic, water mixing valves.
  - 5. Primary water tempering valves.
  - 6. Hose stations.
  - 7. 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 Section 220553 "Identification for Plumbing Piping and Equipment."

### 3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:

1. Test each reduced-pressure-principle backflow preventer according to authorities having jurisdiction and the device's reference standard.
- B. Domestic water piping specialties will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

3.5 ADJUSTING

- A. Set field-adjustable pressure set points of water pressure-reducing valves.
- B. Set field-adjustable flow set points of balancing valves.
- C. Set field-adjustable temperature set points of temperature-actuated, water mixing valves.

END OF SECTION 221119

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## SECTION 221316 - SANITARY WASTE AND VENT PIPING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Hub-and-spigot, cast-iron soil pipe and fittings.
  - 2. Hubless, cast-iron soil pipe and fittings.
  - 3. PVC pipe and fittings.
  - 4. Specialty pipe fittings.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Sustainable Design Submittals:
- C. Shop Drawings: For hubless, single-stack drainage system. Include plans, elevations, sections, and details.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Seismic Qualification Certificates: For waste and vent piping, accessories, and components, from manufacturer.
  - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
  - 2. Detailed description of piping anchorage devices on which the certification is based and their installation requirements.
- B. Field quality-control reports.

#### 1.5 FIELD CONDITIONS

- A. Interruption of Existing Sanitary Waste 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 Construction Manager no fewer than two days in advance of proposed interruption of sanitary waste service.
2. Do not proceed with interruption of sanitary waste service without Construction Manager's written permission.

## 1.6 WARRANTY

- A. Listed manufacturers to provide labeling and warranty of their respective products.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:
  1. Soil, Waste, and Vent Piping: 10-foot head of water.

### 2.2 PIPING MATERIALS

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

### 2.3 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A74, Extra Heavy class(es).
- B. Gaskets: ASTM C564, rubber.
- C. Caulking Materials: ASTM B29, pure lead and oakum or hemp fiber.

### 2.4 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A888 or CISPI 301.
- B. Single-Stack Aerator Fittings: ASME B16.45, hubless, cast-iron aerator and deaerator drainage fittings.
- C. Heavy-Duty, Hubless-Piping Couplings:
  1. Standards: ASTM C1277 and ASTM C1540.
  2. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C564, rubber sleeve with integral, center pipe stop.



## 2.5 PVC PIPE AND FITTINGS

- A. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping and "NSF-sewer" for plastic sewer piping.
- B. Solid-Wall PVC Pipe: ASTM D2665, drain, waste, and vent.
- C. PVC Socket Fittings: ASTM D2665, made to ASTM D3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.
- D. Adhesive Primer: ASTM F656.
- E. Solvent Cement: ASTM D2564.

## 2.6 SPECIALTY PIPE FITTINGS

- A. Transition Couplings:
  - 1. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
  - 2. Unshielded, Nonpressure Transition Couplings:
    - a. Standard: ASTM C1173.
    - b. Description: Elastomeric, sleeve-type, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
    - c. End Connections: Same size as and compatible with pipes to be joined.
    - d. Sleeve Materials:
      - 1) For Cast-Iron Soil Pipes: ASTM C564, rubber.
      - 2) For Plastic Pipes: ASTM F477, elastomeric seal or ASTM D5926, PVC.
      - 3) For Dissimilar Pipes: ASTM D5926, PVC or other material compatible with pipe materials being joined.
  - 3. Shielded, Nonpressure Transition Couplings:
    - a. Standard: ASTM C1460.
    - b. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
    - c. End Connections: Same size as and compatible with pipes to be joined.

## PART 3 - EXECUTION

### 3.1 EARTHWORK

- A. Comply with requirements for excavating, trenching, and backfilling specified in Section 312000 "Earthwork."

### 3.2 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems.
  - 1. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations.
  - 2. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping to permit valve servicing.
- F. Install piping at indicated slopes.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Install piping to allow application of insulation.
- J. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Section 220548.13 "Vibration Controls for Plumbing Piping and Equipment."
- K. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends.
  - 1. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical.
  - 2. Use long-turn, double Y-branch and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drainpipe.
    - a. Straight tees, elbows, and crosses may be used on vent lines.
  - 3. Do not change direction of flow more than 90 degrees.
  - 4. Use proper size of standard increasers and reducers if pipes of different sizes are connected.
    - a. Reducing size of waste piping in direction of flow is prohibited.
- L. Lay buried building waste piping beginning at low point of each system.
  - 1. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream.

2. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
  3. Maintain swab in piping and pull past each joint as completed.
- M. Install soil and waste and vent piping at the following minimum slopes unless otherwise indicated:
1. Building Sanitary Waste: 2 percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
  2. Horizontal Sanitary Waste Piping: 2 percent downward in direction of flow.
  3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.
- N. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
1. Install encasement on underground piping according to ASTM A674 or AWWA C105/A 21.5.
- O. Install aboveground PVC piping according to ASTM D2665.
- P. Install underground PVC piping according to ASTM D2321.
- Q. Install engineered soil and waste and vent piping systems as follows:
1. Combination Waste and Vent: Comply with standards of authorities having jurisdiction.
  2. Hubless, Single-Stack Drainage System: Comply with ASME B16.45 and hubless, single-stack aerator fitting manufacturer's written installation instructions.
  3. Reduced-Size Venting: Comply with standards of authorities having jurisdiction.
- R. Plumbing Specialties:
1. Install backwater valves in sanitary waster gravity-flow piping.
    - a. Comply with requirements for backwater valves specified in Section 221319 "Sanitary Waste Piping Specialties."
  2. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary waste gravity-flow piping.
    - a. Install cleanout fitting with closure plug inside the building in sanitary drainage force-main piping.
    - b. Comply with requirements for cleanouts specified in Section 221319 "Sanitary Waste Piping Specialties."
  3. Install drains in sanitary waste gravity-flow piping.
    - a. Comply with requirements for drains specified in Section 221319 "Sanitary Waste Piping Specialties."
- S. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

- T. Install sleeves for piping penetrations of walls, ceilings, and floors.
  - 1. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- U. Install sleeve seals for piping penetrations of concrete walls and slabs.
  - 1. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- V. Install escutcheons for piping penetrations of walls, ceilings, and floors.
  - 1. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

### 3.3 JOINT CONSTRUCTION

- A. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
- B. Join hub-and-spigot, cast-iron soil piping with calked joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead-and-oakum calked joints.
- C. Join hubless, cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.
- D. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1.
  - 1. Cut threads full and clean using sharp dies.
  - 2. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
    - a. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
    - b. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
    - c. Do not use pipe sections that have cracked or open welds.
- E. Join stainless-steel pipe and fittings with gaskets according to ASME A112.3.1.
- F. Join copper tube and fittings with soldered joints according to ASTM B828. Use ASTM B813, water-flushable, lead-free flux and ASTM B32, lead-free-alloy solder.
- G. Grooved Joints: Cut groove ends of pipe according to AWWA C606. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections, over gasket, with keys seated in piping grooves. Install and tighten housing bolts.
- H. Flanged Joints: Align bolt holes. Select appropriate gasket material, size, type, and thickness. Install gasket concentrically positioned. Use suitable lubricants on bolt threads. Torque bolts in cross pattern.

- I. Plastic, Nonpressure-Piping, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
  - 1. Comply with ASTM F402 for safe-handling practice of cleaners, primers, and solvent cements.
  - 2. PVC Piping: Join according to ASTM D2855 and ASTM D 2665 appendixes.

### 3.4 SPECIALTY PIPE FITTING INSTALLATION

- A. Transition Couplings:
  - 1. Install transition couplings at joints of piping with small differences in ODs.
  - 2. In Waste Drainage Piping: Shielded, nonpressure transition couplings.

### 3.5 VALVE INSTALLATION

- A. Comply with requirements in Section 220523.12 "Ball Valves for Plumbing Piping," for general-duty valve installation requirements.
- B. Shutoff Valves:
  - 1. Install shutoff valve on each sewage pump discharge.
  - 2. Install full-port ball valve for piping NPS 2 and smaller.
  - 3. Install ball valve for piping NPS 2-1/2 and larger.
- C. Check Valves: Install swing check valve, between pump and shutoff valve, on each sewage pump discharge.

### 3.6 INSTALLATION OF HANGERS AND SUPPORTS

- A. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- B. Comply with requirements for pipe hanger and support devices and installation specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
  - 1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
  - 2. Install stainless-steel pipe hangers for horizontal piping in corrosive environments.
  - 3. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
  - 4. Install stainless-steel pipe support clamps for vertical piping in corrosive environments.
  - 5. Vertical Piping: MSS Type 8 or Type 42, clamps.
  - 6. Install individual, straight, horizontal piping runs:
    - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
    - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
    - c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.
  - 7. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.

8. Base of Vertical Piping: MSS Type 52, spring hangers.

- C. Install hangers for PVC piping, with maximum horizontal spacing and minimum rod diameters to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- D. Support horizontal piping and tubing within 12 inches of each fitting, valve, and coupling.
- E. Support vertical runs of cast iron soil piping to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- F. Support vertical runs for PVC piping to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.7 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect waste and vent piping to the following:
  - 1. Plumbing Fixtures: Connect waste piping in sizes indicated, but not smaller than required by plumbing code.
  - 2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
  - 3. Plumbing Specialties: Connect waste and vent piping in sizes indicated, but not smaller than required by plumbing code.
  - 4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
  - 5. Equipment: Connect waste piping as indicated.
    - a. Provide shutoff valve if indicated and union for each connection.
    - b. Use flanges instead of unions for connections NPS 2-1/2 and larger.
- D. Connect force-main piping to the following:
  - 1. Sanitary Sewer: To exterior force main.
  - 2. Sewage Pump: To sewage pump discharge.
- E. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.
- F. Make connections according to the following unless otherwise indicated:
  - 1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
  - 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.

### 3.8 IDENTIFICATION

- A. Identify exposed sanitary waste and vent piping.
- B. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

### 3.9 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
  - 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
  - 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test sanitary waste and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
  - 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired.
    - a. 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 waste and vent piping until it has been tested and approved.
    - a. Expose work that was covered or concealed before it was tested.
  - 3. Roughing-in Plumbing Test Procedure: Test waste and vent piping except outside leaders on completion of roughing-in.
    - a. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water.
    - b. From 15 minutes before inspection starts to completion of inspection, water level must not drop.
    - c. Inspect joints for leaks.
  - 4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight.
    - a. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg.
    - b. Use U-tube or manometer inserted in trap of water closet to measure this pressure.

- c. Air pressure must remain constant without introducing additional air throughout period of inspection.
  - d. Inspect plumbing fixture connections for gas and water leaks.
- 5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
- 6. Prepare reports for tests and required corrective action.
- E. Test force-main piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
  - 1. Leave uncovered and unconcealed new, altered, extended, or replaced force-main piping until it has been tested and approved.
    - a. Expose work that was covered or concealed before it was tested.
  - 2. Cap and subject piping to static-water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials.
    - a. Isolate test source and allow to stand for four hours.
    - b. Leaks and loss in test pressure constitute defects that must be repaired.
  - 3. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
  - 4. Prepare reports for tests and required corrective action.

### 3.10 CLEANING AND PROTECTION

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect sanitary waste and vent piping during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.
- D. Exposed PVC Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.
- E. Repair damage to adjacent materials caused by waste and vent piping installation.

### 3.11 PIPING SCHEDULE

- A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.
- B. Aboveground, soil, waste, and vent piping NPS 4 and smaller shall be the following (cast iron shall only be used where necessary to make connections):
  - 1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
  - 2. Hubless, cast-iron soil pipe and fittings and hubless, single-stack aerator fittings; heavy-duty hubless-piping couplings; and coupled joints.



3. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
  4. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
- C. Underground, soil, waste, and vent piping NPS 4 and smaller shall be the following:
1. Solid wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
  2. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

END OF SECTION 221316

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## SECTION 221319 - SANITARY WASTE PIPING SPECIALTIES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Cleanouts.
  - 2. Miscellaneous sanitary drainage piping specialties.

#### 1.3 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene.
- B. FOG: Fats, oils, and greases.
- C. PVC: Polyvinyl chloride.

#### 1.4 ACTION SUBMITTALS

- A. Shop Drawings:
  - 1. Show fabrication and installation details for frost-resistant vent terminals.
  - 2. Wiring Diagrams: Power, signal, and control wiring.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Seismic Qualification Data: For FOG disposal systems, accessories, and components, from manufacturer.
  - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
  - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
  - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- B. Field quality-control reports.

## 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For sanitary waste piping specialties to include in emergency, operation, and maintenance manuals.

## PART 2 - PRODUCTS

### 2.1 ASSEMBLY DESCRIPTIONS

- A. Sanitary waste piping specialties shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 14 for plastic sanitary waste piping specialty components.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing, and marked for intended location and application.

### 2.2 CLEANOUTS

#### A. Cast-Iron Exposed Cleanouts:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Jay R. Smith Mfg Co; a division of Morris Group International.
  - b. Josam Company.
  - c. Zurn Industries, LLC.
- 2. Standard: ASME A112.36.2M.
- 3. Size: Same as connected drainage piping
- 4. Body Material: Hubless, cast-iron soil pipe test tee as required to match connected piping.
- 5. Closure: Countersunk, brass plug.
- 6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

#### B. Cast-Iron Exposed Floor Cleanouts:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Jay R. Smith Mfg Co; a division of Morris Group International.
  - b. Josam Company.
  - c. Zurn Industries, LLC.
- 2. Standard: ASME A112.36.2M for heavy-duty, adjustable housing cleanout.
- 3. Size: Same as connected branch.
- 4. Type: Heavy-duty, adjustable housing.
- 5. Body or Ferrule: Cast iron.
- 6. Clamping Device: Required.

7. Outlet Connection: Inside calk.
8. Closure: Brass plug with straight threads and gasket.
9. Adjustable Housing Material: Cast iron with threads.
10. Frame and Cover Material and Finish: Nickel-bronze, copper alloy.
11. Frame and Cover Shape: Round.
12. Top Loading Classification: Heavy Duty.
13. Riser: ASTM A74, Service class, cast-iron drainage pipe fitting and riser to cleanout.

C. Cast-Iron Wall Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Jay R. Smith Mfg Co; a division of Morris Group International.
  - b. Josam Company.
  - c. Zurn Industries, LLC.
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 Plug:
  - a. Brass.
  - b. Countersunk or raised head.
  - c. Drilled and threaded for cover attachment screw.
  - d. Size: Same as or not more than one size smaller than cleanout size.
6. Wall Access: Round, flat, chrome-plated brass or stainless-steel cover plate with screw.
7. Wall Access: Round, nickel-bronze, copper-alloy, or stainless-steel wall-installation frame and cover.

2.3 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Open Drains:

1. Description: Shop or field fabricate from ASTM A74, 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 C564 rubber gaskets.
2. Size: Same as connected waste piping with increaser fitting of size indicated.

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: 4-inch- minimum water seal.
  - b. NPS 2-1/2 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 side inlet.

2.4 MOTORS

A. General requirements for motors are specified in Section 220513 "Common Motor Requirements for Plumbing Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, motor shall be large enough, so driven load will not require motor to operate in service factor range above 1.0.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Equipment Mounting:

1. Install FOG disposal systems on cast-in-place concrete equipment base(s).
  - a. Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."
2. Comply with requirements for vibration-isolation and seismic-control devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
3. Comply with requirements for vibration-isolation devices specified in Section 220548.13 "Vibration Controls for Plumbing Piping and Equipment."

B. Install backwater valves in building drain piping.

1. For interior installation, provide cleanout deck plate flush with floor and centered over backwater valve cover, and of adequate size to remove valve cover for servicing.

C. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:

1. Size same as drainage piping up to NPS 4. Use NPS 4 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 and smaller and 100 feet for larger piping.
4. Locate at base of each vertical soil and waste stack.

D. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

- E. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- F. Install fixture air-admittance valves on fixture drain piping.
- G. Install stack air-admittance valves at top of stack vent and vent stack piping.
- H. Install air-admittance-valve wall boxes recessed in wall.
- I. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof. Comply with requirements in Section 076200 "Sheet Metal Flashing and Trim."
- J. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof. Comply with requirements in Section 076200 "Sheet Metal Flashing and Trim."
- K. Assemble open drain fittings and install with top of hub 1 inch above floor.
- L. Install deep-seal traps on floor drains and other waste outlets, if indicated.
- M. 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.
- N. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.
- O. Install sleeve and sleeve seals with each riser and stack passing through floors with waterproof membrane.
- P. Install vent caps on each vent pipe passing through roof.
- Q. Install frost-resistant vent terminals on each vent pipe passing through roof. Maintain 1-inch clearance between vent pipe and roof substrate.
- R. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.
- S. Install frost-proof vent caps on each vent pipe passing through roof. Maintain 1-inch clearance between vent pipe and roof substrate.
- T. Assemble components of FOG disposal systems and install on floor.
  - 1. Install trap, vent, fresh-air inlet, and flow-control fitting according to authorities having jurisdiction.
  - 2. Install shelf fastened to reinforcement in wall construction and adjacent to unit, unless otherwise indicated.
  - 3. Install culture bottle, culture metering pump, timer, and control on shelf. Install tubing between culture bottle, metering pump, and chamber.
- U. Install wood-blocking reinforcement for wall-mounting-type specialties.

- V. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

### 3.2 CONNECTIONS

- A. Comply with requirements in Section 221316 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.
- C. FOG Disposal Systems: Connect inlet and outlet to unit, connect flow-control fitting and fresh-air inlet piping to unit inlet piping, and connect vent piping between trap and media chamber. Connect electrical power.
- D. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- E. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

### 3.3 FLASHING INSTALLATION

- A. Comply with requirements in Section 076200 "Sheet Metal Flashing and Trim."
- B. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required.
- C. 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.
- D. Set flashing on floors and roofs in solid coating of bituminous cement.
- E. Secure flashing into sleeve and specialty clamping ring or device.
- F. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Section 076200 "Sheet Metal Flashing and Trim."
- G. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.



## SECTION 221319.13 - SANITARY DRAINS

### 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. Floor drains.
  - 2. Trench drains.

#### 1.3 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene styrene.
- B. FRP: Fiberglass-reinforced plastic.
- C. HDPE: High-density polyethylene.
- D. PE: Polyethylene.
- E. PP: Polypropylene.
- F. PVC: Polyvinyl chloride.

#### 1.4 ACTION SUBMITTALS

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

### PART 2 - PRODUCTS

#### 2.1 DRAIN ASSEMBLIES

- A. Sanitary drains shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 14 for plastic sanitary piping specialty components.

## 2.2 FLOOR DRAINS

### A. Cast-Iron Floor Drains:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Jay R. Smith Mfg Co; a division of Morris Group International.
  - b. Josam Company.
  - c. Zurn Industries, LLC.
2. Standard: ASME A112.6.3.
3. Pattern: Floor drain.
4. Body Material: Gray iron.
5. Seepage Flange: Required.
6. Anchor Flange: Required.
7. Clamping Device: Required.
8. Outlet: Bottom.
9. Coating on Interior and Exposed Exterior Surfaces: Acid-resistant enamel.
10. Sediment Bucket: Top or Strainer Material: Nickel bronze.
11. Top Shape: Round.
12. Dimensions of Top or Strainer: 6-inch.
13. Top Loading Classification: Heavy Duty.
14. Funnel: Not required.
15. Inlet Fitting: Not required.
16. Trap Material: Cast iron.
17. Trap Pattern: Deep-seal P-trap.
18. Trap Features: Not required.

## 2.3 TRENCH DRAINS

### A. Trench Drains:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Jay R. Smith Mfg Co; a division of Morris Group International.
  - b. MIFAB, Inc.
  - c. WATTS.
  - d. Zurn Industries, LLC.
2. Standard: ASME A112.6.3 for trench drains.
3. Material: Ductile or gray iron.
4. Flange: Anchor.
5. Clamping Device: Required.
6. Outlet: Bottom.
7. Grate Material: Ductile iron.
8. Grate Finish: Painted.
9. Dimensions of Frame and Grate: Refer to plumbing drawings.
10. Top Loading Classification: Heavy Duty.

11. Trap Material: Cast iron.
12. Trap Pattern: Standard P-trap.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. 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.
  3. 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.
  4. Install floor-drain flashing collar or flange, so no leakage occurs between drain and adjoining flooring.
    - a. Maintain integrity of waterproof membranes where penetrated.
  5. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.
- B. Install trench drains at low points of surface areas to be drained.
  1. Set grates of drains flush with finished surface, unless otherwise indicated.
- C. Comply with ASME A112.3.1 for installation of stainless-steel channel drainage systems.
  1. Install on support devices, so that top will be flush with adjacent surface.
- D. Install FRP channel drainage system components on support devices, so that top will be flush with adjacent surface.
- E. Install plastic channel drainage system components on support devices, so that top will be flush with adjacent surface.
- F. Install open drain fittings with top of hub 1 inch above floor.

### 3.2 CONNECTIONS

- A. Comply with requirements in Section 221316 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.

- B. Comply with requirements in Section 221319 "Sanitary Waste Piping Specialties" for backwater valves, air admittance devices and miscellaneous sanitary drainage piping specialties.
- C. Comply with requirements in Section 221323 "Sanitary Waste Interceptors" for grease interceptors, grease-removal devices, oil interceptors, sand interceptors, and solid interceptors.
- D. Install piping adjacent to equipment to allow service and maintenance.
- E. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- F. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

### 3.3 LABELING AND IDENTIFYING

- A. 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 Section 220553 "Identification for Plumbing Piping and Equipment."

### 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 221319.13

## 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. Section Includes:
  - 1. Residential, small-capacity, electric, domestic-water heaters.
  - 2. Domestic-water heater accessories.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings:
  - 1. Include diagrams for power, signal, and control wiring.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Equipment room drawing or BIM model, drawn to scale, on which the items described in this Section are shown and coordinated with all building trades.
- B. Seismic Qualification Data: Certificates, for commercial domestic-water heaters, accessories, and components, from manufacturer.
  - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
  - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
  - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- C. Product Certificates: For each type of commercial and tankless, electric, domestic-water heater.
- D. Domestic-Water Heater Labeling: Certified and labeled by testing agency acceptable to authorities having jurisdiction.

- E. Source quality-control reports.
- F. Field quality-control reports.
- G. Sample Warranty: For special warranty.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For electric, domestic-water heaters to include in emergency, operation, and maintenance manuals.

#### 1.6 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.

#### 1.7 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of electric, domestic-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 Periods: From date of Substantial Completion.
    - a. Electric, Tankless, Domestic-Water Heaters: One year(s).

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and use.
- B. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1.
- C. ASME Compliance: Where ASME-code construction is indicated, fabricate and label commercial, domestic-water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
- D. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61 and NSF 372.
- E. Residential, Tabletop, Electric, Domestic-Water Heaters:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. A. O. Smith Corporation.
  - b. Rheem Manufacturing Company.
  - c. State Industries.
2. Source Limitations: Obtain domestic-water heaters from single source from single manufacturer.
3. Standard: UL 174.
4. Storage-Tank Construction: Steel.
  - a. Tappings: ASME B1.20.1 pipe thread.
  - b. Pressure Rating: 150 psig.
  - c. Interior Finish: Comply with NSF 61 and NSF 372 barrier materials for potable-water tank linings, including extending lining material into tappings.
5. Factory-Installed Storage-Tank Appurtenances:
  - a. Anode Rod: Replaceable magnesium.
  - b. Dip Tube: Required unless cold-water inlet is near bottom of tank.
  - c. Drain Valve: Corrosion-resistant metal with hose-end connection.
  - d. Insulation: Comply with ASHRAE/IES 90.1.
  - e. Jacket: Steel, rectangular, with flat-top work surface, raised back, and enameled finish.
  - f. Heat-Trap Fittings: Inlet type in cold-water inlet and outlet type in hot-water outlet.
  - g. Heating Elements: Electric, screw-in immersion type.
  - h. Temperature Control: Adjustable thermostat.
  - i. Safety Control: High-temperature-limit cutoff device or system.
  - j. Relief Valve: ASME rated and stamped for combination temperature-and-pressure relief valves. Include relieving capacity at least as great as heat input, and include pressure setting less than working-pressure rating of domestic-water heater. Select relief valve with sensing element that extends into storage tank.

## 2.2 DOMESTIC-WATER HEATER ACCESSORIES

- A. Pressure-Reducing Valves: ASSE 1003 for water. Set at 25-psig- maximum outlet pressure unless otherwise indicated.
- B. Combination Temperature-and-Pressure Relief Valves: ASME rated and stamped. Include relieving capacity at least as great as heat input, and include pressure setting less than working-pressure rating of domestic-water heater. Select relief valves with sensing element that extends into storage tank.
- C. Pressure Relief Valves: ASME rated and stamped. Include pressure setting less than working-pressure rating of domestic-water heater.
- D. Vacuum Relief Valves: ANSI Z21.22/CSA 4.4.

- E. Shock Absorbers: ASSE 1010 or PDI-WH 201, Size A water hammer arrester.
- F. Domestic-Water Heater Mounting Brackets: Manufacturer's factory-fabricated steel bracket for wall mounting, capable of supporting domestic-water heater and water.

## 2.3 SOURCE QUALITY CONTROL

- A. Factory Tests: Test and inspect domestic-water heaters specified to be ASME-code construction, in accordance with ASME Boiler and Pressure Vessel Code.
- B. Hydrostatically test commercial domestic-water heaters to minimum of one and one-half times pressure rating before shipment.
- C. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

## PART 3 - EXECUTION

### 3.1 DOMESTIC-WATER HEATER INSTALLATION

- A. Commercial, Electric, Domestic-Water Heater Mounting: Install commercial, electric, domestic-water heaters on concrete base. Comply with requirements for concrete bases specified in Section 033000 "Cast-in-Place Concrete."
  - 1. Exception: Omit concrete bases for commercial, electric, domestic-water heaters if installation on stand, bracket, suspended platform, or directly on floor is indicated.
  - 2. Maintain manufacturer's recommended clearances.
  - 3. Arrange units so controls and devices that require servicing are accessible.
  - 4. 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 concrete base.
  - 5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
  - 6. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 7. Install anchor bolts to elevations required for proper attachment to supported equipment.
  - 8. Anchor domestic-water heaters to substrate.
- B. Install electric, domestic-water heaters level and plumb, in accordance with layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.
  - 1. Install shutoff valves on domestic-water-supply piping to domestic-water heaters and on domestic-hot-water outlet piping. Comply with requirements for shutoff valves specified in Section 220523.12 "Ball Valves for Plumbing Piping."
- 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 domestic-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 combination temperature-and-pressure relief valves in water piping for electric, domestic-water heaters without storage. Extend domestic-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.
- E. 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 electric, domestic-water heaters that do not have tank drains. Comply with requirements for hose-end drain valves specified in Section 221119 "Domestic Water Piping Specialties."
- F. Install thermometers on inlet and outlet piping of residential, solar, electric, domestic-water heaters.
- G. Assemble and install inlet and outlet piping manifold kits for multiple electric, domestic-water heaters. Fabricate, modify, or arrange manifolds for balanced water flow through each electric, domestic-water heater. Include shutoff valve and thermometer in each domestic-water heater inlet and outlet, and throttling valve in each electric, domestic-water heater outlet. Comply with requirements for valves specified in Section 220523.12 "Ball Valves for Plumbing Piping."
- H. Install piping-type heat traps on inlet and outlet piping of electric, domestic-water heater storage tanks without integral or fitting-type heat traps.
- I. Fill electric, domestic-water heaters with water.
- J. Charge domestic-water expansion tanks with air to required system pressure.
- K. Install dielectric fittings in all locations where piping of dissimilar metals is to be joined. The wetted surface of the dielectric fitting contacted by potable water shall contain less than 0.25 percent of lead by weight.

### 3.2 PIPING CONNECTIONS

- A. Comply with requirements for piping specified in Section 221116 "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where installing piping adjacent to electric, domestic-water heaters, allow space for service and maintenance of water heaters. Arrange piping for easy removal of domestic-water heaters.

### 3.3 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

### 3.4 FIELD QUALITY CONTROL

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

- B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- D. Perform tests and inspections.
- E. Tests and Inspections:
  - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
  - 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation.
  - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- F. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections.
- G. Prepare test and inspection reports.

### 3.5 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain commercial and tankless, electric, domestic-water heaters. Training shall be a minimum of one hour(s).

END OF SECTION 223300

## SECTION 224213.13 - COMMERCIAL WATER CLOSETS

### 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. Water closets.
  - 2. Flushometer valves.
  - 3. Toilet seats.
  - 4. Supports.

#### 1.3 DEFINITIONS

- A. Effective Flush Volume: Average of two reduced flushes and one full flush per fixture.
- B. Remote Water Closet: Located more than 30 feet from other drain line connections or fixture and where less than 1.5 drainage fixture units are upstream of the drain line connection.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for water closets.
  - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: Include diagrams for power, signal, and control wiring.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For flushometer valves to include in operation and maintenance manuals.

## 1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Flushometer-Valve Repair Kits: Equal to 10 percent of amount of each type installed, but no fewer than one of each type.

## PART 2 - PRODUCTS

### 2.1 FLOOR-MOUNTED, BACK-OUTLET WATER CLOSETS

- A. Water Closets: Floor mounted, back outlet, top spud.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. American Standard, Huron 3312.001.
    - b. Zurn Industries, LLC, 5645-bwl.
  - 2. Bowl:
    - a. Standards: ASME A112.19.2/CSA B45.1 and ASME A112.19.5.
    - b. Material: Vitreous china.
    - c. Type: Siphon jet.
    - d. Style: Flushometer valve.
    - e. Height: Standard.
    - f. Rim Contour: Elongated.
    - g. Water Consumption: 1.6 gal. per flush.
    - h. Spud Size and Location: NPS 1-1/2; top.
    - i. Color: White.
  - 3. Water-Closet Mounting Height: Handicapped/elderly according to ICC/ANSI A117.1.

### 2.2 FLUSHOMETER VALVES

- A. Lever-Handle, Diaphragm Flushometer Valves:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. Sloan Valve Company (Royal).
  - 2. Standard: ASSE 1037.
  - 3. Minimum Pressure Rating: 125 psig.
  - 4. Features: Include integral check stop and backflow-prevention device.
  - 5. Material: Brass body with corrosion-resistant components.
  - 6. Exposed Flushometer-Valve Finish: Chrome plated.
  - 7. Panel Finish: Chrome plated or stainless steel.

8. Style: Exposed.
9. Consumption: 1.6 gal. per flush.
10. Minimum Inlet: NPS 1.
11. Minimum Outlet: NPS 1-1/4.

## 2.3 TOILET SEATS

### A. Toilet Seats:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - a. Bemis Manufacturing Company (1655CT).
2. Standard: IAPMO/ANSI Z124.5.
3. Material: Plastic.
4. Type: Commercial (Heavy duty).
5. Shape: Elongated rim, open front.
6. Hinge: Check.
7. Hinge Material: Noncorroding metal.
8. Seat Cover: Not required.
9. Color: White.

## 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 water-closet installation.
- B. Examine walls and floors for suitable conditions where water closets will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

#### A. Water-Closet Installation:

1. Install level and plumb according to roughing-in drawings.
2. Install floor-mounted water closets on bowl-to-drain connecting fitting attachments to piping or building substrate.
3. Install accessible, wall-mounted water closets at mounting height for handicapped/elderly, according to ICC/ANSI A117.1.

#### B. Flushometer-Valve Installation:

1. Install flushometer-valve, water-supply fitting on each supply to each water closet.
2. Attach supply piping to supports or substrate within pipe spaces behind fixtures.

3. Install lever-handle flushometer valves for accessible water closets with handle mounted on open side of water closet.
  4. Install actuators in locations that are easy for people with disabilities to reach.
  5. Install fresh batteries in battery-powered, electronic-sensor mechanisms.
- C. Install toilet seats on water closets.
- D. Wall Flange and Escutcheon Installation:
1. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations and within cabinets and millwork.
  2. Install deep-pattern escutcheons if required to conceal protruding fittings.
  3. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."
- E. Joint Sealing:
1. Seal joints between water closets and walls and floors using sanitary-type, one-part, mildew-resistant silicone sealant.
  2. Match sealant color to water-closet color.
  3. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

### 3.3 CONNECTIONS

- A. Connect water closets with water supplies and soil, waste, and vent piping. Use size fittings required to match water closets.
- B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."
- C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."
- D. Where installing piping adjacent to water closets, allow space for service and maintenance.

### 3.4 ADJUSTING

- A. Operate and adjust water closets and controls. Replace damaged and malfunctioning water closets, fittings, and controls.
- B. Adjust water pressure at flushometer valves to produce proper flow.
- C. Install fresh batteries in battery-powered, electronic-sensor mechanisms.

### 3.5 CLEANING AND PROTECTION

- A. Clean water closets and fittings with manufacturers' recommended cleaning methods and materials.
- B. Install protective covering for installed water closets and fittings.

- C. Do not allow use of water closets for temporary facilities unless approved in writing by Owner.

END OF SECTION 224213.13

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## SECTION 224216.13 - COMMERCIAL LAVATORIES

### 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. Lavatories.
2. Faucets.
3. Supply fittings.
4. Waste fittings.
5. Supports.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for lavatories.
  2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: Include diagrams for power, signal, and control wiring of automatic faucets.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Counter cutout templates for mounting of counter-mounted lavatories.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For lavatories and faucets to include in operation and maintenance manuals.
  1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
    - a. Servicing and adjustments of automatic faucets.

## 1.6 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. 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.

## PART 2 - PRODUCTS

### 2.1 VITREOUS-CHINA, WALL-MOUNTED LAVATORIES

- A. Lavatory: Vitreous china, wall mounted, with back.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. American Standard.
    - b. Kohler Co.
    - c. Zurn Industries, LLC.
  - 2. Fixture:
    - a. Standard: ASME A112.19.2/CSA B45.1.
    - b. Type: For wall hanging.
    - c. Nominal Size: Oval, 19 by 16 inches.
    - d. Faucet-Hole Punching: Three holes, 4-inch centers.
    - e. Faucet-Hole Location: Top.
    - f. Color: White.
    - g. Mounting Material: Chair carrier.
  - 3. Support: Type II, concealed-arm lavatory carrier.
  - 4. Lavatory Mounting Height: Handicapped/elderly according to ICC A117.1.

### 2.2 SOLID-BRASS, MANUALLY OPERATED FAUCETS

- A. NSF Standard: Comply with NSF 372 for faucet materials that will be in contact with potable water.
- B. Lavatory Faucets: Manual-type, single-control mixing, commercial, solid-brass valve.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. Chicago Faucets; Geberit Company, 420-ABCP.

2. Standard: ASME A112.18.1/CSA B125.1.
3. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and fixture receptor.
4. Body Type: Centerset.
5. Body Material: Commercial, solid brass.
6. Finish: Polished chrome.
7. Maximum Flow Rate: 0.5 gpm.
8. Mounting Type: Deck, exposed.
9. Valve Handle(s): Single lever.
10. Spout: Rigid type.
11. Spout Outlet: Non-aerating.

## 2.3 SUPPLY FITTINGS

- A. NSF Standard: Comply with NSF 372 for supply-fitting materials that will be in contact with potable water.
- B. Standard: ASME A112.18.1/CSA B125.1.
- C. Supply Piping: Chrome-plated-brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated-brass or stainless-steel wall flange.
- D. Supply Stops: Chrome-plated-brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.
- E. Operation: Wheel handle.
- F. Risers:
  1. NPS 1/2.
  2. Stop valves shall be lead free ¼ turn ball valves with brass ball, stem, and body construction; annealed vertical tube; and chrome plated with cast brass escutcheons. Brasscraft KT Series; McGuire Manufacturing LFBV Series; Keeney Manufacturing PCLF Series: or equal.

## 2.4 WASTE FITTINGS

- A. Standard: ASME A112.18.2/CSA B125.2.
- B. Drain: Grid type with NPS 1-1/4 offset and straight tailpiece.
- C. Trap:
- D. Kohler K 9010 or equal, 1 1/2 in chrome plated cast brass P trap with cleanout plug. K 9015 chrome plated brass waste nipple and cast brass chrome plated escutcheons.

## 2.5 SUPPORTS

- A. Type II Lavatory Carrier:
  - 1. Standard: ASME A112.6.1M.
- B. Type III Lavatory Carrier:
  - 1. Standard: ASME A112.6.1M.

## 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 lavatory installation.
- B. Examine counters and walls for suitable conditions where lavatories will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Install lavatories level and plumb according to roughing-in drawings.
- B. Install supports, affixed to building substrate, for wall-mounted lavatories.
- C. Install accessible wall-mounted lavatories at handicapped/elderly mounting height for people with disabilities or the elderly, according to ICC/ANSI A117.1.
- D. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."
- E. Seal joints between lavatories, counters, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."
- F. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible lavatories. Comply with requirements in Section 220719 "Plumbing Piping Insulation."

### 3.3 CONNECTIONS

- A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."

- C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

#### 3.4 ADJUSTING

- A. Operate and adjust lavatories and controls. Replace damaged and malfunctioning lavatories, fittings, and controls.
- B. Adjust water pressure at faucets to produce proper flow.
- C. Install fresh batteries in battery-powered, electronic-sensor mechanisms.

#### 3.5 CLEANING AND PROTECTION

- A. After completing installation of lavatories, inspect and repair damaged finishes.
- B. Clean lavatories, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.
- C. Provide protective covering for installed lavatories and fittings.
- D. Do not allow use of lavatories for temporary facilities unless approved in writing by Owner.

END OF SECTION 224216.13

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## SECTION 224216.16 - COMMERCIAL SINKS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:

1. Service basins.
2. Supports.
3. Supply fittings.
4. Waste fittings.

#### 1.3 ACTION SUBMITTALS

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

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for sinks.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

- B. Sustainable Design Submittals:

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Counter cutout templates for mounting of counter-mounted lavatories.

#### 1.5 CLOSEOUT SUBMITTALS

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

#### 1.6 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. 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.

## PART 2 - PRODUCTS

### 2.1 SERVICE BASINS

- A. Service Basins: Terrazzo, floor mounted.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Crane Plumbing, L.L.C.
    - b. Florestone Products Co., Inc.
    - c. Stern-Williams Co., Inc.
    - d. Or equal.
  2. Fixture:
    - a. Standard: IAPMO PS 99.
    - b. Shape: Square.
    - c. Nominal Size: 36 by 36 inches.
    - d. Height: 12 inches.
    - e. Tiling Flange: Not required.
    - f. Rim Guard: On all top surfaces.
    - g. Color: Not applicable.
    - h. Drain: Grid with NPS 3 outlet.
  3. Mounting: On floor and flush to wall.
  4. Faucet.

### 2.2 SINK FAUCETS

- A. NSF Standard: Comply with NSF 372 for faucet-spout materials that will be in contact with potable water.
- B. Sink Faucets: Manual type, two-lever-handle mixing valve.
  1. Commercial, Solid-Brass Faucets.
    - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - 1) Elkay Manufacturing Co.
      - 2) T&S Brass and Bronze Works, Inc.
      - 3) Zurn Industries, LLC.
      - 4) Or equal.



2. Standard: ASME A112.18.1/CSA B125.1.
3. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and sink receptor.
4. Body Type: Centerset.
5. Body Material: Commercial, solid brass.
6. Finish: Polished chrome plate.
7. Maximum Flow Rate: 4.0 gpm.
8. Handles: Lever.
9. Mounting Type: Back/wall, exposed.
10. Spout Type: Rigid gooseneck.
11. Vacuum Breaker: Required for hose outlet.
12. Spout Outlet: Aerator.

## 2.3 SUPPLY FITTINGS

- A. NSF Standard: Comply with NSF 372 for supply-fitting materials that will be in contact with potable water.
- B. Standard: ASME A112.18.1/CSA B125.1.
- C. Supply Piping: Chrome-plated brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated brass or stainless-steel wall flange.
- D. Supply Stops: Chrome-plated brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.
- E. Operation: Wheel handle.
- F. Risers:
  1. NPS 1/2.
  2. Chrome-plated, rigid-copper pipe.

## 2.4 WASTE FITTINGS

- A. Standard: ASME A112.18.2/CSA B125.2.
- B. Drain: Grid type with NPS 1-1/2 offset and straight tailpiece.
- C. Trap:
  1. Size: NPS 1-1/2.
  2. Material: Chrome-plated, two-piece, cast-brass trap and swivel elbow with 0.032-inch-thick brass tube to wall; and chrome-plated brass or steel wall flange.
  3. Material: Stainless-steel, two-piece trap and swivel elbow with 0.012-inch-thick stainless-steel tube to wall; and stainless-steel wall flange.

## 2.5 GROUT

- A. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- B. Characteristics: Nonshrink; recommended for interior and exterior applications.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before sink installation.
- B. Examine walls, floors, and counters for suitable conditions where sinks will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Install sinks level and plumb according to roughing-in drawings.
- B. Install supports, affixed to building substrate, for wall-hung sinks.
- C. Install accessible wall-mounted sinks at handicapped/elderly mounting height according to ICC/ANSI A117.1.
- D. Set floor-mounted sinks in leveling bed of cement grout.
- E. Install water-supply piping with stop on each supply to each sink faucet.
  - 1. Exception: Use ball or gate valves if supply stops are not specified with sink. Comply with valve requirements specified in Section 220523.12 "Ball Valves for Plumbing Piping" and Section 220523.15 "Gate Valves for Plumbing Piping."
  - 2. Install stops in locations where they can be easily reached for operation.
- F. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."
- G. Seal joints between sinks and counters, floors, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

- H. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible sinks. Comply with requirements in Section 220719 "Plumbing Piping Insulation."

### 3.3 CONNECTIONS

- A. Connect sinks with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."
- C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

### 3.4 ADJUSTING

- A. Operate and adjust sinks and controls. Replace damaged and malfunctioning sinks, fittings, and controls.
- B. Adjust water pressure at faucets to produce proper flow.

### 3.5 CLEANING AND PROTECTION

- A. After completing installation of sinks, inspect and repair damaged finishes.
- B. Clean sinks, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.
- C. Provide protective covering for installed sinks and fittings.
- D. Do not allow use of sinks for temporary facilities unless approved in writing by Owner.

END OF SECTION 224216.16

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## SECTION 224500 - EMERGENCY 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. Section Includes:
  - 1. Combination units.
  - 2. Supplemental equipment.
  - 3. Water-tempering equipment.

#### 1.3 DEFINITIONS

- A. Plumbed Emergency Plumbing Fixture: Fixture with fixed, potable-water supply.
- B. Self-Contained Emergency Plumbing Fixture: Fixture with flushing-fluid-solution supply.
- C. Tepid: Moderately warm.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include flow rates and capacities, furnished specialties, and accessories.
- B. Shop Drawings:
  - 1. Include plans, elevations, sections, and mounting and attachment details.
  - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 3. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
  - 4. Include diagrams for power, signal, and control wiring.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Product Certificates: Submit certificates of performance testing specified in "Source Quality Control" Article.

- B. Field quality-control test reports.

## 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For emergency plumbing fixtures to include in operation and maintenance manuals.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- 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. ISEA Standard: Comply with ISEA Z358.1.
- C. NSF Standard: Comply with NSF 61 and NSF 372, for fixture materials that will be in contact with potable water.

### 2.2 COMBINATION UNITS

- A. Standard, Plumbed Emergency Shower with Eyewash Combination Units
  - 1. Products: Subject to compliance with requirements, provide the following:
    - a. Speakman Company; SE 693-SSH.
  - 2. Piping:
    - a. Material: stainless steel.
    - b. Unit Supply: NPS 1-1/2.
    - c. Unit Drain: Outlet at back or side near bottom.
  - 3. Shower:
    - a. Capacity: Not less than 20 gpm for at least 15 minutes.
    - b. Supply Piping: NPS 1 with flow regulator and stay-open control valve.
    - c. Control-Valve Actuator: Pull rod.
    - d. Valve: Stainless steel, SSBV1 option.
    - e. Shower Head: 8-inch- minimum diameter, stainless steel.
    - f. Mounting: Pedestal.
  - 4. Eye/Face Wash Unit:
    - a. Capacity: Not less than 3.0 gpm for at least 15 minutes.
    - b. Supply Piping: NPS 1/2 with flow regulator and stay-open control valve.
    - c. Control-Valve Actuator: Paddle.
    - d. Valve: Stainless steel, SSBV2 option.

- e. Spray-Head Assembly: Two or four receptor-mounted spray heads.
- f. Receptor: stainless-steel bowl.
- g. Mounting: Attached shower pedestal.
- h. Drench-Hose Option: May be provided instead of eye/face wash unit.
  - 1) Capacity: Not less than 3.0 gpm for at least 15 minutes.
  - 2) Drench Hose: Hand-held spray head with squeeze-handle actuator and hose.
  - 3) Mounting: Bracket on shower pedestal.

5. Protection devices

- a. Provide outdoor unit with Scald protection bleed valve (SPV) and freeze protection valve (FPV).

2.3 SOURCE QUALITY CONTROL

- A. Certify performance of emergency plumbing fixtures by independent testing organization acceptable to authorities having jurisdiction.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for water piping systems to verify actual locations of piping connections before plumbed emergency plumbing fixture installation.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF EMERGENCY PLUMBING FIXTURE

- A. Assemble emergency plumbing fixture piping, fittings, control valves, and other components.
- B. Install fixtures level and plumb.
- C. Fasten fixtures to substrate.
- D. Fill self-contained fixtures with flushing fluid.

3.3 CONNECTIONS

- A. Indirectly connect emergency plumbing fixture receptors without trapped drain outlet to sanitary waste or storm drainage piping.
- B. Where installing piping adjacent to emergency plumbing fixtures, allow space for service and maintenance of fixtures.

### 3.4 FIELD QUALITY CONTROL

- A. Mechanical-Component Testing: After plumbing connections have been made, test for compliance with requirements. Verify ability to achieve indicated capacities.
- B. Tests and Inspections:
  - 1. Perform each visual and mechanical inspection.
  - 2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
  - 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation.
  - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Emergency plumbing fixtures will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

### 3.5 ADJUSTING

- A. Adjust or replace fixture flow regulators for proper flow.
- B. Adjust equipment temperature settings.

END OF SECTION 224500



## SECTION 230513 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on alternating-current 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 NEMA MG 1 unless otherwise indicated.
- B. Comply with IEEE 841 for severe-duty motors.

#### 2.2 MOTOR CHARACTERISTICS

- A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.
- B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

## 2.3 POLYPHASE MOTORS

- A. Description: NEMA MG 1, Design B, medium induction motor.
- B. Efficiency: Premium efficient, as defined in NEMA MG 1.
- C. Service Factor: 1.15.
- D. Multispeed Motors: Variable torque.
  - 1. For motors with 2:1 speed ratio, consequent pole, single winding.
  - 2. For motors with other than 2:1 speed ratio, separate winding for each speed.
- E. Multispeed Motors: Separate winding for each speed.
- F. Rotor: Random-wound, squirrel cage.
- G. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
- H. Temperature Rise: Match insulation rating.
- I. Insulation: Class F.
- J. Code Letter Designation:
  - 1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
  - 2. Motors Smaller Than 15 HP: Manufacturer's standard starting characteristic.
- K. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

## 2.4 SINGLE-PHASE MOTORS

- A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
  - 1. Permanent-split capacitor.
  - 2. Split phase.
  - 3. Capacitor start, inductor run.
  - 4. Capacitor start, capacitor run.
- B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
- C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
- D. Motors 1/20 HP and Smaller: Shaded-pole type.
- E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor

insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION (NOT USED)

END OF SECTION 230513

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## SECTION 230517 - SLEEVES AND SLEEVE SEALS FOR HVAC 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. Sleeves.
  - 2. Grout.
  - 3. Silicone sealants.

#### 1.3 ACTION SUBMITTALS

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

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

### PART 2 - PRODUCTS

#### 2.1 SLEEVES

- A. Cast-Iron Pipe Sleeves: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop collar.
- B. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, anti-corrosion coated, with plain ends and integral welded waterstop collar.
- C. Galvanized-Steel Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- D. PVC Pipe Sleeves: ASTM D 1785, Schedule 40.
- E. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.
- F. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

## 2.2 GROUT

- A. Description: Nonshrink, recommended for interior and exterior sealing openings in nonfire-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.

## 2.3 SILICONE SEALANTS

- A. Silicone, S, NS, 25, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant, ASTM C 920, Type S, Grade NS, Class 25, use NT.
- B. Silicone, S, P, 25, T, NT: Single-component, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade P, Class 25, Uses T and NT. Grade P Pourable (self-leveling) formulation is for opening in floors and other horizontal surfaces that are not fire rated.
- C. Silicone Foam: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

# PART 3 - EXECUTION

## 3.1 SLEEVE INSTALLATION

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
- B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.
  - 1. Sleeves are not required for core-drilled holes.
- C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
  - 1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
  - 2. 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.
  - 3. Using grout or silicone sealant, seal space outside of sleeves in slabs and walls without sleeve-seal system.

- D. Install sleeves for pipes passing through interior partitions.
  - 1. Cut sleeves to length for mounting flush with both surfaces.
  - 2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
  - 3. Seal annular space between sleeve and piping or piping insulation; use sealants appropriate for size, depth, and location of joint.
- E. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke-Barrier Penetrations: Maintain indicated fire or smoke rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping and fill materials specified in Section 078413 "Penetration Firestopping."

### 3.2 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
  - 1. Leak Test: After allowing for a full cure, test sleeves and sleeve seals for leaks. Repair leaks and retest until no leaks exist.
- B. Sleeves and sleeve seals will be considered defective if they do not pass tests and inspections.

### 3.3 SLEEVE AND SLEEVE-SEAL SCHEDULE

- A. Use sleeves and sleeve seals for the following piping-penetration applications:
  - 1. Exterior Concrete Walls Above Grade:
    - a. Piping Smaller Than NPS 6: Steel pipe sleeves.
  - 2. Interior Partitions:
    - a. Piping Smaller Than NPS 6: PVC-pipe sleeves.

END OF SECTION 230517

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## SECTION 230518 - ESCUTCHEONS FOR HVAC 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. Escutcheons.
  - 2. Floor plates.

#### 1.3 DEFINITIONS

- A. Existing Piping to Remain: Existing piping that is not to be removed and that is not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

#### 1.4 ACTION SUBMITTALS

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

### PART 2 - PRODUCTS

#### 2.1 ESCUTCHEONS

- A. One-Piece, Steel Type: With polished, chrome-plated finish and setscrew fastener.
- B. Split-Plate, Stamped-Steel Type: With polished, chrome-plated finish; concealed and exposed-rivet hinge; and spring-clip fasteners.

#### 2.2 FLOOR PLATES

- A. Split Floor Plates: Steel with concealed hinge.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.
- B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
  - 1. Escutcheons for New Piping:
    - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep pattern.
    - b. Chrome-Plated Piping: One-piece steel or split-plate steel with polished, chrome-plated finish.

### 3.2 FIELD QUALITY CONTROL

- A. Using new materials, replace broken and damaged escutcheons and floor plates.

END OF SECTION 230518

## SECTION 230529 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Fiberglass pipe hangers.
4. Metal framing systems.
5. Fiberglass strut systems.
6. Thermal-hanger shield inserts.
7. Fastener systems.
8. Pipe stands.
9. Equipment supports.

- B. Related Requirements:

1. Section 230548.13 "Vibration Controls for HVAC" for vibration isolation devices.
2. Section 233113 "Metal Ducts" and Section 233116 "Nonmetal Ducts" for duct hangers and supports.

#### 1.3 ACTION SUBMITTALS

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

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

#### 1.5 QUALITY ASSURANCE

- A. Structural-Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code, Section IX.

- C. Qualification Data: For testing agency.

## PART 2 - PRODUCTS

### 2.1 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pregalvanized, hot-dip galvanized, or electro-galvanized.
3. Nonmetallic Coatings: Plastic coated, or epoxy powder-coated.
4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

B. Stainless-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

### 2.2 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

- B. Mechanical-Expansion Anchors: Insert-wedge-type anchors for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

1. Indoor Applications: Zinc-coated or stainless-steel.
2. Outdoor Applications: Stainless steel.

### 2.3 EQUIPMENT SUPPORTS

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

### 2.4 MATERIALS

- A. Aluminum: ASTM B 221.
- B. Carbon Steel: ASTM A 1011/A 1011M.
- C. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; galvanized.

- D. Stainless Steel: ASTM A 240/A 240M.
- E. Threaded Rods: Continuously threaded. Zinc-plated or galvanized steel for indoor applications and stainless steel for outdoor applications. Mating nuts and washers of similar materials as rods.
- F. Grout: ASTM C 1107/C 1107M, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
  - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
  - 2. Design Mix: 5000-psi, 28-day compressive strength.

### PART 3 - EXECUTION

#### 3.1 APPLICATION

- A. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.
- B. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

#### 3.2 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-58. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-58. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
  - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
  - 2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
- C. Fiberglass Pipe-Hanger Installation: Comply with applicable portions of MSS SP-58. Install hangers and attachments as required to properly support piping from building structure.
- D. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled strut systems.
- E. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

F. 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.

G. Pipe Stand Installation:

1. Pipe Stand Types except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. See Section 077200 "Roof Accessories" for curbs.

H. Install hangers and supports complete with necessary attachments, 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 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 that 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 to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

O. Insulated Piping:

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 allowed by ASME B31.9 for building services piping.

2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
  - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
  - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
4. Shield Dimensions for Pipe: Not less than the following:
  - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
  - b. NPS 4: 12 inches long and 0.06 inch thick.
  - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
  - d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
  - e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
5. Pipes NPS 8 and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
6. 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 bearing surface smooth.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

### 3.4 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
  1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  2. Obtain fusion without undercut or overlap.
  3. Remove welding flux immediately.
  4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

### 3.5 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. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
  - 1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.
- B. Touchup: Comply with requirements in Section 099113 "Painting" 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/A 780M.

### 3.7 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-58 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use carbon-steel pipe hangers and supports and attachments for general service applications.
- F. Use stainless-steel pipe hangers and stainless-steel attachments for hostile environment applications.
- G. Use padded hangers for piping that is subject to scratching.
- H. Use thermal-hanger shield inserts for insulated piping and tubing.
- I. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.



2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F, pipes NPS 4 to NPS 24, 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 36, 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 if little or no insulation is required.
5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
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, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, 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 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, from two 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 24, 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 if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is unnecessary.
20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is unnecessary.
21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.

J. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.

2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.
- K. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
  2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
  3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
  4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
  5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
- L. 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.

- M. 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.
- N. 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 allow 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 allow 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 allow 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.
- O. Comply with MSS SP-58 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- P. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.
- Q. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION 230529

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## SECTION 230548.13 - VIBRATION CONTROLS FOR HVAC

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:

- 1. Elastomeric isolation pads.
  - 2. Elastomeric hangers.
  - 3. Spring hangers.

- B. Related Requirements:

- 1. Section 220548.13 "Vibration Controls for Plumbing" for devices for plumbing equipment and systems.

#### 1.3 ACTION SUBMITTALS

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

- 1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
  - 2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of vibration isolation device type required.

- B. Shop Drawings:

- 1. Detail fabrication and assembly of equipment bases. Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
  - 2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

#### 1.4 DELEGATED-DESIGN SUBMITTAL

- A. For each vibration isolation device:

- 1. Include design calculations for selecting vibration isolators and for designing vibration isolation bases.

## 1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Show coordination of vibration isolation device installation for HVAC piping and equipment with other systems and equipment in the vicinity, including other supports and restraints, if any.
- B. Qualification Data: For testing agency.
- C. Welding certificates.
- D. Air-Mounting System Performance Certification: Include natural frequency, load, and damping test data.

## 1.6 QUALITY ASSURANCE

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

## PART 2 - PRODUCTS

### 2.1 ELASTOMERIC ISOLATION PADS

- A. Elastomeric Isolation Pads: .
  - 1. Fabrication: Single or multiple layers of sufficient durometer stiffness for uniform loading over pad area.
  - 2. Size: Factory or field cut to match requirements of supported equipment.
  - 3. Pad Material: Oil and water resistant with elastomeric properties.
  - 4. Surface Pattern: Smooth or Waffle pattern.
  - 5. Infused nonwoven cotton or synthetic fibers.
  - 6. Load-bearing metal plates adhered to pads.
  - 7. Sandwich-Core Material: Resilient and elastomeric.
    - a. Surface Pattern: Smooth or Waffle pattern.
    - b. Infused nonwoven cotton or synthetic fibers.

### 2.2 ELASTOMERIC HANGERS

- A. Elastomeric Mount in a Steel Frame with Upper and Lower Steel Hanger Rods: .
  - 1. Frame: Steel, fabricated with a connection for an upper threaded hanger rod and an opening on the underside to allow for a maximum of 30 degrees of angular lower hanger-rod misalignment without binding or reducing isolation efficiency.
  - 2. Dampening Element: Molded, oil-resistant rubber, neoprene, or other elastomeric material with a projecting bushing for the underside opening preventing steel to steel contact.

## 2.3 SPRING HANGERS

- A. 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. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
  8. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- 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. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 033000 "Cast-in-Place Concrete."
- B. Installation of vibration isolators must not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.

### 3.3 VIBRATION ISOLATION EQUIPMENT BASES INSTALLATION

- A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 033000 "Cast-in-Place Concrete."

END OF SECTION 230548.13



## SECTION 230553 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:

1. Equipment labels.
2. Pipe labels.
3. Duct labels.
4. Valve tags.

#### 1.3 ACTION SUBMITTALS

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

### PART 2 - PRODUCTS

#### 2.1 EQUIPMENT LABELS

- A. 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: Blue.
3. Background Color: White.
4. Maximum Temperature: Able to withstand temperatures up to 160 deg 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-quarters 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.
- B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.
- C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number, and identify Drawing numbers where equipment is indicated (plans, details, and schedules) and the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

## 2.2 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction according to ASME A13.1.
- B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to partially cover 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; also include 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: Size letters according to ASME A13.1 for piping.

## 2.3 DUCT 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: White.
- C. Background Color: Blue.
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

- F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters 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. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings; also include duct size and an arrow indicating flow direction.
  - 1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions or as separate unit on each duct label to indicate flow direction.

## 2.4 VALVE TAGS

- A. Description: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
  - 1. Tag Material: aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
  - 2. Fasteners: Brass wire-link chain or S-hook.
- B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
  - 1. Valve-tag schedule shall be included in operation and maintenance data.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

### 3.2 GENERAL INSTALLATION REQUIREMENTS

- 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.

### 3.3 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

### 3.4 PIPE LABEL INSTALLATION

- A. Piping Color Coding: Painting of piping is specified in Section 099123 "Painting."
- B. Stenciled Pipe Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels, complying with ASME A13.1, on each piping system.
  - 1. Identification Paint: Use for contrasting background.
  - 2. Stencil Paint: Use for pipe marking.
- C. Pipe Label Locations: 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 and on both sides of through walls, floors, ceilings, and inaccessible enclosures.
  - 4. At access doors, manholes, and similar access points that permit view of concealed piping.
  - 5. Near major equipment items and other points of origination and termination.
  - 6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
  - 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
- D. Directional Flow Arrows: Arrows shall be used to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.
- E. Pipe Label Color Schedule:
  - 1. Refrigerant Piping: Black letters on a safety-white background.

### 3.5 DUCT LABEL INSTALLATION

- A. Install self-adhesive duct labels with permanent adhesive on air ducts in the following color codes:
  - 1. Blue: For cold-air supply ducts.
  - 2. Yellow: For hot-air supply ducts.
  - 3. Green: For exhaust-, outside-, relief-, return-, and mixed-air ducts.

- B. Stenciled Duct Label Option: Stenciled labels showing service and flow direction may be provided instead of plastic-laminated duct labels, at Installer's option.
- C. Locate labels near points where ducts enter into and exit from concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

### 3.6 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems, except check valves, valves within factory-fabricated equipment units, shutoff valves, faucets, convenience and lawn-watering hose connections, and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:
  - 1. Valve-Tag Size and Shape:
    - a. Refrigerant: 1-1/2 inches, round.
  - 2. Valve-Tag Colors:
    - a. Toxic and Corrosive Fluids: Black letters on a safety-orange background.
    - b. Flammable Fluids: Black letters on a safety-yellow background.
    - c. Combustible Fluids: White letters on a safety-brown background.
    - d. Potable and Other Water: White letters on a safety-green background.
    - e. Compressed Air: White letters on a safety-blue background.
    - f. Defined by User: White letters on a safety-purple background, black letters on a safety-white background, white letters on a safety-gray background, and white letters on a safety-black background

### 3.7 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 230553

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## SECTION 230593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:

- 1. Balancing Air Systems:
  - a. Constant-volume air systems.
  - b. Dedicated Outside Air Units
- 2. Testing, Adjusting, and Balancing Equipment:
  - a. Motors.
  - b. Condensing units.
- 3. Testing, adjusting, and balancing existing systems and equipment.
- 4. Sound tests.
- 5. Vibration tests.
- 6. Duct leakage tests.
- 7. Control system verification.

#### 1.3 DEFINITIONS

- A. AABC: Associated Air Balance Council.
- B. BAS: Building automation systems.
- C. NEBB: National Environmental Balancing Bureau.
- D. TAB: Testing, adjusting, and balancing.
- E. TABB: Testing, Adjusting, and Balancing Bureau.
- F. TAB Specialist: An independent entity meeting qualifications to perform TAB work.
- G. TDH: Total dynamic head.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: Within 30 days of Contractor's Notice to Proceed, submit documentation that the TAB specialist and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.
- B. Contract Documents Examination Report: Within 30 days of Contractor's Notice to Proceed, submit the Contract Documents review report as specified in Part 3.
- C. Examination Report: Submit a summary report of the examination review required in "Examination" Article.
- D. Certified TAB reports.
- E. Sample report forms.
- F. 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 Specialists Qualifications: Certified by AABC.
  - 1. TAB Field Supervisor: Employee of the TAB specialist and certified by AABC.
  - 2. TAB Technician: Employee of the TAB specialist and certified by AABC as a TAB technician.
- B. TAB Specialists Qualifications: Certified by NEBB or TABB.
  - 1. TAB Field Supervisor: Employee of the TAB specialist and certified by NEBB or TABB.
  - 2. TAB Technician: Employee of the TAB specialist and certified by NEBB or TABB as a TAB technician.
- C. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."
- D. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6.7.2.3 - "System Balancing."

#### 1.6 FIELD CONDITIONS

- A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.



- B. 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.

## PART 2 - PRODUCTS (NOT USED)

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems designs that may preclude proper TAB of systems and equipment.
- B. Examine installed systems for 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 applicable for intended purpose and are accessible.
- C. Examine the approved submittals for HVAC systems and equipment.
- D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems output, and statements of philosophies and assumptions about HVAC system and equipment controls.
- E. Examine ceiling plenums and underfloor air plenums used for supply, return, or relief air to verify that they are properly separated from adjacent areas. Verify that penetrations in plenum walls are sealed and fire-stopped if required.
- F. Examine equipment performance data including fan and pump curves.
  - 1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
  - 2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.
- G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
- H. Examine test reports specified in individual system and equipment Sections.
- I. Examine HVAC equipment and verify that bearings are greased, belts are aligned and tight, filters are clean, and equipment with functioning controls is ready for operation.
- J. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible, and their controls are connected and functioning.

- K. Examine strainers. Verify that startup screens have been replaced by permanent screens with indicated perforations.
- L. Examine control valves for proper installation for their intended function of throttling, diverting, or mixing fluid flows.
- M. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- N. Examine system pumps to ensure absence of entrained air in the suction piping.
- O. Examine operating safety interlocks and controls on HVAC equipment.
- P. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

### 3.2 PREPARATION

- A. Prepare a TAB plan that includes the following:
  - 1. Equipment and systems to be tested.
  - 2. Strategies and step-by-step procedures for balancing the systems.
  - 3. Instrumentation to be used.
  - 4. Sample forms with specific identification for all equipment.
- B. Perform system-readiness checks of HVAC systems and equipment to verify system readiness for TAB work. Include, at a minimum, the following:
  - 1. Airside:
    - a. Verify that leakage and pressure tests on air distribution systems have been satisfactorily completed.
    - b. Duct systems are complete with terminals installed.
    - c. Volume, smoke, and fire dampers are open and functional.
    - d. Clean filters are installed.
    - e. Fans are operating, free of vibration, and rotating in correct direction.
    - f. Variable-frequency controllers' startup is complete, and safeties are verified.
    - g. Automatic temperature-control systems are operational.
    - h. Ceilings are installed.
    - i. Windows and doors are installed.
    - j. Suitable access to balancing devices and equipment is provided.

### 3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Total System Balance" or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and in this Section.
- B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.

1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
  2. After testing and balancing, install test ports and duct access doors that comply with requirements in Section 233300 "Air Duct Accessories."
  3. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Section 230713 "Duct Insulation," Section 230716 "HVAC Equipment Insulation," and Section 230719 "HVAC Piping Insulation."
- C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.
- D. Take and report testing and balancing measurements in inch-pound (IP) units.

### 3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Cross-check the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic diagrams of systems' "as-built" duct layouts.
- C. For variable-air-volume systems, develop a plan to simulate diversity.
- D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.
- E. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.
- F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- G. Verify that motor starters are equipped with properly sized thermal protection.
- H. Check dampers for proper position to achieve desired airflow path.
- I. Check for airflow blockages.
- J. Check condensate drains for proper connections and functioning.
- K. Check for proper sealing of air-handling-unit components.
- L. Verify that air duct system is sealed as specified in 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.
    - a. Set outside-air, return-air, and relief-air dampers for proper position that simulates minimum outdoor-air conditions.
    - b. Where duct conditions allow, measure airflow by Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses to obtain total airflow.
    - c. Where duct conditions are not suitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
    - d. If a reliable Pitot-tube traverse or coil traverse is not possible, measure airflow at terminals and calculate the total airflow.
  2. Measure fan static pressures as follows:
    - a. Measure static pressure directly at the fan outlet or through the flexible connection.
    - b. Measure static pressure directly at the fan inlet or through the flexible connection.
    - c. Measure static pressure across each component that makes up the air-handling system.
    - d. Report artificial loading of filters at the time static pressures are measured.
  3. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
  4. Obtain approval from Engineer for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in HVAC Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
  5. 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 occurs. 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.
1. Measure airflow of submain and branch ducts.
  2. Adjust submain and branch duct volume dampers for specified airflow.
  3. Re-measure each submain and branch duct after all have been adjusted.
- C. Adjust air inlets and outlets for each space to indicated airflows.
1. Set airflow patterns of adjustable outlets for proper distribution without drafts.
  2. Measure inlets and outlets airflow.
  3. Adjust each inlet and outlet for specified airflow.
  4. Re-measure each inlet and outlet after they have been adjusted.
- D. Verify final system conditions.
1. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to design if necessary.
  2. Re-measure and confirm that total airflow is within design.

3. Re-measure all final fan operating data, rpms, volts, amps, and static profile.
4. Mark all final settings.
5. Test system in economizer mode. Verify proper operation and adjust if necessary.
6. Measure and record all operating data.
7. Record final fan-performance data.

### 3.6 PROCEDURES FOR MOTORS

- A. Motors 1/2 HP and Larger: Test at final balanced conditions and record the following data:
  1. Manufacturer's name, model number, and serial number.
  2. Motor horsepower rating.
  3. Motor rpm.
  4. Phase and hertz.
  5. Nameplate and measured voltage, each phase.
  6. Nameplate and measured amperage, each phase.
  7. Starter size and thermal-protection-element rating.
  8. Service factor and frame size.
- B. Motors Driven by Variable-Frequency Controllers: Test manual bypass of controller to prove proper operation.

### 3.7 PROCEDURES FOR CONDENSING UNITS

- A. Verify proper rotation of fans.
- B. Measure entering- and leaving-air temperatures.
- C. Record fan and motor operating data.

### 3.8 PROCEDURES FOR HEAT-TRANSFER COILS

- A. Measure, adjust, and record the following data for each electric heating coil:
  1. Nameplate data.
  2. Airflow.
  3. Entering- and leaving-air temperature at full load.
  4. Voltage and amperage input of each phase at full load.
  5. Calculated kilowatt at full load.
  6. Fuse or circuit-breaker rating for overload protection.
- B. Measure, adjust, and record the following data for each refrigerant coil:
  1. Dry-bulb temperature of entering and leaving air.
  2. Wet-bulb temperature of entering and leaving air.
  3. Airflow.

### 3.9 CONTROLS VERIFICATION

- A. In conjunction with system balancing, perform the following:
  - 1. Verify temperature control system is operating within the design limitations.
  - 2. Confirm that the sequences of operation are in compliance with Contract Documents.
  - 3. Verify that controllers are calibrated and function as intended.
  - 4. Verify that controller set points are as indicated.
  - 5. Verify the operation of lockout or interlock systems.
  - 6. Verify the operation of valve and damper actuators.
  - 7. Verify that controlled devices are properly installed and connected to correct controller.
  - 8. Verify that controlled devices travel freely and are in position indicated by controller: open, closed, or modulating.
  - 9. Verify location and installation of sensors to ensure that they sense only intended temperature, humidity, or pressure.
- B. Reporting: Include a summary of verifications performed, remaining deficiencies, and variations from indicated conditions.

### 3.10 TOLERANCES

- A. Set HVAC system's airflow rates and water flow rates within the following tolerances:
  - 1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent.
  - 2. Air Outlets and Inlets: Plus or minus 10 percent.
- B. Maintaining pressure relationships as designed shall have priority over the tolerances specified above.

### 3.11 PROGRESS REPORTING

- A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems balancing devices. Recommend changes and additions to systems balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.
- B. Status Reports: Prepare biweekly progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

### 3.12 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. Certify validity and accuracy of field data.
- B. Final Report Contents: In addition to certified field-report data, include the following:
1. Pump curves.
  2. Fan curves.
  3. Manufacturers' test data.
  4. Field test reports prepared by system and equipment installers.
  5. Other information relative to equipment performance; do not include Shop Drawings and Product Data.
- C. General Report Data: In addition to form titles and entries, include the following data:
1. Title page.
  2. Name and address of the TAB specialist.
  3. Project name.
  4. Project location.
  5. Engineer's name and address.
  6. Engineer's name and address.
  7. Contractor's name and address.
  8. Report date.
  9. Signature of TAB supervisor who certifies the report.
  10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
  11. Summary of contents including the following:
    - a. Indicated versus final performance.
    - b. Notable characteristics of systems.
    - c. Description of system operation sequence if it varies from the Contract Documents.
  12. Nomenclature sheets for each item of equipment.
  13. Data for terminal units, including manufacturer's name, type, size, and fittings.
  14. Notes to explain why certain final data in the body of reports vary from indicated values.
  15. Test conditions for fans and pump performance forms including the following:
    - a. Settings for outdoor-, return-, and exhaust-air dampers.
    - b. Conditions of filters.
    - c. Cooling coil, wet- and dry-bulb conditions.
    - d. Face and bypass damper settings at coils.
    - e. Fan drive settings including settings and percentage of maximum pitch diameter.
    - f. Inlet vane settings for variable-air-volume systems.
    - g. Settings for supply-air, static-pressure controller.
    - h. Other system operating conditions that affect performance.

D. Air-Handling-Unit Test Reports: For air-handling units with coils, include the following:

1. Unit Data:

- a. Unit identification.
- b. Location.
- c. Make and type.
- d. Model number and unit size.
- e. Manufacturer's serial number.
- f. Unit arrangement and class.
- g. Discharge arrangement.
- h. Sheave make, size in inches, and bore.
- i. Center-to-center dimensions of sheave and amount of adjustments in inches.
- j. Number, make, and size of belts.
- k. Number, type, and size of filters.

2. Motor Data:

- a. Motor make, and frame type and size.
- b. Horsepower and rpm.
- c. Volts, phase, and hertz.
- d. Full-load amperage and service factor.
- e. Sheave make, size in inches, and bore.
- f. Center-to-center dimensions of sheave and amount of adjustments in inches.

3. Test Data (Indicated and Actual Values):

- a. Total airflow rate in cfm.
- b. Total system static pressure in inches wg.
- c. Fan rpm.
- d. Discharge static pressure in inches wg.
- e. Filter static-pressure differential in inches wg.
- f. Preheat-coil static-pressure differential in inches wg.
- g. Cooling-coil static-pressure differential in inches wg.
- h. Heating-coil static-pressure differential in inches wg.
- i. Outdoor airflow in cfm.
- j. Return airflow in cfm.
- k. Outdoor-air damper position.
- l. Return-air damper position.
- m. Vortex damper position.

E. Apparatus-Coil Test Reports:

1. Coil Data:

- a. System identification.
- b. Location.
- c. Coil type.
- d. Number of rows.
- e. Fin spacing in fins per inch o.c.
- f. Make and model number.



- g. Face area in sq. ft..
- h. Tube size in NPS.
- i. Tube and fin materials.
- j. Circuiting arrangement.

2. Test Data (Indicated and Actual Values):

- a. Airflow rate in cfm.
- b. Average face velocity in fpm.
- c. Air pressure drop in inches wg.
- d. Outdoor-air, wet- and dry-bulb temperatures in deg F.
- e. Return-air, wet- and dry-bulb temperatures in deg F.
- f. Entering-air, wet- and dry-bulb temperatures in deg F.
- g. Leaving-air, wet- and dry-bulb temperatures in deg F.
- h. Water flow rate in gpm.
- i. Water pressure differential in feet of head or psig.
- j. Entering-water temperature in deg F.
- k. Leaving-water temperature in deg F.
- l. Refrigerant expansion valve and refrigerant types.
- m. Refrigerant suction pressure in psig.
- n. Refrigerant suction temperature in deg F.
- o. Inlet steam pressure in psig.

F. Electric-Coil Test Reports: For electric furnaces, duct coils, and electric coils installed in central-station air-handling units, include the following:

1. Unit Data:

- a. System identification.
- b. Location.
- c. Coil identification.
- d. Capacity in Btu/h.
- e. Number of stages.
- f. Connected volts, phase, and hertz.
- g. Rated amperage.
- h. Airflow rate in cfm.
- i. Face area in sq. ft..
- j. Minimum face velocity in fpm.

2. Test Data (Indicated and Actual Values):

- a. Heat output in Btu/h.
- b. Airflow rate in cfm.
- c. Air velocity in fpm.
- d. Entering-air temperature in deg F.
- e. Leaving-air temperature in deg F.
- f. Voltage at each connection.
- g. Amperage for each phase.

G. Fan Test Reports: For supply, return, and exhaust fans, include the following:

1. Fan Data:
  - a. System identification.
  - b. Location.
  - c. Make and type.
  - d. Model number and size.
  - e. Manufacturer's serial number.
  - f. Arrangement and class.
  - g. Sheave make, size in inches, and bore.
  - h. Center-to-center dimensions of sheave and amount of adjustments in inches.
2. Motor Data:
  - a. Motor make, and frame type and size.
  - b. Horsepower and rpm.
  - c. Volts, phase, and hertz.
  - d. Full-load amperage and service factor.
  - e. Sheave make, size in inches, and bore.
  - f. Center-to-center dimensions of sheave, and amount of adjustments in inches.
  - g. Number, make, and size of belts.
3. Test Data (Indicated and Actual Values):
  - a. Total airflow rate in cfm.
  - b. Total system static pressure in inches wg.
  - c. Fan rpm.
  - d. Discharge static pressure in inches wg.
  - e. Suction static pressure in inches wg.

H. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:

1. Report Data:
  - a. System and air-handling-unit number.
  - b. Location and zone.
  - c. Traverse air temperature in deg F.
  - d. Duct static pressure in inches wg.
  - e. Duct size in inches.
  - f. Duct area in sq. ft..
  - g. Indicated airflow rate in cfm.
  - h. Indicated velocity in fpm.
  - i. Actual airflow rate in cfm.
  - j. Actual average velocity in fpm.
  - k. Barometric pressure in psig.

I. Air-Terminal-Device Reports:

1. Unit Data:

- a. System and air-handling unit identification.
- b. Location and zone.
- c. Apparatus used for test.
- d. Area served.
- e. Make.
- f. Number from system diagram.
- g. Type and model number.
- h. Size.
- i. Effective area in sq. ft..

2. Test Data (Indicated and Actual Values):

- a. Airflow rate in cfm.
- b. Air velocity in fpm.
- c. Preliminary airflow rate as needed in cfm.
- d. Preliminary velocity as needed in fpm.
- e. Final airflow rate in cfm.
- f. Final velocity in fpm.
- g. Space temperature in deg F.

J. Instrument Calibration Reports:

1. Report Data:

- a. Instrument type and make.
- b. Serial number.
- c. Application.
- d. Dates of use.
- e. Dates of calibration.

3.13 VERIFICATION OF TAB REPORT

- A. The TAB specialist's test and balance engineer shall conduct the inspection in the presence of Construction Manager.
- B. Construction Manager shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.
- C. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
- D. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.

- E. If TAB work fails, proceed as follows:
  - 1. TAB specialists shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.
  - 2. If the second final inspection also fails, Owner may contract the services of another TAB specialist to complete TAB work according to the Contract Documents and deduct the cost of the services from the original TAB specialist's final payment.
  - 3. If the second verification also fails, Engineer may contact AABC Headquarters regarding the AABC National Performance Guaranty.
- F. Prepare test and inspection reports.

### 3.14 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 230713 - DUCT 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 insulating the following duct services:
  - 1. Indoor, concealed supply and outdoor air.
  - 2. Indoor, exposed supply and outdoor air.
  - 3. Indoor, concealed exhaust between isolation damper and penetration of building exterior.
  - 4. Outdoor, exposed supply.
- B. Related Sections:
  - 1. Section 230719 "HVAC Piping Insulation."
  - 2. Section 233113 "Metal Ducts" for duct liners.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied if any).
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
  - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
  - 2. Detail insulation application at elbows, fittings, dampers, specialties and flanges for each type of insulation.
  - 3. Detail application of field-applied jackets.
  - 4. Detail application at linkages of control devices.
- C. Samples: For each type of insulation and jacket indicated. Identify each Sample, describing product and intended use. Sample sizes are as follows:
  - 1. Sheet Form Insulation Materials: 12 inches square.
  - 2. Sheet Jacket Materials: 12 inches square.
  - 3. Manufacturer's Color Charts: For products where color is specified, show the full range of colors available for each type of finish material.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.
- C. Field quality-control reports.

#### 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
  - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
  - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.
- C. Mockups: Before installing insulation, build mockups for each type of insulation and finish listed below to demonstrate quality of insulation application and finishes. Build mockups in the location indicated or, if not indicated, as directed by Engineer. Use materials indicated for the completed Work.
  - 1. Ductwork Mockups:
    - a. One 10-foot section each of rectangular and round straight duct.
    - b. One each of a 90-degree mitered round and rectangular elbow, and one each of a 90-degree radius round and rectangular elbow.
    - c. One rectangular branch takeoff and one round branch takeoff from a rectangular duct. One round tee fitting.
    - d. One rectangular and round transition fitting.
    - e. Four support hangers for round and rectangular ductwork.
    - f. Each type of damper and specialty.
  - 2. For each mockup, fabricate cutaway sections to allow observation of application details for insulation materials, adhesives, mastics, attachments, and jackets.
  - 3. Notify Engineer seven days in advance of dates and times when mockups will be constructed.
  - 4. Obtain Engineer's approval of mockups before starting insulation application.

5. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Engineer specifically approves such deviations in writing.
6. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
7. Demolish and remove mockups when directed.

#### 1.6 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.

#### 1.7 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."
- B. Coordinate clearance requirements with duct Installer for duct insulation application. Before preparing ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
- C. Coordinate installation and testing of heat tracing.

#### 1.8 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 "Duct Insulation Schedule, General," "Indoor Duct and Plenum Insulation Schedule," and "Aboveground, Outdoor Duct and Plenum Insulation Schedule" articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C871.

- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C553, Type II and ASTM C1290, Type III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. CertainTeed Corporation.
    - b. Johns Manville; a Berkshire Hathaway company.
    - c. Knauf Insulation.
    - d. Owens Corning.
- G. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Johns Manville; a Berkshire Hathaway company.
    - b. Knauf Insulation.
    - c. Owens Corning.

## 2.2 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
- B. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
- C. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

## 2.3 MASTICS AND COATINGS

- A. Materials shall be compatible with insulation materials, jackets, and substrates.
- B. Vapor-Retarder Mastic: Water based; suitable for indoor use on below ambient services.
  - 1. Water-Vapor Permeance: Comply with ASTM C755, Section 7.2.2, Table 2, for insulation type and service conditions.
  - 2. Service Temperature Range: Minus 20 to plus 180 deg F.



3. Comply with MIL-PRF-19565C, Type II, for permeance requirements.
  4. Color: White.
- C. Vapor-Retarder Mastic: Solvent based; suitable for indoor use on below ambient services.
1. Water-Vapor Permeance: Comply with ASTM C755, Section 7.2.2, Table 2, for insulation type and service conditions.
  2. Service Temperature Range: 0 to 180 deg F.
  3. Color: White.
- D. Vapor-Retarder Mastic: Solvent based; suitable for outdoor use on below ambient services.
1. Water-Vapor Permeance: Comply with ASTM C755, Section 7.2.2, Table 2, for insulation type and service conditions.
  2. Service Temperature Range: Minus 50 to plus 220 deg F.
  3. Color: White.
- E. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.
1. Water-Vapor Permeance: ASTM E96, greater than 1.0 perm at manufacturer's recommended dry film thickness.
  2. Service Temperature Range: Minus 20 to plus 180 deg F.
  3. Color: White.

## 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. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct insulation.
  2. Service Temperature Range: 0 to plus 180 deg F.
  3. Color: White.

## 2.5 SEALANTS

- A. FSK and Metal Jacket Flashing Sealants:
1. Materials shall be compatible with insulation materials, jackets, and substrates.
  2. Fire- and water-resistant, flexible, elastomeric sealant.
  3. Service Temperature Range: Minus 40 to plus 250 deg F.
  4. Color: Aluminum.

## 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 C1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C1136, Type II.
4. FSP Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C1136, Type II.
5. Vinyl Jacket: White vinyl with a permeance of 1.3 perms when tested according to ASTM E96/E96M, Procedure A, and complying with NFPA 90A and NFPA 90B.

## 2.7 FIELD-APPLIED FABRIC-REINFORCING MESH

- A. Woven Glass-Fiber Fabric: Approximately 6 oz./sq. yd. with a thread count of 5 strands by 5 strands/sq. in. for covering ducts.

## 2.8 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C921, Type I, unless otherwise indicated.
- B. Metal Jacket:
  1. Aluminum Jacket: Comply with ASTM B209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.
    - a. Sheet and roll stock ready for shop or field sizing.
    - b. Finish and thickness are indicated in field-applied jacket schedules.
    - c. Moisture Barrier for Indoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper.
    - d. Moisture Barrier for Outdoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper.
- C. Self-Adhesive Outdoor Jacket: 60-mil- thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a crosslaminated polyethylene film covered with white aluminum-foil facing.

## 2.9 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C1136.
  1. Width: 3 inches.
  2. Thickness: 11.5 mils.
  3. Adhesion: 90 ounces force/inch in width.
  4. Elongation: 2 percent.
  5. Tensile Strength: 40 lbf/inch in width.
  6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Width: 2 inches.
2. Thickness: 3.7 mils.
3. Adhesion: 100 ounces force/inch in width.
4. Elongation: 5 percent.
5. Tensile Strength: 34 lbf/inch in width.

2.10 SECUREMENTS

A. Bands:

1. Stainless Steel: ASTM A167 or ASTM A240/A240M, Type 316; 0.015 inch thick, 1/2 inch wide with wing seal or closed seal.

B. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit depth of insulation indicated.
2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
  - a. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
  - b. Spindle: Aluminum, fully annealed, 0.106-inch- diameter shank, length to suit depth of insulation indicated.
  - c. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
4. 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. 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.

## 2.11 CORNER ANGLES

- A. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch, aluminum according to ASTM B209, Alloy 3003, 3005, 3105, or 5005; Temper H-14.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
  - 1. Verify that systems to be insulated have been tested and are free of defects.
  - 2. Verify that surfaces to be insulated are clean and dry.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

### 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 ducts and fittings.
- B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Keep insulation materials dry during application and finishing.
- G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- H. Install insulation with least number of joints practical.
- I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
  2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
  3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
- J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- K. Install insulation with factory-applied jackets as follows:
1. Draw jacket tight and smooth.
  2. Cover circumferential joints with 3-inch- 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. 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, according to insulation material manufacturer's written instructions, to maintain vapor seal.
  5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.
- L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

### 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 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.
- C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- D. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.
  - 1. Comply with requirements in Section 078413 "Penetration Firestopping."
- E. Insulation Installation at Floor Penetrations:
  - 1. Duct: For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.
  - 2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

### 3.5 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

### 3.6 INSTALLATION OF MINERAL-FIBER INSULATION

- A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
  - 1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
  - 2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
  - 3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
    - a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.

- b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
    - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
    - d. Do not overcompress insulation during installation.
    - e. Impale insulation over pins and attach speed washers.
    - f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
  - 4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
    - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
    - b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.
  - 5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.
  - 6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
  - 7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.
- B. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
- 1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
  - 2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
  - 3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
    - a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
    - b. On duct sides with dimensions larger than 18 inches, space pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
    - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.

- d. Do not overcompress insulation during installation.
  - e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
- a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
  - b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.
5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

### 3.7 FIELD-APPLIED JACKET INSTALLATION

- A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.
- 1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
  - 2. Embed glass cloth between two 0.062-inch- thick coats of lagging adhesive.
  - 3. Completely encapsulate insulation with coating, leaving no exposed insulation.
- B. Where FSK jackets are indicated, install as follows:
- 1. Draw jacket material smooth and tight.
  - 2. Install lap or joint strips with same material as jacket.
  - 3. Secure jacket to insulation with manufacturer's recommended adhesive.
  - 4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch- wide joint strips at end joints.
  - 5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.
- C. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.



1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
- D. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

### 3.8 FIRE-RATED INSULATION SYSTEM INSTALLATION

- A. Where fire-rated insulation system is indicated, secure system to ducts and duct hangers and supports to maintain a continuous fire rating.
- B. Insulate duct access panels and doors to achieve same fire rating as duct.
- C. Install firestopping at penetrations through fire-rated assemblies. Fire-stop systems are specified in Section 078413 "Penetration Firestopping."

### 3.9 FINISHES

- A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
  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 Engineer. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless-steel jackets.

### 3.10 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. Tests and Inspections:
  1. Inspect ductwork, randomly selected by Engineer, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each duct system defined in the "Duct Insulation Schedule, General" Article.

- D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

### 3.11 DUCT INSULATION SCHEDULE, GENERAL

#### A. Plenums and Ducts Requiring Insulation:

1. Indoor, concealed supply and outdoor air.
2. Indoor, exposed supply and outdoor air.
3. Indoor, concealed exhaust between isolation damper and penetration of building exterior.
4. Outdoor, concealed supply.

#### B. Items Not Insulated:

1. Fibrous-glass ducts.
2. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
3. Factory-insulated flexible ducts.
4. Factory-insulated plenums and casings.
5. Flexible connectors.
6. Vibration-control devices.
7. Factory-insulated access panels and doors.
8. Exposed ductwork located in the area it serves.
9. Return air ductwork located in return air ceiling spaces above the area it serves, except where the return ductwork is installed in ceiling spaces with a roof above.

### 3.12 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

#### A. Concealed duct insulation shall be the following:

1. Mineral-Fiber Blanket: 2 inches thick and 1.5-lb/cu. ft. nominal density.

#### B. Exposed duct insulation shall be the following:

1. Mineral-Fiber Board: 2 inches thick and 3-lb/cu. ft. nominal density.

### 3.13 ABOVEGROUND, OUTDOOR DUCT AND PLENUM INSULATION SCHEDULE

#### A. Exposed, rectangular, supply-air duct insulation shall be the following:

1. Insulation Material - Flexible closed cell foam sheet, minimum density 5.5 lbs/cu ft and a maximum "K" factor of 0.27 at 75 degrees F mean temperature.
2. Provide a field applied 0.016-inch aluminum jacket secured with stainless steel straps for all piping.

3.14 INDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Ducts and Plenums, Concealed:
  - 1. None.
- D. Ducts and Plenums, Exposed:
  - 1. None.

END OF SECTION 230713

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## SECTION 230719 - HVAC PIPING 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 insulation for HVAC piping systems.
- B. Related Sections:
  - 1. Section 230713 "Duct Insulation" for duct insulation.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied if any).
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
  - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
  - 2. Detail attachment and covering of heat tracing inside insulation.
  - 3. Detail insulation application at pipe expansion joints for each type of insulation.
  - 4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
  - 5. Detail removable insulation at piping specialties.
  - 6. Detail application of field-applied jackets.
  - 7. Detail application at linkages of control devices.
- C. Samples: For each type of insulation and jacket indicated. Identify each Sample, describing product and intended use.
  - 1. Preformed Pipe Insulation Materials: 12 inches long by NPS 2.
  - 2. Sheet Form Insulation Materials: 12 inches square.
  - 3. Jacket Materials for Pipe: 12 inches long by NPS 2.
  - 4. Sheet Jacket Materials: 12 inches square.
  - 5. Manufacturer's Color Charts: For products where color is specified, show the full range of colors available for each type of finish material.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.
- C. Field quality-control reports.

#### 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
  - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
  - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

#### 1.6 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.

#### 1.7 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping 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.

## 1.8 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 "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come into contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested in accordance with ASTM C871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable in accordance with ASTM C795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C534/C534M, Type I for tubular materials, Type II for sheet materials.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Aeroflex USA.
    - b. Armacell LLC.
    - c. K-Flex USA.

### 2.2 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
- B. Flexible Elastomeric and Polyolefin Adhesive: Solvent-based adhesive.
  - 1. Flame-spread index shall be 25 or less and smoke-developed index shall be 50 or less as tested in accordance with ASTM E84.
  - 2. Wet Flash Point: Below 0 deg F.

3. Service Temperature Range: 40 to 200 deg F.
4. Color: Black.

## 2.3 MASTICS AND COATINGS

- A. Materials shall be compatible with insulation materials, jackets, and substrates.
- B. Vapor-Retarder Mastic, Water Based: Suitable for indoor use on below-ambient services.
  1. Water-Vapor Permeance: Comply with ASTM E96/E96M or ASTM F1249.
  2. Service Temperature Range: 0 to plus 180 deg F.
  3. Comply with MIL-PRF-19565C, Type II, for permeance requirements.
  4. Color: White.
- C. Vapor-Retarder Mastic, Solvent Based, Indoor Use: Suitable for indoor use on below-ambient services.
  1. Water-Vapor Permeance: Comply with ASTM E96/E96M or ASTM F1249.
  2. Service Temperature Range: 0 to 180 deg F.
  3. Color: White.
- D. Vapor-Retarder Mastic, Solvent Based, Outdoor Use: Suitable for outdoor use on below-ambient services.
  1. Water-Vapor Permeance: Comply with ASTM E96/E96M or ASTM F1249.
  2. Service Temperature Range: Minus 50 to plus 220 deg F.
  3. Color: White.
- E. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.
  1. Water-Vapor Permeance: ASTM E96/E96M, greater than 1.0 perm at manufacturer's recommended dry film thickness.
  2. Service Temperature Range: 0 to plus 180 deg F.
  3. Color: White.

## 2.4 LAGGING ADHESIVES

- A. Adhesive shall comply with MIL-A-3316C, Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.
  1. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over pipe insulation.
  2. Service Temperature Range: 20 to plus 180 deg F.
  3. Color: White.

## 2.5 SEALANTS

- A. Materials shall be as recommended by the insulation manufacturer and shall be compatible with insulation materials, jackets, and substrates.



B. Joint Sealants:

1. Permanently flexible, elastomeric sealant.
  - a. Service Temperature Range: Minus 150 to plus 250 deg F.
  - b. Color: White or gray.

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 C1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C1136, Type II.

2.7 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C1136, Type I, unless otherwise indicated.

B. Metal Jacket:

1. Aluminum Jacket: Comply with ASTM B209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.
  - a. Sheet and roll stock ready for shop or field sizing.
  - b. Finish and thickness are indicated in field-applied jacket schedules.
  - c. Moisture Barrier for Indoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper.
  - d. Moisture Barrier for Outdoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper.
  - e. Factory-Fabricated Fitting Covers:
    - 1) Same material, finish, and thickness as jacket.
    - 2) Preformed two-piece or gore, 45- and 90-degree, short- and long-radius elbows.
    - 3) Tee covers.
    - 4) Flange and union covers.
    - 5) End caps.
    - 6) Beveled collars.
    - 7) Valve covers.
    - 8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

C. Self-Adhesive Outdoor Jacket: 60-mil- thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a

rubberized bituminous resin on a cross-laminated polyethylene film covered with white aluminum-foil facing.

## 2.8 SECUREMENTS

- A. Bands:
  - 1. Stainless Steel: ASTM A240/A240M, Type 316; 0.015 inch thick, 1/2 inch wide with wing seal or closed seal.
- B. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.
- C. Wire: 0.062-inch soft-annealed, stainless steel.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
  - 1. Verify that systems to be insulated have been tested and are free of defects.
  - 2. Verify that surfaces to be insulated are clean and dry.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:
  - 1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils thick and an epoxy finish 5 mils thick if operating in a temperature range between 140 and 300 deg F. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
  - 2. Carbon Steel: Coat carbon steel operating at a service temperature of between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
- C. Coordinate insulation installation with the tradesman installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless steel surfaces, use demineralized water.

### 3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and of thicknesses required for each item of 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 storage, application, and finishing. Replace insulation materials that get wet.
- 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 attached to structure with vapor-barrier mastic.
  - 3. Install insert materials and insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
  - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
  - 1. Draw jacket tight and smooth.
  - 2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward-clinching staples along both edges of strip, spaced 4 inches o.c.

3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward-clinching staples along edge at 2 inches o.c.
    - a. For below-ambient services, apply vapor-barrier mastic over staples.
  4. Cover joints and seams with tape, in accordance with insulation material manufacturer's written instructions, to maintain vapor seal.
  5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 25 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 100 mm beyond damaged areas. Adhere, staple, and seal patches in similar fashion 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.

### 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 Section 078413 "Penetration Firestopping" for 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 Section 078413 "Penetration Firestopping."

### 3.5 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, Mechanical Couplings, and Unions:
1. Install insulation over fittings, valves, strainers, flanges, mechanical couplings, 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 that of 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. 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.
  4. 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.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers. 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 that of adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union at least 2 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.

3.6 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install 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 cut sections of sheet insulation of same thickness as that of pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as that of pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.

3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties, and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

### 3.7 FIELD-APPLIED JACKET INSTALLATION

- A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.
  1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
  2. Embed glass cloth between two 0.062-inch- thick coats of lagging adhesive.
  3. Completely encapsulate insulation with coating, leaving no exposed insulation.
- B. Where FSK jackets are indicated, install as follows:
  1. Draw jacket material smooth and tight.
  2. Install lap or joint strips with same material as jacket.
  3. Secure jacket to insulation with manufacturer's recommended adhesive.
  4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch- wide joint strips at end joints.
  5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.
- C. Where PVC jackets are indicated and for horizontal applications, install with 1-inch overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.
  1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
- D. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless steel bands 12 inches o.c. and at end joints.
- E. Where PVDC jackets are indicated, install as follows:
  1. Apply three separate wraps of filament tape per insulation section to secure pipe insulation to pipe prior to installation of PVDC jacket.
  2. Wrap factory-presize jackets around individual pipe insulation sections, with one end overlapping the previously installed sheet. Install presized jacket with an approximate overlap at butt joint of 2 inches over the previous section. Adhere lap seal using adhesive or SSL, and then apply 1-1/4 circumferences of appropriate PVDC tape around overlapped butt joint.
  3. Continuous jacket can be spiral-wrapped around a length of pipe insulation. Apply adhesive or PVDC tape at overlapped spiral edge. When electing to use adhesives, refer to manufacturer's written instructions for application of adhesives along this spiral edge to maintain a permanent bond.
  4. Jacket can be wrapped in cigarette fashion along length of roll for insulation systems with an outer circumference of 33-1/2 inches or less. The 33-1/2-inch- circumference limit

allows for 2-inch- overlap seal. Using the length of roll allows for longer sections of jacket to be installed at one time. Use adhesive on the lap seal. Visually inspect lap seal for "fishmouthing," and use PVDC tape along lap seal to secure joint.

5. Repair holes or tears in PVDC jacket by placing PVDC tape over the hole or tear and wrapping a minimum of 1-1/4 circumferences to avoid damage to tape edges.

### 3.8 FINISHES

- A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
  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 Engineer. 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. Owner will engage a qualified testing agency to perform tests and inspections.
- B. Engage a qualified testing agency to perform tests and inspections.
- C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- D. Perform tests and inspections.
- E. Tests and Inspections: Inspect pipe, fittings, strainers, and valves, randomly selected by Engineer, 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.
- F. All insulation applications will be considered defective if they do not pass tests and inspections.
- G. Prepare test and inspection reports.



3.10 PIPING INSULATION SCHEDULE, GENERAL

- A. Insulation conductivity and thickness per pipe size shall comply with schedules in this Section or with requirements of authorities having jurisdiction, whichever is more stringent.
- B. 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.

3.11 PIPING INSULATION SCHEDULE

- A. Condensate and Equipment Drain Water below 60 Deg F:
  - 1. All Pipe Sizes: Insulation shall be the following:
    - a. Flexible Elastomeric: 1 inch thick.
- B. Refrigerant Suction and Hot-Gas Piping:
  - 1. All Pipe Sizes: Insulation shall be the following:
    - a. Flexible Elastomeric: 1 inch thick.
- C. Refrigerant Suction and Hot-Gas Flexible Tubing:
  - 1. All Pipe Sizes: Insulation shall be the following:
    - a. Flexible Elastomeric: 2 inches thick.
- D. Refrigerant Liquid Piping:
  - 1. All Pipe Sizes: Insulation shall be the following:
    - a. Flexible Elastomeric: 1 inch thick.

END OF SECTION 230719

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## SECTION 232300 - REFRIGERANT 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. Refrigerant pipes and fittings.
  - 2. Refrigerant piping valves and specialties.
  - 3. Refrigerants.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of valve, refrigerant piping, and piping specialty.
  - 1. Include pressure drop, based on manufacturer's test data, for the following:
    - a. Thermostatic expansion valves.
    - b. Solenoid valves.
    - c. Hot-gas bypass valves.
    - d. Filter dryers.
    - e. Strainers.
    - f. Pressure-regulating valves.
- B. Shop Drawings:
  - 1. Show layout of refrigerant piping and specialties, including pipe, tube, and fitting sizes; flow capacities; valve arrangements and locations; slopes of horizontal runs; oil traps; double risers; wall and floor penetrations; and equipment connection details.
  - 2. Show piping size and piping layout, including oil traps, double risers, specialties, and pipe and tube sizes to accommodate, as a minimum, equipment provided, elevation difference between compressor and evaporator, and length of piping to ensure proper operation and compliance with warranties of connected equipment.
  - 3. Show interface and spatial relationships between piping and equipment.
  - 4. Shop Drawing Scale: 1/4 inch equals 1 foot.
  - 5. Submit letter of acceptance for the refrigeration system design by the equipment manufacturer or their authorized representative.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
- B. Field quality-control reports.
- C. Total weight, type and number of refrigerant in system(s).

#### 1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For refrigerant valves and piping specialties to include in maintenance manuals.

#### 1.6 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to 2010 ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
- B. Comply with ASHRAE 15, "Safety Code for Refrigeration Systems."
- C. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."

#### 1.7 PRODUCT STORAGE AND HANDLING

- A. Store piping with end caps in place to ensure that piping interior and exterior are clean when installed.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Line Test Pressure for Refrigerant R-410A:
  - 1. Suction Lines for Air-Conditioning Applications: 300 psig.
  - 2. Suction Lines for Heat-Pump Applications: 535 psig.
  - 3. Hot-Gas and Liquid Lines: 535 psig.

#### 2.2 COPPER TUBE AND FITTINGS

- A. Copper Tube: ASTM B88, Type K or L or ASTM B280, Type ACR.
- B. Wrought-Copper Fittings: ASME B16.22.
- C. Wrought-Copper Unions: ASME B16.22.

- D. Solder Filler Metals: ASTM B32. Use 95-5 tin antimony or alloy HB solder to join copper socket fittings on copper pipe.
- E. Refer to drawings for refrigerant piping coating requirements.
- F. Brazing Filler Metals: AWS A5.8/A5.8M.
- G. Flexible Connectors:
  - 1. Body: Tin-bronze bellows with woven, flexible, tinned-bronze-wire-reinforced protective jacket.
  - 2. End Connections: Socket ends.
  - 3. Offset Performance: Capable of minimum 3/4-inch misalignment in minimum 7-inch-long assembly.
  - 4. Working Pressure Rating: Factory test at minimum 500 psig.
  - 5. Maximum Operating Temperature: 250 deg F.
- H. Service Valves:
  - 1. Body: Forged brass with brass cap including key end to remove core.
  - 2. Core: Removable ball-type check valve with stainless-steel spring.
  - 3. Seat: Polytetrafluoroethylene.
  - 4. End Connections: Copper spring.
  - 5. Working Pressure Rating: 500 psig.
- I. Solenoid Valves: Comply with AHRI 760 and UL 429; listed and labeled by a National Recognized Testing Laboratory (NRTL).
  - 1. Body and Bonnet: Plated steel.
  - 2. Solenoid Tube, Plunger, Closing Spring, and Seat Orifice: Stainless steel.
  - 3. Seat: Polytetrafluoroethylene.
  - 4. End Connections: Threaded.
  - 5. Working Pressure Rating: 400 psig.
  - 6. Maximum Operating Temperature: 240 deg F.
- J. Safety Relief Valves: Comply with 2010 ASME Boiler and Pressure Vessel Code; listed and labeled by an NRTL.
  - 1. Body and Bonnet: Ductile iron and steel, with neoprene O-ring seal.
  - 2. Piston, Closing Spring, and Seat Insert: Stainless steel.
  - 3. Seat: Polytetrafluoroethylene.
  - 4. End Connections: Threaded.
  - 5. Working Pressure Rating: 400 psig.
  - 6. Maximum Operating Temperature: 240 deg F.
- K. Thermostatic Expansion Valves: Comply with AHRI 750.
  - 1. Body, Bonnet, and Seal Cap: Forged brass or steel.
  - 2. Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
  - 3. Packing and Gaskets: Non-asbestos.
  - 4. Capillary and Bulb: Copper tubing filled with refrigerant charge.

5. Suction Temperature: 40 deg F.
6. Reverse-flow option (for heat-pump applications).
7. End Connections: Socket, flare, or threaded union.
8. Working Pressure Rating: 450 psig.

L. Straight-Type Strainers:

1. Body: Welded steel with corrosion-resistant coating.
2. Screen: 100-mesh stainless steel.
3. End Connections: Socket or flare.
4. Working Pressure Rating: 500 psig.
5. Maximum Operating Temperature: 275 deg F.

M. Angle-Type Strainers:

1. Body: Forged brass or cast bronze.
2. Drain Plug: Brass hex plug.
3. Screen: 100-mesh monel.
4. End Connections: Socket or flare.
5. Working Pressure Rating: 500 psig.
6. Maximum Operating Temperature: 275 deg F.

N. Moisture/Liquid Indicators:

1. Body: Forged brass.
2. Window: Replaceable, clear, fused glass window with indicating element protected by filter screen.
3. Indicator: Color coded to show moisture content in parts per million (ppm).
4. Minimum Moisture Indicator Sensitivity: Indicate moisture above 60 ppm.
5. End Connections: Socket or flare.
6. Working Pressure Rating: 500 psig.
7. Maximum Operating Temperature: 240 deg F.

O. Permanent Filter Dryers: Comply with AHRI 730.

1. Body and Cover: Painted-steel shell.
2. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
3. Designed for reverse flow (for heat-pump applications).
4. End Connections: Socket.
5. Access Ports: NPS 1/4 connections at entering and leaving sides for pressure differential measurement.
6. Maximum Pressure Loss: 2 psig.
7. Working Pressure Rating: 500 psig.
8. Maximum Operating Temperature: 240 deg F.

P. Mufflers:

1. Body: Welded steel with corrosion-resistant coating.
2. End Connections: Socket or flare.
3. Working Pressure Rating: 500 psig.
4. Maximum Operating Temperature: 275 deg F.

## 2.3 REFRIGERANTS

- A. ASHRAE 34, R-410A: Pentafluoroethane/Difluoromethane.

## PART 3 - EXECUTION

### 3.1 PIPING APPLICATIONS FOR REFRIGERANT R-410A

- A. Suction Lines NPS 1-1/2 and Smaller for Conventional Air-Conditioning Applications: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with soldered joints.
- B. Suction Lines NPS 3-1/2 and Smaller for Conventional Air-Conditioning Applications: Copper, Type ACR, drawn-temper tubing and wrought-copper fittings with soldered joints.
- C. Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications:
  - 1. NPS 5/8 and Smaller: Copper, Type ACR, annealed- or drawn-temper tubing and wrought-copper fittings with soldered joints.
  - 2. NPS 3/4 to NPS 1 and Smaller: Copper, Type K, annealed- or drawn-temper tubing and wrought-copper fittings with soldered joints.

### 3.2 VALVE AND SPECIALTY APPLICATIONS

- A. Install valves in suction and discharge lines of compressor.
- B. Install service valves for gage taps at inlet and outlet of hot-gas bypass valves and strainers if they are not an integral part of valves and strainers.
- C. Install a check valve at the compressor discharge and a liquid accumulator at the compressor suction connection.
- D. Except as otherwise indicated, install valves on inlet and outlet side of filter dryers.
- E. Install a full-size, three-valve bypass around filter dryers.
- F. Install solenoid valves upstream from each expansion valve and hot-gas bypass valve. Install solenoid valves in horizontal lines with coil at top.
- G. Install thermostatic expansion valves as close as possible to distributors on evaporators.
  - 1. Install valve so diaphragm case is warmer than bulb.
  - 2. Secure bulb to clean, straight, horizontal section of suction line using two bulb straps. Do not mount bulb in a trap or at bottom of the line.
  - 3. If external equalizer lines are required, make connection where it will reflect suction-line pressure at bulb location.
- H. Install safety relief valves where required by 2010 ASME Boiler and Pressure Vessel Code. Pipe safety-relief-valve discharge line to outside according to ASHRAE 15.

- I. Install moisture/liquid indicators in liquid line at the inlet of the thermostatic expansion valve or at the inlet of the evaporator coil capillary tube.
- J. Install strainers upstream from and adjacent to the following unless they are furnished as an integral assembly for the device being protected:
  - 1. Solenoid valves.
  - 2. Thermostatic expansion valves.
  - 3. Hot-gas bypass valves.
  - 4. Compressor.
- K. Install filter dryers in liquid line between compressor and thermostatic expansion valve.
- L. Install receivers sized to accommodate pump-down charge.
- M. Install flexible connectors at compressors.

### 3.3 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems; indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations.
- B. Install refrigerant piping according to ASHRAE 15.
- 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 adjacent to machines to allow service and maintenance.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Select system components with pressure rating equal to or greater than system operating pressure.
- J. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.
- K. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install access doors or panels as specified in Section 083113 "Access Doors and Frames" if valves or equipment requiring maintenance is concealed behind finished surfaces.



- L. Install refrigerant piping in protective conduit where installed belowground.
- M. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.
- N. Slope refrigerant piping as follows:
  - 1. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
  - 2. Install horizontal suction lines with a uniform slope downward to compressor.
  - 3. Install traps and double risers to entrain oil in vertical runs (a properly sized refrigerant riser may be used if only on/off compressor operation is used).
  - 4. Liquid lines may be installed level.
- O. When brazing or soldering, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.
- P. Before installation of steel refrigerant piping, clean pipe and fittings using the following procedures:
  - 1. Shot blast the interior of piping.
  - 2. Remove coarse particles of dirt and dust by drawing a clean, lintless cloth through tubing by means of a wire or electrician's tape.
  - 3. Draw a clean, lintless cloth saturated with trichloroethylene through the tube or pipe. Continue this procedure until cloth is not discolored by dirt.
  - 4. Draw a clean, lintless cloth, saturated with compressor oil, squeezed dry, through the tube or pipe to remove remaining lint. Inspect tube or pipe visually for remaining dirt and lint.
  - 5. Finally, draw a clean, dry, lintless cloth through the tube or pipe.
  - 6. Safety-relief-valve discharge piping is not required to be cleaned but is required to be open to allow unrestricted flow.
- Q. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.
- R. Identify refrigerant piping and valves according to Section 230553 "Identification for HVAC Piping and Equipment."
- S. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."
- T. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."
- U. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 230518 "Escutcheons for HVAC Piping."

### 3.4 PIPE JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Fill pipe and fittings with an inert gas (nitrogen or carbon dioxide), during brazing or welding, to prevent scale formation.
- D. Soldered Joints: Construct joints according to ASTM B828 or CDA's "Copper Tube Handbook."
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."
  - 1. Use Type BCuP (copper-phosphorus) alloy for joining copper socket fittings with copper pipe.
  - 2. Use Type BAg (cadmium-free silver) alloy for joining copper with bronze or steel.
- F. Threaded Joints: Thread steel 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 to 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. Steel pipe can be threaded, but threaded joints must be seal brazed or seal welded.
- H. Welded Joints: Construct joints according to AWS D10.12M/D10.12.
- I. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

### 3.5 INSTALLATION OF HANGERS AND SUPPORTS

- A. Comply with requirements for seismic restraints in Section 230548 "Vibration and Seismic Controls for HVAC."
- B. Comply with Section 230529 "Hangers and Supports for HVAC Piping and Equipment" for hangers, supports, and anchor devices.
- C. Suction line hangers shall be sized for pipe insulation outside diameter.
- D. Install the following pipe attachments:
  - 1. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet long.
  - 2. Roller hangers and spring hangers for individual horizontal runs 20 feet or longer.

3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
  4. Spring hangers to support vertical runs.
  5. Copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
- E. Install hangers for copper tubing, with maximum horizontal spacing and minimum rod diameters, to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- F. Support horizontal piping within 12 inches of each fitting.
- G. Support vertical runs of copper tubing to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

### 3.6 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
1. Comply with ASME B31.5, Chapter VI.
  2. Test refrigerant piping, specialties, and receivers. Isolate compressor, condenser, evaporator, and safety devices from test pressure if they are not rated above the test pressure.
  3. Test high- and low-pressure side piping of each system separately at not less than the pressures indicated in "Performance Requirements" Article.
    - a. Fill system with nitrogen to the required test pressure.
    - b. System shall maintain test pressure at the manifold gage throughout duration of test.
    - c. Test joints and fittings with electronic leak detector or by brushing a small amount of soap and glycerin solution over joints.
    - d. Remake leaking joints using new materials, and retest until satisfactory results are achieved.
- B. Prepare test and inspection reports.

### 3.7 SYSTEM CHARGING

- A. Charge system using the following procedures:
1. Install core in filter dryers after leak test but before evacuation.
  2. Evacuate entire refrigerant system with a vacuum pump to 500 micrometers. If vacuum holds for 12 hours, system is ready for charging.
  3. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig.
  4. Charge system with a new filter-dryer core in charging line.

### 3.8 ADJUSTING

- A. Adjust thermostatic expansion valve to obtain proper evaporator superheat.

- B. Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.
- C. Adjust set-point temperature of air-conditioning or chilled-water controllers to the system design temperature.
- D. Perform the following adjustments before operating the refrigeration system, according to manufacturer's written instructions:
  - 1. Open shutoff valves in condenser water circuit.
  - 2. Verify that compressor oil level is correct.
  - 3. Open compressor suction and discharge valves.
  - 4. Open refrigerant valves except bypass valves that are used for other purposes.
  - 5. Check open compressor-motor alignment and verify lubrication for motors and bearings.
- E. Replace core of replaceable filter dryer after system has been adjusted and after design flow rates and pressures are established.

END OF SECTION 232300

## 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.

#### 1.2 SUMMARY

- A. Section Includes:

1. Single-wall rectangular ducts and fittings.
2. Double-wall rectangular ducts and fittings.
3. Sheet metal materials.
4. Duct liner.
5. Sealants and gaskets.
6. Hangers and supports.
7. Seismic-restraint devices.

- B. Related Sections:

1. Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
2. Section 233300 "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

#### 1.3 DEFINITIONS

- A. OSHPD: Office of Statewide Health Planning and Development (State of California).

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of the following products:

1. Liners and adhesives.
2. Sealants and gaskets.
3. Seismic-restraint devices.

- B. Sustainable Design Submittals:

1. Product Data: For adhesives, indicating VOC content.
2. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
3. Product Data: For sealants, indicating VOC content.

4. Laboratory Test Reports: For sealants, indicating compliance with requirements for low-emitting materials.
5. Laboratory Test Reports: For antimicrobial coatings, indicating compliance with requirements for low-emitting materials.

C. Shop Drawings:

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Factory- and shop-fabricated ducts and fittings.
3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
4. Elevation of top and bottom of ducts.
5. Dimensions of all 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.

D. Delegated-Design Submittal:

1. Sheet metal thicknesses.
2. Joint and seam construction and sealing.
3. Reinforcement details and spacing.
4. Materials, fabrication, assembly, and spacing of hangers and supports.
5. Design Calculations: Calculations for selecting hangers and supports.

## 1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: A single set of plans or BIM model, drawn to scale, showing the items described in this Section, and coordinated with all building trades.
- B. Welding certificates.
- C. Field quality-control reports.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and with performance requirements and design criteria indicated in "Duct Schedule" Article.

- B. Structural Performance: Duct hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and Florida Building Code. Airstream Surfaces: Surfaces in contact with airstream shall comply with requirements in ASHRAE 62.1.
- C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment," and Section 7 - "Construction and System Startup."
- D. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."
- E. Duct Dimensions: Unless otherwise indicated, all duct dimensions indicated on Drawings are inside clear dimensions and do not include insulation or duct wall thickness.

## 2.2 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.
  - 1. Construct ducts of galvanized sheet steel unless otherwise indicated.
  - 2. For ducts exposed to weather, construct of Type 316 stainless steel indicated by manufacturer to be suitable for outdoor installation.
- B. Transverse Joints: Fabricate joints in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
  - 1. For ducts with longest side less than 36 inches, select joint types in accordance with Figure 2-1.
  - 2. For ducts with longest side 36 inches or greater, use flange joint connector Type T-22, T-24, T-24A, T-25a, or T-25b. Factory-fabricated flanged duct connection system may be used if submitted and approved by engineer of record.
- C. Longitudinal Seams: Select seam types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible." All longitudinal seams shall be Pittsburgh lock seams unless otherwise specified for specific application.
- D. Select types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

## 2.3 DOUBLE-WALL RECTANGULAR DUCTS AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. McGill AirFlow LLC.
  - 2. MKT Metal Manufacturing.
  - 3. Set Duct Manufacturing.
- B. Rectangular Ducts: Fabricate ducts with indicated dimensions for clear internal dimensions of the inner duct.
- C. Outer Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
  - 1. Construct ducts of galvanized sheet steel unless otherwise indicated.
  - 2. For ducts exposed to weather, construct outer duct of Type 316 stainless steel indicated by manufacturer to be suitable for outdoor installation.
- D. Transverse Joints: Select joint types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
  - 1. For ducts with longest side less than 36 inches, select joint types in accordance with Figure 2-1.
  - 2. For ducts with longest side 36 inches or greater, use flange joint connector Type T-22, T-24, T-24A, T-25a, or T-25b. Factory-fabricated flanged duct connection system may be used if submitted and approved by engineer of record.
- E. Longitudinal Seams: Select seam types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- F. Interstitial Insulation: Fibrous-glass liner complying with ASTM C1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
  - 1. Maximum Thermal Conductivity: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
  - 2. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.
  - 3. Coat insulation with antimicrobial coating.
  - 4. Cover insulation with polyester film complying with UL 181, Class 1.
- G. Interstitial Insulation: Flexible elastomeric duct liner complying with ASTM C534/C534M, Type II for sheet materials, and with NFPA 90A or NFPA 90B.



1. Maximum Thermal Conductivity: 0.25 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.

## 2.4 SINGLE-WALL ROUND DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
  1. Construct ducts of galvanized sheet steel unless otherwise indicated.
  2. For ducts exposed to weather, construct of Type 316 stainless steel indicated by manufacturer to be suitable for outdoor installation.
- B. Transverse Joints: Select joint types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
  1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.
- C. Longitudinal Seams: Select seam types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
  1. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.
  2. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.
- D. Tees and Laterals: Select types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

## 2.5 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 A653/A653M.
  1. Galvanized Coating Designation: G60.
  2. Finishes for Surfaces Exposed to View: Mill phosphatized.

- C. PVC-Coated, Galvanized Sheet Steel: Comply with ASTM A653/A653M.
  - 1. Galvanized Coating Designation: G60.
  - 2. Minimum Thickness for Factory-Applied PVC Coating: 4 mils thick.
  - 3. Coating Materials: Acceptable to authorities having jurisdiction for use on ducts listed and labeled by an NRTL for compliance with UL 181, Class 1.
- D. Carbon-Steel Sheets: Comply with ASTM A1008/A1008M, with oiled, matte finish for exposed ducts.
- E. Stainless-Steel Sheets: Comply with ASTM A480/A480M, Type 304 or 316, as indicated in "Duct Schedule" Article; cold rolled, annealed, sheet. Exposed surface finish shall be No. 2B, No. 2D, No. 3, or No. 4 as indicated in "Duct Schedule" Article.
- F. Aluminum Sheets: Comply with ASTM B209 Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.
- G. Factory- or Shop-Applied Antimicrobial Coating:
  - 1. Apply to the surface of sheet metal that will form the interior surface of the duct. An untreated clear coating shall be applied to the exterior surface.
  - 2. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
  - 3. Coating containing the antimicrobial compound shall have a hardness of 2H, minimum, when tested in accordance with ASTM D3363.
  - 4. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested in accordance with UL 723; certified by an NRTL.
  - 5. Shop-Applied Coating Color: White.
  - 6. Antimicrobial coating on sheet metal is not required for duct containing liner treated with antimicrobial coating.
- H. Reinforcement Shapes and Plates: ASTM A36/A36M, 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.
- I. 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.

## 2.6 DUCT LINER

- A. Fibrous-Glass Duct Liner: Comply with ASTM C1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
  - 1. Maximum Thermal Conductivity:
    - a. Type I, Flexible: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
    - b. Type II, Rigid: 0.23 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.

2. Antimicrobial Erosion-Resistant Coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
  3. Water-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C916.
    - a. Adhesive shall have a VOC content of 80 g/L or less.
    - b. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- B. Flexible Elastomeric Duct Liner: Preformed, cellular, closed-cell, sheet materials complying with ASTM C534/C534M, Type II, Grade 1; and with NFPA 90A or NFPA 90B.
1. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested in accordance with UL 723; certified by an NRTL.
  2. Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.
    - a. Adhesive shall have a VOC content of 80 g/L or less.
    - b. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- C. Fiberglass-Free Duct Liner: Made from partially recycled cotton or polyester products and containing no fiberglass. Airstream surface overlaid with fire-resistant facing to prevent surface erosion by airstream, complying with NFPA 90A or NFPA 90B. Treat natural-fiber products with antimicrobial coating.
1. Maximum Thermal Conductivity: 0.24 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature when tested in accordance with ASTM C518.
  2. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested in accordance with ASTM E84; certified by an NRTL.
  3. Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.
    - a. Adhesive shall have a VOC content of 80 g/L or less.
    - b. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

D. Insulation Pins and Washers:

1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick aluminum or stainless steel; with beveled edge sized as required to hold insulation securely in place, but not less than 1-1/2 inches in diameter.

E. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 7-11, "Flexible Duct Liner Installation."

1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.
2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
3. Butt transverse joints without gaps, and coat joint with adhesive.
4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.
6. Apply adhesive coating on longitudinal seams in ducts with air velocity of 2500 fpm or greater.
7. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.
8. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:
  - a. Fan discharges.
  - b. Intervals of lined duct preceding unlined duct.
  - c. Upstream edges of transverse joints in ducts where air velocities are higher than 2500 fpm or where indicated.
9. Secure insulation between perforated sheet metal inner duct of same thickness as specified for outer shell. Use mechanical fasteners that maintain inner duct at uniform distance from outer shell without compressing insulation.
  - a. Sheet Metal Inner Duct Perforations: 3/32-inch diameter, with an overall open area of 23 percent.
10. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

## 2.7 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 in accordance with UL 723; certified by an NRTL.
- B. Two-Part Tape Sealing System:
  - 1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
  - 2. Tape Width: 4 inches.
  - 3. Sealant: Modified styrene acrylic.
  - 4. Water resistant.
  - 5. Mold and mildew resistant.
  - 6. Maximum Static-Pressure Class: 10 inch wg, positive and negative.
  - 7. Service: Indoor and outdoor.
  - 8. Service Temperature: Minus 40 to plus 200 deg F.
  - 9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
  - 10. Sealant shall have a VOC content of 420 g/L or less.
  - 11. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- C. Water-Based Joint and Seam Sealant:
  - 1. Application Method: Brush on.
  - 2. Solids Content: Minimum 65 percent.
  - 3. Shore A Hardness: Minimum 20.
  - 4. Water resistant.
  - 5. Mold and mildew resistant.
  - 6. VOC: Maximum 75 g/L (less water).
  - 7. Maximum Static-Pressure Class: 10 inch wg, positive and negative.
  - 8. Service: Indoor or outdoor.
  - 9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
- D. Solvent-Based Joint and Seam Sealant:
  - 1. Application Method: Brush on.
  - 2. Base: Synthetic rubber resin.
  - 3. Solvent: Toluene and heptane.
  - 4. Solids Content: Minimum 60 percent.
  - 5. Shore A Hardness: Minimum 60.
  - 6. Water resistant.
  - 7. Mold and mildew resistant.
  - 8. Sealant shall have a VOC content of 420 g/L or less.
  - 9. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of

Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

10. Maximum Static-Pressure Class: 10-inch wg, positive or negative.
11. Service: Indoor or outdoor.
12. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

E. Flanged Joint Sealant: Comply with ASTM C920.

1. General: Single-component, acid-curing, silicone, elastomeric.
2. Type: S.
3. Grade: NS.
4. Class: 25.
5. Use: O.
6. Sealant shall have a VOC content of 420 g/L or less.
7. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

F. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

G. Round Duct Joint O-Ring Seals:

1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

## 2.8 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Galvanized-steel rods and nuts.
- B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
- C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."
- D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A603.
- E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A492.
- F. Steel Cable End Connections: Galvanized-steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

H. Trapeze and Riser Supports:

1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

PART 3 - EXECUTION

3.1 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 in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- C. Install ducts in maximum practical lengths 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 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. Install fire and smoke dampers where indicated on Drawings and as required by code, and by local authorities having jurisdiction. Comply with requirements in Section 233300 "Air Duct Accessories" for fire and smoke dampers and specific installation requirements of the damper UL listing.
- K. Install heating coils, cooling coils, air filters, dampers, and all other duct-mounted accessories in air ducts where indicated on Drawings.
- L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials both before and after installation.

- M. Elbows: Use long-radius elbows wherever they fit.
  - 1. Fabricate 90-degree rectangular mitered elbows to include turning vanes.
  - 2. Fabricate 90-degree round elbows with a minimum of three segments for 12 inches and smaller and a minimum of five segments for 14 inches and larger.

- N. Branch Connections: Use lateral or conical branch connections.

### 3.2 INSTALLATION OF EXPOSED DUCTWORK

- A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.
- B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.
- C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.
- D. Maintain consistency, symmetry, and uniformity in arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.
- E. Repair or replace damaged sections and finished work that does not comply with these requirements.

### 3.3 DUCTWORK EXPOSED TO WEATHER

- A. All external joints are to be welded. Seal all openings to provide weatherproof construction.
- B. Construct ductwork to resist external loads of wind, snow, ice, and other effects of weather. Provide necessary supporting structures.
- C. Single Wall:
  - 1. Ductwork shall be Type 316 stainless steel.
  - 2. Ductwork shall be galvanized steel.
    - a. If duct outer surface is uninsulated, protect outer surface with suitable paint. Paint materials and application requirements are specified in Section 099113 "Exterior Painting."
  - 3. Where ducts have external insulation, provide weatherproof aluminum jacket. See Section 230713 "Duct Insulation."
- D. Double Wall:
  - 1. Ductwork shall comply with requirements in "Double-Wall Rectangular Ducts and Fittings" Article.
  - 2. Ductwork outer wall shall be Type 316 stainless steel indicated by manufacturer to be suitable for outdoor installation.



3. Provide interstitial insulation.

### 3.4 DUCT SEALING

- A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- B. Seal ducts at a minimum to the following seal classes in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":
  1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
  2. Outdoor, Supply-Air Ducts: Seal Class A.
  3. Outdoor, Exhaust Ducts: Seal Class C.
  4. Outdoor, Return-Air Ducts: Seal Class C.
  5. Unconditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class B.
  6. Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class A.
  7. Unconditioned Space, Exhaust Ducts: Seal Class C.
  8. Unconditioned Space, Return-Air Ducts: Seal Class B.
  9. Conditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class C.
  10. Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class B.
  11. Conditioned Space, Exhaust Ducts: Seal Class B.
  12. Conditioned Space, Return-Air Ducts: Seal Class C.

### 3.5 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
  1. Where practical, install concrete inserts before placing concrete.
  2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
  3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
  4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
  5. Do not use powder-actuated concrete fasteners for seismic restraints.
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.

- D. Hangers Exposed to View: Threaded rod and angle or channel supports.
- E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.
- F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

### 3.6 CONNECTIONS

- A. Make connections to equipment with flexible connectors complying with Section 233300 "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 Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

### 3.8 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Leakage Tests:
  - 1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Submit a test report for each test.
- C. Duct system will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

### 3.9 DUCT CLEANING

- A. Clean new duct system(s) before testing, adjusting, and balancing.
- B. For cleaning of existing ductwork, see Section 230130.52 "Existing HVAC Air Distribution System Cleaning."
- C. Use duct cleaning methodology as indicated in NADCA ACR.

D. Use service openings for entry and inspection.

1. Provide openings with access panels appropriate for duct static-pressure and leakage class at dampers, coils, and any other locations where required for inspection and cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Section 233300 "Air Duct Accessories" for access panels and doors.
2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
3. Remove and reinstall ceiling to gain access during the cleaning process.

E. Particulate Collection and Odor Control:

1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.
2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.

F. Clean the following components by removing surface contaminants and deposits:

1. Air outlets and inlets (registers, grilles, and diffusers).
2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
4. Coils and related components.
5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
6. Supply-air ducts, dampers, actuators, and turning vanes.
7. Dedicated exhaust and ventilation components and makeup air systems.

G. Mechanical Cleaning Methodology:

1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
5. Clean coils and coil drain pans in accordance with NADCA ACR. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
6. Provide drainage and cleanup for wash-down procedures.

7. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents in accordance with manufacturer's written instructions after removal of surface deposits and debris.

### 3.10 STARTUP

- A. Air Balance: Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC."

### 3.11 DUCT SCHEDULE

- A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:
  1. Fabricate all ducts to achieve SMACNA pressure class, seal class, and leakage class as indicated below.
- B. Supply Ducts:
  1. Ducts Connected to Constant-Volume Air-Handling Units:
    - a. Pressure Class: Positive 2-inch wg.
    - b. Minimum SMACNA Seal Class: A.
  2. Ducts Connected to Equipment Not Listed Above:
    - a. Pressure Class: Positive 3-inch wg.
    - b. Minimum SMACNA Seal Class: A.
- C. Return Ducts:
  1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:
    - a. Pressure Class: Positive or negative 2-inch wg.
    - b. Minimum SMACNA Seal Class: A.
- D. Exhaust Ducts:
  1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:
    - a. Pressure Class: Negative 2-inch wg.
    - b. Minimum SMACNA Seal Class: A if negative pressure, and A if positive pressure.
- E. Outdoor-Air (Not Filtered, Heated, or Cooled) Ducts:
  1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:
    - a. Pressure Class: Positive or negative 2-inch wg.
    - b. Minimum SMACNA Seal Class: A.

F. Intermediate Reinforcement:

1. Stainless-Steel Ducts:
  - a. Exposed to Airstream: Match duct material.
  - b. Not Exposed to Airstream: Match duct material.
2. Aluminum Ducts: Aluminum.

G. Double-Wall Duct Interstitial Insulation:

1. Supply-Air Ducts: 2 inch(es thick).

H. Elbow Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
  - a. Velocity 1000 fpm or Lower:
    - 1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
    - 2) Mitered Type RE 4 without vanes.
  - b. Velocity 1000 to 1500 fpm:
    - 1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
    - 2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.
    - 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
  - c. Velocity 1500 fpm or Higher:
    - 1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
    - 2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
    - 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
2. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
  - a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
  - b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
  - c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
3. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbows."

- a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
  - 1) Velocity 1000 fpm or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
  - 2) Velocity 1000 to 1500 fpm: 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
  - 3) Velocity 1500 fpm or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
  - 4) Radius-to Diameter Ratio: 1.5.
- b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
- c. Round Elbows, 14 Inches and Larger in Diameter: Welded.

I. Branch Configuration:

- 1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."
  - a. Rectangular Main to Rectangular Branch: 45-degree entry.
  - b. Rectangular Main to Round Branch: Conical spin in.
- 2. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.
  - a. Velocity 1000 fpm or Lower: 90-degree tap.
  - b. Velocity 1000 to 1500 fpm: Conical tap.
  - c. Velocity 1500 fpm or Higher: 45-degree lateral.

END OF SECTION 233113

## SECTION 233346 - FLEXIBLE 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.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Non-insulated flexible ducts.
  - 2. Insulated flexible ducts.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For flexible ducts.
  - 1. Include plans showing locations and mounting and attachment details.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from installers of the items involved.

### PART 2 - PRODUCTS

#### 2.1 ASSEMBLY DESCRIPTION

- A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
- B. Comply with 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.
- C. Comply with the Air Diffusion Council's "ADC Flexible Air Duct Test Code FD 72-R1."

- D. Comply with ASTM E 96/E 96M, "Test Methods for Water Vapor Transmission of Materials."

## 2.2 INSULATED FLEXIBLE DUCTS

- A. Insulated, Flexible Duct: UL 181, Class 1, multiple layers of aluminum laminate supported by helically wound, spring-steel wire; fibrous-glass insulation; aluminized vapor-barrier film.
  - 1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
  - 2. Maximum Air Velocity: 4000 fpm.
  - 3. Temperature Range: Minus 20 to plus 210 deg F.
  - 4. Insulation R-Value: Comply with ASHRAE/IES 90.1.

## 2.3 FLEXIBLE DUCT CONNECTORS

- A. Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action in sizes 3 through 18 inches, to suit duct size.
- B. Non-Clamp Connectors: Adhesive plus sheet metal screws.

# PART 3 - EXECUTION

## 3.1 INSTALLATION

- A. Install flexible ducts 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 in indoor applications only. Flexible ductwork should not be exposed to UV lighting.
- C. Connect terminal units to supply ducts with maximum 12-inch lengths of flexible duct. Do not use flexible ducts to change directions.
- D. Connect diffusers or light troffer boots to ducts with maximum 60-inch lengths of flexible duct clamped or strapped in place.
- E. Connect flexible ducts to metal ducts with draw bands.
- F. Install duct test holes where required for testing and balancing purposes.
- G. Installation:
  - 1. Install ducts fully extended.
  - 2. Do not bend ducts across sharp corners.
  - 3. Bends of flexible ducting shall not exceed a minimum of one duct diameter.
  - 4. Avoid contact with metal fixtures, water lines, pipes, or conduits.
  - 5. Install flexible ducts in a direct line, without sags, twists, or turns.



H. Supporting Flexible Ducts:

1. Suspend flexible ducts with bands 1-1/2 inches wide or wider and spaced a maximum of 48 inches apart. Maximum centerline sag between supports shall not exceed 1/2 inch per 12 inches.
2. Install extra supports at bends placed approximately one duct diameter from center line of the bend.
3. Ducts may rest on ceiling joists or truss supports. Spacing between supports shall not exceed the maximum spacing per manufacturer's written installation instructions.
4. Vertically installed ducts shall be stabilized by support straps at a maximum of 72 inches o.c.

END OF SECTION 233346

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## 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.

#### 1.2 SUMMARY

- A. Section Includes:

- 1. Centrifugal ventilators - roof upblast and sidewall.
- 2. Square in-line centrifugal fans.

#### 1.3 ACTION SUBMITTALS

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

- 1. Construction details, material descriptions, dimensions of individual components and profiles, and finishes for fans.
- 2. Rated capacities, operating characteristics, and furnished specialties and accessories.
- 3. Certified fan performance curves with system operating conditions indicated.
- 4. Certified fan sound-power ratings.
- 5. Motor ratings and electrical characteristics, plus motor and electrical accessories.
- 6. Material thickness and finishes, including color charts.
- 7. Dampers, including housings, linkages, and operators.
- 8. Prefabricated roof curbs.
- 9. Fan speed controllers.

- B. Shop Drawings:

- 1. Include plans, elevations, sections, and attachment details.
- 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
- 3. Include diagrams for power, signal, and control wiring.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Floor plans, reflected ceiling plans, and other details, or BIM model, drawn to scale, showing the items described in this Section and coordinated with all building trades.

- B. Seismic Qualification Data: For fans, accessories, and components, from manufacturer.
  - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
  - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
  - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- C. Field quality-control reports.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For HVAC power ventilators to include in normal and emergency, operation, and maintenance manuals.

#### 1.6 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.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Capacities and Characteristics: Refer to HVAC Drawings

#### 2.2 CENTRIFUGAL VENTILATORS - ROOF UPBLAST OR SIDEWALL

- A. Configuration: Centrifugal sidewall ventilator.
- B. Housing: Removable spun aluminum; square, one-piece aluminum base with venturi inlet cone.
  - 1. Upblast Units: Provide spun-aluminum discharge baffle to direct discharge air upward, with rain and snow drains.
  - 2.
- C. Fan Wheels: Aluminum hub and wheel with backward-inclined blades.
- D. Belt Drives:
  - 1. Resiliently mounted to housing.
  - 2. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
  - 3. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings; minimum ABMA9, L(10) of 100,000 hours.
  - 4. Fan Pulleys: Cast iron or cast steel with split, tapered bushing; dynamically balanced at factory.

5. Motor Pulleys: Adjustable pitch for use with motors through 5 hp. Select pulley so pitch adjustment is at the middle of adjustment range at fan design conditions. Provide fixed pitch for use with motors larger than 5 hp.
6. Fan and motor isolated from exhaust airstream.

E. Accessories:

1. Variable-Frequency Motor Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
2. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted outside fan housing, factory wired through an internal aluminum conduit.
3. Bird Screens: Removable, 1/2-inch mesh, aluminum or brass wire.
4. Dampers: Counterbalanced, parallel-blade, backdraft dampers mounted in curb base; factory set to close when fan stops.
5. Motorized Dampers: Parallel-blade dampers mounted in curb base with electric actuator; wired to close when fan stops.
6. Spark-resistant, all-aluminum wheel construction.
7. Mounting Pedestal: Galvanized steel with removable access panel.
8. Wall Mount Adapter: Attach wall-mounted fan to wall.

## 2.3 SQUARE IN-LINE CENTRIFUGAL FANS

A. Description: Square in-line centrifugal fans.

B. Housing:

1. Housing Material: Aluminum Insert material.
2. Housing Coating: See schedule.
3. Housing Construction: Side panels shall be easily removable for service. Include inlet and outlet flanges, and support bracket adaptable to floor, side wall, or ceiling mounting.

C. Direct-Drive Units: Motor mounted in airstream, factory wired to disconnect switch located on outside of fan housing.

D. Belt-Driven Units: Motor mounted on adjustable base, with adjustable sheaves, enclosures around belts within fan housing, and lubricating tubes from fan bearings extended to outside of fan housing.

E. Fan Wheels: Aluminum airfoil blades welded to aluminum hub.

F. Motor Enclosure: Totally enclosed, fan cooled.

G. Accessories:

1. Access for Inspection, Cleaning, and Maintenance: Comply with requirements in ASHRAE 62.1.
2. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
3. Volume-Control Damper: Manually operated with quadrant lock, located in fan outlet.
4. Companion Flanges: For inlet and outlet duct connections.

5. Fan Guards: 1/2- by 1-inch mesh of galvanized steel in removable frame. Provide guard for inlet or outlet for units not connected to ductwork.
6. Motor and Drive Cover (Belt Guard): Epoxy-coated steel.
7. Side Discharge: Flange connector and attachment hardware to provide right-angle discharge on side of unit.

## 2.4 MOTORS

- A. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
  1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

## 2.5 SOURCE QUALITY CONTROL

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
- B. AMCA Certification: Fans shall comply with AMCA 11 and bear the AMCA-Certified Ratings Seal.
- C. Fan Sound Ratings: Comply with AMCA 311, and label fans with the AMCA-Certified Ratings Seal. Sound ratings shall comply with AMCA 301. The fans shall be tested according to AMCA 300.
- D. Fan Performance Ratings: Comply with AMCA 211 and label fans with AMCA-Certified Rating Seal. The fans shall be tested for air performance - flow rate, fan pressure, power, fan efficiency, air density, speed of rotation, and fan efficiency - according to AMCA 210/ASHRAE 51.
- E. Operating Limits: Classify according to AMCA 99.
- F. UL Standards: Power ventilators shall comply with UL 705. Power ventilators for use for restaurant kitchen exhaust shall also comply with UL 762.

## PART 3 - EXECUTION

### 3.1 INSTALLATION OF HVAC POWER VENTILATORS

- A. Install power ventilators level and plumb.

B. Equipment Mounting:

1. Install power ventilators on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."
2. Comply with requirements for vibration isolation and seismic control devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."
3. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."

C. Secure roof-mounted fans to roof curbs with zinc-plated hardware. See Section 077200 "Roof Accessories" for installation of roof curbs.

D. Ceiling Units: Suspend units from structure; use steel wire or metal straps.

E. Support suspended units from structure using threaded steel rods and elastomeric hangers or spring hangers having a static deflection of 1 inch. Vibration-control devices are specified in Section 230548.13 "Vibration Controls for HVAC."

F. Install units with clearances for service and maintenance.

G. Label units according to requirements specified in Section 230553 "Identification for HVAC Piping and Equipment."

3.2 DUCTWORK CONNECTIONS

A. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Section 233300 "Air Duct Accessories."

3.3 ELECTRICAL CONNECTIONS

A. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

C. Install electrical devices furnished by manufacturer, but not factory mounted, according to NFPA 70 and NECA 1.

1. Nameplate shall be laminated acrylic or melamine plastic signs, as specified in Section 260553 "Identification for Electrical Systems."
2. Nameplate shall be laminated acrylic or melamine plastic signs with a black background and engraved white letters at least 1/2 inch high.

3.4 CONTROL CONNECTIONS

A. Install control and electrical power wiring to field-mounted control devices.

- B. Connect control wiring according to Section 260523 "Control-Voltage Electrical Power Cables."

### 3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- D. Perform tests and inspections.
- E. 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 there is adequate maintenance and access space.
  - 4. Verify that cleaning and adjusting are complete.
  - 5. Adjust damper linkages for proper damper operation.
  - 6. Verify lubrication for bearings and other moving parts.
  - 7. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
  - 8. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
  - 9. Shut unit down and reconnect automatic temperature-control operators.
  - 10. Remove and replace malfunctioning units and retest as specified above.
- F. Test and adjust controls and safeties. Controls and equipment will be considered defective if they do not pass tests and inspections.
- G. Prepare test and inspection reports.

### 3.6 ADJUSTING

- A. Adjust damper linkages for proper damper operation.
- B. Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing procedures.
- C. Replace fan and motor pulleys as required to achieve design airflow.
- D. Lubricate bearings.



3.7 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain centrifugal fans.

END OF SECTION 233423

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## SECTION 233713.13 - AIR DIFFUSERS

### 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. Rectangular and square ceiling diffusers.
  - 2. High-capacity drum louver diffusers.

- B. Related Requirements:

- 1. Section 233300 "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers.
  - 2. Section 233713.23 "Air Registers and Grilles" for adjustable-bar register and grilles, fixed-face registers and grilles, and linear bar grilles.

#### 1.3 ACTION SUBMITTALS

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

- 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 Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

- B. Samples: For each exposed product and for each color and texture specified. Actual size of smallest diffuser indicated.

- C. Samples for Initial Selection: For diffusers with factory-applied color finishes. Actual size of smallest diffuser indicated.

- D. Samples for Verification: For diffusers, in manufacturer's standard sizes to verify color selected. Actual size of smallest diffuser indicated.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

- 1. Ceiling suspension assembly members.
  - 2. Method of attaching hangers to building structure.

3. Size and location of initial access modules for acoustical tile.
  4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
  5. Duct access panels.
- B. Source quality-control reports.

## PART 2 - PRODUCTS

### 2.1 RECTANGULAR AND SQUARE CEILING DIFFUSERS

- A. Material: Aluminum.
- B. Finish: Baked enamel, white.
- C. Face Size: 24 by 24 inches.
- D. Face Style: Four cone.
- E. Mounting: T-bar Spline.
- F. Pattern: Fixed Adjustable.
- G. Dampers: Radial opposed blade.
- H. Accessories:
  1. Equalizing grid.
  2. Plaster ring.
  3. Safety chain.
  4. Wire guard.
  5. Sectorizing baffles.
  6. Operating rod extension.

### 2.2 HIGH-CAPACITY DRUM LOUVER DIFFUSERS

- A. Airflow Principle: Extended distance for high airflow rates.
- B. Material: Aluminum, heavy gage extruded.
- C. Finish: White baked acrylic.
- D. Border: 1-1/4-inch width with countersunk screw holes.
- E. Gasket between drum and border.
- F. Body: Drum shaped; adjustable vertically.
- G. Blades: Individually adjustable horizontally.

- H. Mounting: Surface to duct or wall.
- I. Inlet Width: refer to plans.
- J. Inlet Length: refer to plans.
- K. Accessories:
  - 1. Opposed-blade steel damper.
  - 2. Duct-mounting collars with countersunk screw holes.

### 2.3 SOURCE QUALITY CONTROL

- A. Verification of Performance: Rate diffusers 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 are 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 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 Engineer for a determination of final location.
- C. Install diffusers 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 to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 233713.13

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## SECTION 233713.23 - 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.

#### 1.2 SUMMARY

- A. Section Includes:

- 1. Adjustable blade face registers and grilles.
- 2. Fixed face registers and grilles.

- B. Related Requirements:

- 1. Section 233300 "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to registers and grilles.
- 2. Section 233713.13 "Air Diffusers" for various types of air diffusers.

#### 1.3 ACTION SUBMITTALS

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

- 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. Register and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

- B. Samples: For each exposed product and for each color and texture specified. Smallest size register and grille indicated.

- C. Samples for Initial Selection: For registers and grilles with factory-applied color finishes. Smallest size register and grille indicated.

- D. Samples for Verification: For registers and grilles, in manufacturer's standard sizes to verify color selected. Smallest size register and grille indicated.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Ceiling suspension assembly members.
2. Method of attaching hangers to building structure.
3. Size and location of initial access modules for acoustical tile.
4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
5. Duct access panels.

B. Source quality-control reports.

## PART 2 - PRODUCTS

### 2.1 REGISTERS

A. Adjustable Blade Face Register:

1. Material: Aluminum.
2. Finish: Baked enamel, white.
3. Face Blade Arrangement: Vertical spaced 1-1/2 inches apart.
4. Core Construction: Integral.
5. Rear-Blade Arrangement: Horizontal spaced 3/4 inch apart.
6. Frame: 1-1/4 inches wide.
7. Mounting: Lay in.
8. Damper Type: Adjustable opposed blade.
9. Accessories:
  - a. Rear-blade gang operator.
  - b. Filter.

### 2.2 GRILLES

A. Adjustable Blade Face Grille:

1. Material: Aluminum.
2. Finish: Baked enamel, white Baked enamel, color selected by Engineer.
3. Face Blade Arrangement: Horizontal spaced 1-1/2 inches apart.
4. Core Construction: Integral.
5. Rear-Blade Arrangement: Vertical spaced 3/4 inch apart.
6. Frame: 1-1/4 inches wide.
7. Mounting: Lay in.
8. Accessories:
  - a. Rear-blade gang operator.
  - b. Filter.

### 2.3 SOURCE QUALITY CONTROL

- A. Verification of Performance: Rate 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 registers and grilles are 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 registers and grilles level and plumb.
- B. Outlets and Inlets Locations: 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 Engineer for a determination of final location.
- C. Install 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 registers and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 233713.23

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## SECTION 237433 - DEDICATED OUTDOOR-AIR UNITS

### 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 factory-packaged units capable of supplying up to 100 percent outdoor air and providing cooling and heating.
- B. Related Requirements:
  - 1. Section 033000 "Cast-in-Place Concrete."
  - 2. Section 230513 "Common Motor Requirements for HVAC Equipment"
  - 3. Section 230548 "Vibration and Seismic Controls for HVAC Piping and Equipment: Requirements."
  - 4. Section 230593 "Testing, Adjusting, and Balancing for HVAC."
  - 5. Section 232300 "Refrigerant Piping."
  - 6. Section 233113 "Metal Ducts."
  - 7. Section 233300 "Air Duct Accessories."
  - 8. Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
  - 9. Section 260523 "Control-Voltage Electrical Power Cables."
  - 10. Section 260526 "Grounding and Bonding for Electrical Systems."

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include rated capacities, operating characteristics, and furnished specialties and accessories.
- B. Shop Drawings:
  - 1. Include plans, elevations, sections, and attachment details.
  - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 3. Prepare the following by or under the supervision of a qualified professional engineer:
    - a. Mounting Details: For securing and flashing roof curb to roof structure. Indicate coordinating requirements with roof membrane system.
  - 4. Include diagrams for power, signal, and control wiring.

1.4 DELEGATED-DESIGN SUBMITTAL:

- A. For design of seismic restraints and wind restraints, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
  - 1. Unit fabrication and assembly details.
  - 2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
  - 3. Design Calculations:
    - a. Calculate requirements for selecting vibration isolators and seismic restraints and wind restraints and for designing vibration isolation bases.
    - b. Indicate compliance with "Performance Requirements" article.
  - 4. Wind- and Seismic-Restraint Details: Detail fabrication and attachment of wind and seismic restraints and snubbers. Show anchorage details and indicate quantity, diameter, and depth of penetration of anchors.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Roof-curb mounting details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
  - 1. Size and location of unit-mounted rails and anchor points and methods for anchoring units to roof curb.
  - 2. Required roof penetrations for ducts, pipes, and electrical raceways, including size and location of each penetration.
- B. Seismic Qualification Certificates: For dedicated outdoor-air units, accessories, and components, from manufacturer.
  - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
  - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
  - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
  - 4. Restraint of internal components, including fans, coils, and refrigeration components.
- C. Product Certificates: Submit certification that specified equipment will withstand wind forces identified in "Performance Requirements" Article and in Section 230548 "Vibration and Seismic Controls for HVAC."
  - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculations.
  - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of wind force and locate and describe mounting and anchorage provisions.

3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- D. Startup service reports.
- E. Sample Warranty: For special warranty.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For units to include in emergency, operation, and maintenance manuals.

#### 1.7 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. Fan Belts: One set for each belt-driven fan.
  2. Filters: One set for each unit.

#### 1.8 WARRANTY

- A. Special Warranty: Manufacturer agrees to replace components of units that fail in materials or workmanship within specified warranty period.
  1. Warranty Period for Compressors: Five years from date of Substantial Completion.
  2. Warranty Period for Heat Exchangers: Five years from date of Substantial Completion.
  3. Warranty Period for Solid-State Ignition Modules: Manufacturer's standard, but not less than three years from date of Substantial Completion.
  4. Warranty Period for Control Boards: Manufacturer's standard, but not less than three years from date of Substantial Completion.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. AAON.
  2. Addison.
  3. Greenheck.
  4. Or equal.

## 2.2 PERFORMANCE REQUIREMENTS

- A. General Fabrication Requirements: Comply with requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment," and Section 7 - "Construction and System Start-up."
- B. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design seismic restraints and wind restraints.
- C. Seismic Performance: Units shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
  - 1. The term "withstand" means "the unit will remain in place without separation of any parts when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
- D. Wind-Restraint Performance:
  - 1. Basic Wind Speed: 112 MPH.
  - 2. Building Classification Category: I.
  - 3. Minimum 10 lb./sq. ft multiplied by the maximum area of unit projected on a vertical plane that is normal to the wind direction and 45 degrees either side of normal.
- E. Cabinet Thermal Performance:
  - 1. Maximum Overall U-Value: Comply with requirements in ASHRAE/IESNA 90.1.
  - 2. Maximum Overall U-Value: 0.10 Btu/h x sq. ft. x deg F.
  - 3. Include effects of metal-to-metal contact and thermal bridges in the calculations.
- F. Cabinet Surface Condensation:
  - 1. Cabinet shall have additional insulation and vapor seals if required to prevent condensation on the interior and exterior of the cabinet.
  - 2. Portions of cabinet located downstream from the cooling coil shall have a thermal break at each thermal bridge between the exterior and interior casing to prevent condensation from occurring on the interior and exterior surfaces. The thermal break shall not compromise the structural integrity of the cabinet.
- G. Maximum Cabinet Leakage: 1 percent of the total supply-air flow at a pressure rating equal to the fan shut-off pressure.
- H. Cabinet Deflection Performance:
  - 1. Walls and roof deflection shall be within 1/200 of the span at the design working pressure equal to the fan shut-off pressure. Deflection limits shall be measured at any point on the surface.
  - 2. Floor deflections shall be within 1/240 of the span considering the worst-case condition caused by the following:
    - a. Service personnel.
    - b. Internal components.
    - c. Design working pressure defined for the walls and roof.

- I. 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.

## 2.3 CAPACITIES AND CHARACTERISTICS

- A. As scheduled on the HVAC drawings.

## 2.4 CABINET

- A. Construction: double wall.
- B. Exterior Casing Material:
  - 1. Galvanized steel with paint finish.
  - 2. Exterior Casing Thickness: 0.052 inch thick.
- C. Corrosion-Resistant Coating: Apply a corrosion-resistant coating capable of withstanding a 3,000-hour salt-spray test according to ASTM B117.
  - 1. Standards:
    - a. ASTM B117 for salt spray.
    - b. ASTM D2794 for minimum impact resistance of 100 in-lb.
    - c. ASTM B3359 for cross-hatch adhesion of 5B.
  - 2. Application: Immersion.
  - 3. Thickness: 1 mil.
  - 4. Gloss: Minimum of 50 gloss units on a single-angle, 60-degree meter.
  - 5. UV Protection: Spray-applied topcoat.
- D. Interior Casing Material:
  - 1. Galvanized or stainless steel.
  - 2. Material: Galvanized steel, solid, minimum 18 gauge thick.
  - 3. Material: Stainless steel, solid, minimum 18 gauge thick.
- E. Lifting and Handling Provisions: Factory-installed shipping skids and lifting lugs.
- F. Base Rails: Galvanized-steel rails for mounting on roof curb or pad as indicated.
  - 1. Height: 6 inches.
  - 2. Seismic Fabrication Requirements: Fabricate mounting base and attachment to air-handling-unit sections, accessories, and components with reinforcement strong enough to withstand seismic forces defined in Section 230548 "Vibration and Seismic Controls for HVAC" when air-handling-unit frame is anchored to building structure.

- G. Access for Inspection, Cleaning, and Maintenance: Comply with requirements in ASHRAE 62.1.
1. Service Doors: Hinged access doors with gaskets. Material and construction of doors shall match material and construction of cabinet in which doors are installed.
- H. Roof: Standing seam or membrane; sloped to drain water.
- I. Floor: Reinforced, metal surface; reinforced to limit deflection when walked on by service personnel. Insulation shall be below metal walking surface.
- J. Cabinet Insulation:
1. Type: Fibrous-glass duct lining complying with ASTM C1071, Type II or flexible elastomeric insulation complying with ASTM C534, Type II, sheet materials.
  2. Thickness: 1 inch.
  3. Insulation Adhesive: Comply with ASTM C916, Type I.
  4. Mechanical Fasteners: Suitable for adhesive, mechanical, or welding attachment to casing without damaging liner and without causing air leakage when applied as recommended by manufacturer.
  5. Casing Panel R-Value: Minimum R-11.
  6. Thermal Break: Provide continuity of insulation with no through-casing metal in casing walls, floors, or roofs of air-handling unit.
- K. Condensate Drain Pans:
1. Shape: Rectangular, with 1 percent slope in at least two planes to direct water toward drain connection.
  2. Size: Large enough to collect condensate from cooling coils including coil piping connections, coil headers, and return bends.
    - a. Length: Extend drain pan downstream from leaving face to comply with ASHRAE 62.1.
    - b. Depth: A minimum of 2 inches deep.
  3. Configuration: Single wall.
  4. Configuration: Double wall, with space between walls filled with foam insulation and moisture-tight seal.
  5. Material: Galvanized-steel sheet with asphaltic waterproofing compound coating on pan top surface.
  6. Material: Stainless-steel sheet.
  7. Drain Connection:
    - a. Located on one end of pan, at lowest point of pan.
    - b. Terminated with threaded nipple.
    - c. Minimum Connection Size: NPS 1 Insert size.
  8. Units with stacked coils shall have an intermediate drain pan to collect condensate from top coil.



- L. Surfaces in Contact with Airstream: Comply with requirements in ASHRAE 62.1 for resistance to mold and erosion.

## 2.5 SUPPLY FAN

- A. Forward-Curved Fan Type: Centrifugal; statically and dynamically balanced.
  - 1. Fan Wheel Material: Coated steel, mounted on solid-steel shaft.
  - 2. Bearings: Pillow-block bearings rated L<sub>50</sub> for 200,000 hours and having external grease fittings.
  - 3. Prelubricated and Sealed, Ball Bearings: Self-aligning, pillow-block type with an L-50 rated life of 200,000 hours according to ABMA 9.
  - 4. Grease-Lubricated, Tapered-Roller Bearings: Self-aligning, pillow-block type with double-locking collars and two-piece, cast-iron housing with grease lines extended to outside unit and an L-50 rated life of 200,000 hours according to ABMA 11.
  - 5. Grease-Lubricated Bearings: Self-aligning, pillow-block-type, ball or roller bearings with adapter mount and two-piece, cast-iron housing with grease lines extended to outside unit and an L-50 rated life of 200,000.
- B. Plenum Fan Type: Single width, non-overloading, with backward-inclined or airfoil blades.
  - 1. Fan Wheel Material: Aluminum; attached directly to motor shaft.
  - 2. Fan Wheel Drive and Arrangement: Direct drive, AMCA Arrangement 4.
  - 3. Fan panel and frame Material: Powder-coated steel, stainless steel, or aluminum.
  - 4. Fan Enclosure: Easily removable enclosure around rotating parts.
  - 5. Fan Balance: Precision balance fan below 0.08 inch/s at design speed with filter in.
  - 6. Bearings: Pillow-block bearings rated L<sub>50</sub> for 200,000 hours and having external grease fittings.
- C. Service Factor for Belt Drive Applications:
  - 1. Multiple V-belt drive with matching fan pulley and adjustable motor sheaves and belt assembly with minimum 2.0 service factor.
  - 2. Belt Guards: Comply with requirements specified by OSHA and fabricate according to SMACNA's "HVAC Duct Construction Standards"; 0.146 inch-thick, 3/4-inch diamond-mesh wire screen, welded to steel angle frame; prime coated.
- D. Motors:
  - 1. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
  - 2. Enclosure: Totally enclosed.
  - 3. Enclosure Materials: Cast iron Cast aluminum Rolled steel.
  - 4. Motor Bearings: .
  - 5. Unusual Service Conditions:
    - a. Ambient Temperature: 95 degrees.
    - b. Altitude: above sea level.
    - c. High humidity.

6. Efficiency: Premium efficient.
7. NEMA Design: .
8. Service Factor: 1.15.

E. Mounting:

1. Fan wheel, motor, and drives shall be mounted to fan casing with restrained elastomeric spring isolators.
2. Minimum static deflection of 1 inch

## 2.6 COOLING COILS

- A. Capacity Ratings: Comply with ASHRAE 33 and ARI 410.
- B. Coil Casing Material: Manufacturer's standard material.
- C. Tube Material: Copper.
- D. Tube Header Material: Copper.
- E. Fin Material: Aluminum.
- F. Fin and Tube Joints: Mechanical bond.
- G. Leak Test: Coils shall be leak tested with air underwater.
- H. Refrigerant Coil Capacity Reduction: Circuit coils for face control.
- I. Refrigerant Coil Suction and Distributor Header Materials: Seamless copper tube with brazed joints.
- J. Coating: Corrosion-resistant coating after assembly.

## 2.7 REFRIGERATION SYSTEM

- A. Comply with requirements in ASHRAE 15, "Safety Standard for Refrigeration Systems."
- B. Number of Refrigerant Circuits: Two.
- C. Refrigerant Charge: Factory charged with refrigerant and filled with oil.
- D. Compressors: Reciprocating or scroll compressors with integral vibration isolators, internal overcurrent and overtemperature protection, internal pressure relief, and crankcase heater
- E. Refrigerant: R-407C or R-410A.
  1. Classified as Safety Group A1 according to ASHRAE 34.

F. Refrigeration System Specialties:

1. Low-pressure switch.
2. Thermostat for coil freeze-up protection during low ambient temperature operation or loss of air.
3. Brass service valves installed in compressor suction discharge and liquid lines.
4. Minimum off-time relay.
5. Low-ambient kit high-pressure sensor.
6. Hot-gas reheat solenoid valve single stage with a replaceable magnetic coil.
7. Hot-gas bypass solenoid valve with a replaceable magnetic coil.
8. Four-way reversing valve with a replaceable magnetic coil, thermostatic expansion valves with bypass check valves, and a suction line accumulator.

G. Capacity Control:

1. Hot-gas bypass refrigerant control for capacity control with continuous dehumidification on a single compressor.
2. Patented, Rawal APR control with zero to 100 percent modulating capacity control using hot-gas bypass. Evaporator coil shall be continuously active for dehumidification.
3. Single compressor with evaporator and condenser coil within the refrigerant section to provide initial pre-cooling and to reheat for humidity control.
4. Heat-pipe heat exchanger wrapped around the evaporator coil to pre-cool the air entering the evaporator coil and reheat the air leaving the evaporator coil to control humidity.

H. Refrigerant condenser and reheat condenser coils:

1. Capacity Ratings: Complying with ASHRAE 33 and ARI 410.
2. Tube Material: Copper.
3. Fin Material: Aluminum.
4. Fin and Tube Joint: Mechanical bond.
5. Leak Test: Coils shall be leak tested with air underwater.
6. Coating: Corrosion-resistant coating after assembly.

I. Condenser Fan Assembly:

1. Fans: Direct-drive propeller type with statically and dynamically balanced fan blades.
2. Fan Motors:
  - a. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
  - b. Motor Enclosure: Totally enclosed non-ventilating (TENV) or totally enclosed air over (TEAO) enclosure.
  - c. Enclosure Materials: Cast iron Cast aluminum Rolled steel.
  - d. Motor Bearings: Permanently lubricated bearings.
  - e. Built-in overcurrent and thermal-overload protection.
  - f. Efficiency: Premium efficient.
  - g. Service Factor: 1.5.
3. Fan Safety Guards: Steel with corrosion-resistant coating.

J. Safety Controls:

1. Compressor motor and condenser coil fan motor low ambient lockout.
2. Overcurrent protection for compressor motor.

2.8 ELECTRIC-RESISTANCE HEATING COIL

A. UL Compliance: Comply with requirements in UL 1995, "Heating and Cooling Equipment."

B. Electric-Resistance Heating Elements:

1. Coiled Resistance Wire: 80 percent nickel and 20 percent chromium.
2. Tubular-Steel Sheath: Compacted magnesium oxide powder.
3. Fins: Spiral-wound, copper-plated, steel fins continuously brazed to sheath.
4. Heating Capacity: Low density 35 W per sq. in., factory wired for single-point wiring connection; with time delay for element staging and overcurrent- and overheat-protection devices.
5. Safety Controls:
  - a. Blower-motor interlock, air-pressure switch.
  - b. Quiet mercury contactors.
  - c. Time delay between steps.
  - d. Integral, nonfused power disconnect switch.
  - e. Step Controller: Pilot lights and override toggle switch for each step.
  - f. SCR Controller: Pilot lights operate on load ratio, a minimum of five steps.
  - g. Overtemperature Protection: Disk-type, automatically reset, thermal-cutout, safety device; serviceable through terminal box.
  - h. Overcurrent Protection: Manual-reset thermal cutouts, factory wired in each heater stage.

C. Electric-Resistance Heating Elements:

1. Open-Coil Resistance Wire: 80 percent nickel and 20 percent chromium.
2. Supports and Insulation: Floating ceramic bushings recessed into casing openings; fastened to supporting brackets and mounted in galvanized-steel frame.
3. Heating Capacity: Low density 35 W per sq. in., factory wired for single-point wiring connection; with time delay for element staging and overcurrent- and overheat-protection devices.
4. Safety Controls:
  - a. Blower-motor interlock, air-pressure switch.
  - b. Quiet mercury contactors.
  - c. Time delay between steps.
  - d. Integral, nonfused power disconnect switch.
  - e. Step Controller: Pilot lights and override toggle switch for each step.
  - f. SCR Controller: Pilot lights operate on load ratio, a minimum of five steps.
  - g. Overtemperature Protection: Disk-type, automatically reset, thermal-cutout, safety device; serviceable through terminal box.
  - h. Overcurrent Protection: Manual-reset thermal cutouts, factory wired in each heater stage.

## 2.9 CORROSION-RESISTANT COATINGS

- A. Corrosion-Resistant Coating: Coat coils and fan guards with a corrosion-resistant coating capable of withstanding a 3,000-hour salt-spray test according to ASTM B117.
  - 1. Standards:
    - a. ASTM B117 for salt spray.
    - b. ASTM D2794 for minimum impact resistance of 100 in-lb.
    - c. ASTM D3359 for cross hatch adhesion of 5B.
  - 2. Application: Immersion.
  - 3. Thickness: 1 mil.
  - 4. Gloss: Minimum gloss of 50 gloss units on a single angle 60-degree meter.
  - 5. UV Protection: Spray applied topcoat.

## 2.10 OUTDOOR-AIR INTAKE HOOD

- A. Type: Manufacturer's standard louver.
- B. Materials: Match cabinet.
- C. Configuration: Designed to inhibit wind-driven rain and snow from entering unit.
- D. Bird Screen: Comply with requirements in ASHRAE 62.1.
- E. Filter: MERV 8.
- F. Filter differential pressure switch with sensor tubing on either side of filter. Set for final filter pressure loss.

## 2.11 FILTERS

- A. Cleanable Filters: 2-inch-thick, cleanable metal mesh.
- B. Disposable Panel Filters:
  - 1. Comply with NFPA 90A.
  - 2. Factory-fabricated, viscous-coated, flat-panel type.
  - 3. Thickness: 1 inch.
  - 4. Minimum Arrestance: 80, according to ASHRAE 52.1.
  - 5. Minimum MERV: 8, according to ASHRAE 52.2.
  - 6. Media: Interlaced glass fibers sprayed with nonflammable adhesive and antimicrobial agent.
- C. Mounting Frames:
  - 1. Panel filters arranged for flat or angular orientation, with access doors on both sides of unit. Filters shall be removable from one side or from access plenum.
  - 2. Extended surface filters arranged for flat orientation, removable from access plenum.

3. Galvanized or stainless steel with gaskets and fasteners, suitable for bolting together into built-up filter banks with space for prefilter.
- D. Filter differential pressure switch with sensor tubing on either side of filter. Set for final filter pressure loss.
- E. Filter gauge.

## 2.12 ELECTRICAL POWER CONNECTIONS

- A. General Electrical Power Connection Requirements: Factory-installed and -wired switches, motor controllers, transformers, and other necessary electrical devices shall provide a single-point field power connection to unit.
- B. Enclosure: NEMA 250, Type 4X, mounted in unit with hinged access door in unit cabinet having a lock and key or padlock and key,
- C. Wiring: Numbered and color-coded to match wiring diagram.
- D. Wiring Location: Install factory wiring outside an enclosure in a raceway.
- E. Power Interface: Field power interface shall be to NEMA KS 1, heavy-duty, nonfused disconnect switch.
- F. Factory Wiring: Branch power circuit to each motor and to controls with one of the following disconnecting means:
  1. NEMA KS 1, heavy-duty, fusible switch with rejection-type fuse clips rated for fuses. Select and size fuses to provide Type 2 protection according to IEC 60947-4-1.
  2. NEMA KS 1, heavy-duty, nonfusible switch.
  3. UL 489, motor-circuit protector (circuit breaker) with field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.
- G. Factory-Mounted, Overcurrent-Protection Service: For each motor.
- H. Transformer: Factory mounted with primary and secondary fuses and sized with enough capacity to operate electrical load plus spare capacity.
- I. Controls: Factory wire unit-mounted controls where indicated.
- J. Lights: Factory wire unit-mounted lights.
- K. Receptacle: Factory wire unit-mounted, ground fault interrupt (GFI) duplex receptacle.
- L. Control Relays: Auxiliary and adjustable time-delay relays.

## 2.13 DAMPERS

### A. Control Dampers:

1. Damper Location: Factory installed inside unit for ease of blade axle and bushing service.
2. Damper Leakage: Comply with requirements in AMCA 500-D. Leakage shall not exceed 6.5 cfm per sq. ft. at a static-pressure differential of 4.0 inches water column when a torque of 5 inch pounds per sq. ft. is applied to the damper jackshaft.
3. Damper Rating: Rated for close-off pressure equal to the fan shutoff pressure.
4. Damper Label: Bear the AMCA seal for both air leakage and performance.
5. Blade Configuration: Unless otherwise indicated, use parallel blade configuration for two-position control and equipment isolation service and use opposed blade configuration for modulating control.
6. Damper Frame Material: Extruded aluminum.
7. Blade Type: Single-thickness metal reinforced with multiple V-grooves or hollow-shaped airfoil.
8. Blade Material: Extruded aluminum or stainless steel.
9. Maximum Blade Width: 6 inches.
10. Maximum Blade Length: 48 inches.
11. Blade Seals: Replaceable, continuous perimeter vinyl seals and jambs with stainless-steel compression-type seals.
12. Bearings: Thrust bearings for vertical blade axles.
13. Airflow Measurement:
  - a. Monitoring System: Complete and functioning system of airflow monitoring as an integral part of the damper assembly where indicated.
  - b. Remote Monitoring Signal: 0-10 volt or 4-20 mA scaled signal.
  - c. Accuracy of flow measurement: Within 5 percent of the actual flow rate between the range of the scheduled minimum and maximum airflow. For units with a large range between minimum and maximum airflow, configure the damper sections and flow measurement assembly as necessary to comply with accuracy.
  - d. Straightening Device: Integral to the flow measurement assembly if required to achieve the specified accuracy as installed.
  - e. Flow measuring device: Suitable for operation in untreated and unfiltered outdoor air. If necessary, include temperature and altitude compensation and correction to maintain the accuracy.

### B. Damper Operators:

1. Factory-installed electric operator for each damper assembly with one operator for each damper assembly mounted to the damper frame.
2. Operator capable of shutoff against fan pressure and able to operate the damper with sufficient reserve power to achieve smooth modulating action and proper speed of response at the velocity and pressure conditions to which the damper is subjected.
3. Maximum Operating Time: Open or close damper 90 degrees in 60 seconds.
4. Adjustable Stops: For both maximum and minimum positions.
5. Position Indicator and Graduated Scale: Factory installed on each actuator with words "OPEN" and "CLOSED," or similar identification, at travel limits.
6. Spring-return operator to fail-safe; either closed or open as required by application.
7. Operator Type: Direct coupled, designed for minimum 60,000 full-stroke cycles at rated torque.

8. Position feedback Signal: For remote monitoring of damper position.
9. Coupling: V-bolt and V-shaped, toothed cradle.
10. Circuitry: Electronic overload or digital rotation-sensing circuitry.
11. Damper Position Switch:
12. Actuator Sizing:
13. Torque Criteria:

## 2.14 CONTROLS

- A. Control equipment and sequence of operation are specified in Section 230993.11 "Sequence of Operations for HVAC DDC."
- B. Control Wiring: Factory wire connection for controls' power supply.
- C. Control Devices: Sensors, transmitters, relays, switches, detectors, operators, actuators, and valves shall be manufacturer's standard items to accomplish indicated control functions.
- D. Unit-Mounted Status Panel:
  1. Cooling/Off/Heating Controls: Control operational mode.
  2. Damper Position: Indicate position of outdoor-air dampers in terms of percentage of outdoor air.
  3. Enclosure: NEMA 250, Type 4.
  4. Status Lights:
    - a. Filter dirty.
    - b. Fan operating.
    - c. Cooling operating.
    - d. Heating operating.
    - e. Smoke alarm.
    - f. General alarm.
  5. Digital Numeric Display:
    - a. Outdoor airflow.
    - b. Supply airflow.
    - c. Outdoor dry-bulb temperature.
    - d. Outdoor dew point temperature.
    - e. Space temperature.
    - f. Supply temperature.
    - g. Space relative humidity.
    - h. Space carbon dioxide level.
- E. Refrigeration System Controls:
  1. Unit-mounted enthalpy controller shall lock out refrigerant system when outdoor-air enthalpy is less than 28 Btu/lb. of dry air or outdoor-air temperature is less than 60 deg F.
  2. Outdoor-air sensor de-energizes dehumidifier operation when outdoor-air temperature is less than 60 deg F.



3. Relative-humidity sensor energizes dehumidifier operation when relative humidity is more than 50 percent.

F. Electric-Resistance Heat Controls:

1. Factory-mounted sensor in unit discharge with sensor adjustment located in control panel to control electric coil to maintain temperature.
2. Wall-mounted, space-temperature sensor with temperature adjustment to control electric coil to maintain temperature.
3. Capacity Controls: Multiple steps.

G. Damper Controls: Space pressure sensor modulates outdoor- and return-air dampers to maintain a positive pressure in space at a minimum of 0.05 inch wg with respect to outdoor reference.

H. Integral Smoke Alarm: Smoke detector installed in supply air shall stop fans when the presence of smoke is detected.

I. Supply Fan Operation:

1. Occupied Periods: Run fan continuously.
2. Unoccupied Periods: Cycle fan to maintain setback temperature.

## 2.15 ACCESSORIES

- A. Service Lights and Switch: Factory installed in each accessible section with weatherproof cover. Factory wire lights to a single-point field connection.
- B. Duplex Receptacle: Factory mounted in unit supply-fan section, with 20 amp, 120 V GFI duplex receptacle and weatherproof cover.
- C. Hail guards of galvanized steel painted to match casing.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for piping, ducts, and electrical systems to verify actual locations of connections before equipment installation.
- C. Examine roof curbs and equipment supports for suitable conditions where units will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Comply with manufacturer's rigging and installation instructions for unloading units and moving to final locations.
- B. Curb Support: Install roof curb on roof structure according to "The NRCA Roofing Manual."
  - 1. Install and secure units on curbs and coordinate roof penetrations and flashing with roof construction.
  - 2. Coordinate size, installation, and structural capacity of roof curbs, equipment supports, and roof penetrations. These items are specified in Section 077200 "Roof Accessories."
  - 3. Coordinate size, location, and installation of unit manufacturer's roof curbs and equipment supports with roof Installer.
- C. Restrained Curb Support: Install restrained vibration isolation roof-curb rails on roof structure according to "The NRCA Roofing Manual."
- D. Equipment Mounting:
  - 1. Install air units on cast-in-place concrete equipment bases. Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."
  - 2. Comply with requirements for vibration isolation and seismic control devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."
- E. Install wall- and duct-mounted sensors furnished by manufacturer for field installation. Install control wiring and make final connections to control devices and unit control panel.
- F. Install 3000-psi, compressive-strength (28-day) concrete base inside roof curb, 4 inches thick. Concrete and reinforcement are specified with concrete.
- G. Comply with requirements for gas-fired furnace installation in NFPA 54, "National Fuel Gas Code."
- H. Install separate devices furnished by manufacturer and not factory installed.
- I. Do not operate fan system until filters (temporary or permanent) are in place. Replace temporary filters used during construction and testing with new, clean filters.

### 3.3 CONNECTIONS

- A. Piping Connections
  - 1. Drain Piping
    - a. Install drain pipes from unit drain pans to sanitary drain.
    - b. Drain Piping: Drawn-temper copper water tubing complying with ASTM B88, Type L, with soldered joints.
    - c. Drain Piping: Schedule 40 PVC pipe complying with ASTM D1785, with solvent-welded fittings.
    - d. Pipe Size: Same size as condensate drain pan connection.

2. Where installing piping adjacent to units, allow space for service and maintenance.
3. Refrigerant Piping: Comply with applicable requirements in Section 232300 "Refrigerant Piping." Install shutoff valve and union or flange at each supply and return connection.

B. Duct Connections:

1. Comply with requirements in Section 233113 "Metal Ducts."
2. Drawings indicate the general arrangement of ducts.
3. Connect ducts to units with flexible duct connectors. Comply with requirements for flexible duct connectors in Section 233300 "Air Duct Accessories."

3.4 ELECTRICAL CONNECTIONS

- A. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- B. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- C. Install electrical devices furnished by manufacturer, but not factory mounted, according to NFPA 70 and NECA 1.
- D. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.
  1. Nameplate shall be laminated acrylic or melamine plastic signs, as specified in Section 260553 "Identification for Electrical Systems."
  2. Nameplate shall be laminated acrylic or melamine plastic signs with a black background and engraved white letters at least 1/2 inch high.

3.5 CONTROL CONNECTIONS

- A. Install control and electrical power wiring to field-mounted control devices.
- B. Connect control wiring according to Section 260523 "Control-Voltage Electrical Power Cables."

3.6 FIELD QUALITY CONTROL

- A. Article copied from 237313.13
- B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- C. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- D. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

- E. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
  - 1. Leak Test: After installation, fill water and steam coils with water, and test coils and connections for leaks.
  - 2. Charge refrigerant coils with refrigerant and test for leaks.
  - 3. Fan Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
  - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- F. Air-handling unit or components will be considered defective if unit or components do not pass tests and inspections.
- G. Prepare test and inspection reports.

### 3.7 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
  - 1. Complete installation and startup checks according to manufacturer's written instructions.
  - 2. Inspect units for visible damage to furnace combustion chamber.
  - 3. Perform the following operations for both minimum and maximum firing and adjust burner for peak efficiency:
    - a. Measure gas pressure at manifold.
    - b. Measure combustion-air temperature at inlet to combustion chamber.
    - c. Measure flue-gas temperature at furnace discharge.
    - d. Perform flue-gas analysis. Measure and record flue-gas carbon dioxide and oxygen concentration.
    - e. Measure supply-air temperature and volume when burner is at maximum firing rate and when burner is off. Calculate useful heat to supply air.
  - 4. Verify operation of remote panel including pilot-light operation and failure modes. Inspect the following:
    - a. High-limit heat exchanger.
    - b. Alarms.
  - 5. Inspect units for visible damage to refrigerant compressor, condenser and evaporator coils, and fans.
  - 6. Start refrigeration system when outdoor-air temperature is within normal operating limits and measure and record the following:
    - a. Cooling coil leaving-air, dry- and wet-bulb temperatures.
    - b. Cooling coil entering-air, dry- and wet-bulb temperatures.
    - c. Condenser coil entering-air dry-bulb temperature.
    - d. Condenser coil leaving-air dry-bulb temperature.
  - 7. Simulate maximum cooling demand and inspect the following:

- a. Compressor refrigerant suction and hot-gas pressures.
  - b. Short-circuiting of air through outside coil or from outside coil to outdoor-air intake.
8. Inspect casing insulation for integrity, moisture content, and adhesion.
  9. Verify that clearances have been provided for servicing.
  10. Verify that controls are connected and operable.
  11. Verify that filters are installed.
  12. Clean coils and inspect for construction debris.
  13. Clean furnace flue and inspect for construction debris.
  14. Inspect operation of power vents.
  15. Purge gas line.
  16. Inspect and adjust vibration isolators and seismic restraints.
  17. Verify bearing lubrication.
  18. Clean fans and inspect fan-wheel rotation for movement in correct direction without vibration and binding.
  19. Adjust fan belts to proper alignment and tension.
  20. Verify that manual and automatic volume control and fire and smoke dampers in connected duct systems are in fully open position.
  21. Verify that shipping, blocking, and bracing are removed.
  22. Verify that proper thermal-overload protection is installed in motors, controllers, and switches.
  23. Verify that unit is secure on mountings and supporting devices and that connections to piping, ducts, and electrical systems are complete.
  24. Start unit.
  25. Inspect and record performance of interlocks and protective devices including response to smoke detectors by fan controls and fire alarm.
  26. Operate unit for run-in period.
  27. Calibrate controls.
  28. Adjust and inspect high-temperature limits.
  29. Inspect outdoor-air dampers for proper stroke.
  30. Verify operational sequence of controls.
  31. Measure and record the following airflows. Plot fan volumes on fan curve.
    - a. Supply-air volume.
    - b. Return-air flow.
    - c. Outdoor-air flow.
- B. After startup, change filters.
  - C. Remove and replace components that do not properly operate, and repeat startup procedures as specified above.
  - D. Prepare written report of the results of startup services.

### 3.8 CLEANING AND ADJUSTING

- A. Adjust initial temperature and humidity set points.
- B. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

- C. Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC" for air-handling system testing, adjusting, and balancing.
- D. After completing system installation and testing, adjusting, and balancing of air-handling unit and air-distribution systems, and after completing startup service, clean air-handling units internally to remove foreign material and construction dirt and dust. Clean fan wheels, cabinets, dampers, coils, and filter housings, and install new, clean filters.
- E. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

### 3.9 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain units.
  - 1. Instructor shall be factory trained and certified.
  - 2. Provide not less than eight hours of training.
  - 3. Train personnel in operation and maintenance and to obtain maximum efficiency in plant operation.
  - 4. Provide instructional videos showing general operation and maintenance that are coordinated with operation and maintenance manuals.
  - 5. Obtain Owner sign-off that training is complete.
  - 6. Owner training shall be held at Project site.

END OF SECTION 237433

## SECTION 238126 - SPLIT-SYSTEM AIR-CONDITIONERS

### 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 split-system air-conditioning and heat-pump units consisting of separate evaporator-fan and compressor-condenser components.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
  - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 2. Wiring Diagrams: For power, signal, and control wiring.
- C. Samples for Initial Selection: For units with factory-applied color finishes.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.
- B. Warranty: Sample of special warranty.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For split-system air-conditioning units to include in emergency, operation, and maintenance manuals.

## 1.6 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. Filters: One set(s) for each air-handling unit.
  - 2. Gaskets: One set(s) for each access door.
  - 3. Fan Belts: One set(s) for each air-handling unit fan.

## 1.7 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. ASHRAE Compliance:
  - 1. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Standard for Refrigeration Systems."
  - 2. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 4 - "Outdoor Air Quality," Section 5 - "Systems and Equipment," Section 6 - "Procedures," and Section 7 - "Construction and System Start-up."
- C. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1.

## 1.8 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork are specified in Section 033000 "Cast-in-Place Concrete."
- B. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

## 1.9 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of split-system air-conditioning units that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period:
    - a. For Compressor: Five year(s) from date of Substantial Completion.
    - b. For Parts: One year(s) from date of Substantial Completion.
    - c. For Labor: One year(s) from date of Substantial Completion.



## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

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

1. Trane.

### 2.2 INDOOR UNITS (5 TONS OR LESS)

- A. Floor-Mounted, Evaporator-Fan Components:

1. Cabinet: Enameled steel with removable panels on front and ends in color selected by Engineer.
  - a. Insulation: Faced, glass-fiber duct liner.
  - b. Drain Pans: Galvanized steel, with connection for drain; insulated.
2. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermal-expansion valve. Comply with ARI 206/110.
3. Coil Coating: Refer to HVAC Schedules for Requirements.
4. Water Coil: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch; leak tested to 300 psig underwater; with a two-position control valve.
5. Electric Coil: Helical, nickel-chrome, resistance-wire heating elements; with refractory ceramic support bushings, automatic-reset thermal cutout, built-in magnetic contactors, manual-reset thermal cutout, airflow proving device, and one-time fuses in terminal box for overcurrent protection.
6. Fan: Direct drive, centrifugal.
7. Fan Motors:
  - a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
  - b. Multitapped, multispeed with internal thermal protection and permanent lubrication.
8. Air Filtration Section:
  - a. General Requirements for Air Filtration Section:
    - 1) Comply with NFPA 90A.
    - 2) Minimum MERV according to ASHRAE 52.2.
    - 3) Filter-Holding Frames: Arranged for flat or angular orientation, with access doors on both sides of unit. Filters shall be removable from one side or lifted out from access plenum.

b. Disposable Panel Filters:

- 1) Factory-fabricated, viscous-coated, flat-panel type.
- 2) Thickness: Refer to HVAC Schedules on the Drawings
- 3) MERV according to ASHRAE 52.2: 8.
- 4) Media: Interlaced glass fibers sprayed with nonflammable adhesive.
- 5) Frame: Galvanized steel, with metal grid on outlet side, steel rod grid on inlet side, and hinged; with pull and retaining handles.

2.3 OUTDOOR UNITS (5 TONS OR LESS)

A. Air-Cooled, Compressor-Condenser Components:

1. Casing: Steel, finished with baked enamel in color selected by Engineer, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.
2. Compressor: Hermetically sealed with crankcase heater and mounted on vibration isolation device. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.
  - a. Compressor Type: Scroll.
  - b. Two-speed compressor motor with manual-reset high-pressure switch and automatic-reset low-pressure switch.
  - c. Refrigerant: R-410A.
  - d. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and liquid subcooler. Comply with ARI 206/110.
  - e. Coil Coating: Refer to HVAC Schedules for Requirements.
3. Heat-Pump Components: Reversing valve and low-temperature-air cutoff thermostat.
4. Fan: Aluminum-propeller type, directly connected to motor.
5. Motor: Permanently lubricated, with integral thermal-overload protection.
6. Low Ambient Kit: Permits operation down to 45 deg F.
7. Mounting Base: Polyethylene.

2.4 ACCESSORIES

- A. Thermostat: Low voltage with subbase to control compressor and evaporator fan.
- B. Thermostat: Wireless infrared functioning to remotely control compressor and evaporator fan, with the following features:
1. Compressor time delay.
  2. 24-hour time control of system stop and start.
  3. Liquid-crystal display indicating temperature, set-point temperature, time setting, operating mode, and fan speed.
  4. Fan-speed selection including auto setting.
- C. Automatic-reset timer to prevent rapid cycling of compressor.

- D. Refrigerant Line Kits: Soft-annealed copper suction and liquid lines factory cleaned, dried, pressurized, and sealed; factory-insulated suction line with flared fittings at both ends.
- E. Drain Hose: For condensate.
- F. Monitoring:
  - 1. Monitor constant and variable motor loads.
  - 2. Monitor variable-frequency-drive operation.
  - 3. Monitor economizer cycle.
  - 4. Monitor cooling load.
  - 5. Monitor air distribution static pressure and ventilation air volumes.

## 2.5 CAPACITIES AND CHARACTERISTICS: Refer to HVAC Drawings

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Install units level and plumb.
- B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.
- C. Install roof-mounted, compressor-condenser components on equipment supports specified in Section 077200 "Roof Accessories." Anchor units to supports with removable, cadmium-plated fasteners.
- D. Equipment Mounting:
  - 1. Install ground-mounted, compressor-condenser components on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."
  - 2. Install ground-mounted, compressor-condenser components on polyethylene mounting base.
  - 3. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."
- E. Install and connect precharged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.

#### 3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where piping is installed adjacent to unit, allow space for service and maintenance of unit.

- C. Duct Connections: Duct installation requirements are specified in Section 233113 "Metal Ducts." Drawings indicate the general arrangement of ducts. Connect supply and return ducts to split-system air-conditioning units with flexible duct connectors. Flexible duct connectors are specified in Section 233300 "Air Duct Accessories."

### 3.3 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. 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.
- C. Tests and Inspections:
  - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
  - 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
  - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Remove and replace malfunctioning units and retest as specified above.
- E. Prepare test and inspection reports.

### 3.4 STARTUP SERVICE

- A. Perform startup service.
  - 1. Complete installation and startup checks according to manufacturer's written instructions.

### 3.5 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION 238126

## SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Copper building wire rated 600 V or less.
  - 2. Connectors, splices, and terminations rated 600 V and less.
- B. Related Requirements:
  - 1. Section 260523 "Low-Voltage Electrical Control and Signal Cables" for control systems communications cables.

#### 1.3 DEFINITIONS

- A. RoHS: Restriction of Hazardous Substances.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Product Schedule: Indicate type, use, location, and termination locations.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

### PART 2 - PRODUCTS

#### 2.1 COPPER BUILDING WIRE

- A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.

- B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
1. Alpha Wire Company.
  2. Encore Wire Corporation.
  3. General Cable Technologies Corporation.
  4. Okonite Company (The).
  5. Service Wire Co.
  6. 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 B3 for bare annealed copper and with ASTM B8 for stranded conductors.
- E. Conductor Insulation:
1. Type RHW-2: Comply with UL 44.
  2. Type THWN-2: Comply with UL 83.
  3. Type XHHW-2: Comply with UL 44.

## 2.2 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.
- B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but not limited to the following:
1. 3M Electrical Products.
  2. Ideal Industries, Inc.
  3. TE Connectivity Ltd.
  4. Thomas & Betts Corporation: A Member of the ABB Group.
- 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: Tinned-plated Copper.
  2. Type:
    - a. Locking spade with insulated sleeve for No. 10 AWG and smaller.

- b. One hole with long barrels for No. 8 AWG to No. 4/0 AWG.
  - c. Two holes with long barrels for 250 kcmil and larger.
- 3. Termination: Compression for No. 8 AWG and larger.
- E. Connectors:
  - 1. Solderless pressure type (wirenuts) for No. 10 AWG and smaller.
  - 2. Pre-filled with silicone based sealant for exterior, wet, or corrosive locations.
  - 3. Split bolt type for No. 8 AWG and larger splices.
- F. Motor Terminations:
  - 1. Mechanical compression ring type, secured with bolt, nut and spring washer.

### PART 3 - EXECUTION

#### 3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Wires and cables: Copper, stranded, except for lighting and receptacle wiring which may be solid.
- B. Minimum size: No. 12 AWG.

#### 3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Service Entrance: Type RHW-2, single conductors in raceway.
- B. Feeders and Branch Circuits: Type XHHW-2, single conductors in raceway for sizes No. 4/0 AWG and smaller. Type RHW-2, single conductors in raceway for sizes 250 kcmil and larger.

#### 3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Comply with NECA 1.
- B. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.
- C. 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.
- D. 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.
- E. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

- F. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible. Use of steel fish tapes and/or steel pulling cables in PVC conduit or raceways that terminate into energized enclosures is prohibited.
- G. Adequately support cables.
- H. Install equipment grounding conductors with all feeders and branch circuits.
- I. If cable cannot be terminated immediately after installation, install heat shrinkable end caps.

### 3.4 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- B. 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. Do not splice service or feeder cables without prior written approval of Engineer.
- C. Wiring at Outlets:
  - 1. Install conductor at each outlet, with at least 6 inches of slack.
  - 2. Form solid wire into loop to fit around device terminal screw. Do no overlap wire.

### 3.5 IDENTIFICATION

- A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."
- B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.
- C. Identify circuit number associated with lights, receptacles, and other miscellaneous loads to panelboards. Identify phase and neutral conductors with circuit number.

### 3.6 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
  - 1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.
  - 2. Perform each of the following visual and electrical tests:
    - a. Inspect exposed sections of conductor and cable for physical damage and correct connection according to the single-line diagram.
    - b. Test bolted connections for high resistance using one of the following:



- 1) A low-resistance ohmmeter.
  - 2) Calibrated torque wrench.
  - 3) Thermographic survey.
- c. Inspect compression-applied connectors for correct cable match and indentation.
  - d. Inspect for correct identification.
  - e. Inspect cable jacket and condition.
  - f. 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.
  - g. Continuity test on each conductor and cable.
  - h. Uniform resistance of parallel conductors.
- B. Cables will be considered defective if they do not pass tests and inspections.
- C. 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

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## SECTION 260523 - LOW-VOLTAGE ELECTRICAL CONTROL AND SIGNAL CABLES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Industrial Ethernet cable.
  - 2. Low-voltage instrumentation cabling.
  - 3. Control-circuit conductors.
  - 4. Terminations products.

#### 1.3 DEFINITIONS

- A. EMI: Electromagnetic interference.
- B. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control and signaling power-limited circuits.

#### 1.4 ACTION SUBMITTALS

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

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- 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. Flame Travel and Smoke Density for Riser Cables in Non-Plenum Building Spaces: As determined by testing identical products according to UL 1666.
- C. Flame Travel and Smoke Density for Cables in Non-Riser Applications and Non-Plenum Building Spaces: As determined by testing identical products according to UL 1685.
- D. RoHS compliant.

## 2.2 INDUSTRIAL ETHERNET CABLE

- A. Description: Four-pair, balanced-twisted pair cable, certified to meet transmission characteristics of Category 6 cable at frequencies up to 250 MHz.
- B. Standard: Comply with NEMA WC 66/ICEA S-116-732 and TIA-568-C.2 for Category 6 cables.
- C. Conductors: 100-ohm, 22 AWG solid copper.
- D. Shielding/Screening: Shielded twisted pairs (FTP).
- E. Cable Rating: Non-Plenum, 600V insulation.
- F. Jacket: PVC.
- G. Manufacturer: Rockwell Automation 1585-C8HB-S, or equal.
- H. Terminations: Match conductor count, RJ-45 industrial type intended for shielded cable, Rockwell Automation 1585J, or equal.

## 2.3 LOW-VOLTAGE INSTRUMENTATION CABLING

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - 1. Belden.
  - 2. Rockbestos.
- B. Single Paired Cable: NEC Type ITC (Instrumentation Tray Cable), UL Type TC. for 4-20mA process instrumentation signals and use under NEC Article 727.
  - 1. One pair, twisted, shielded, No. 16 AWG, stranded tinned-copper conductors.
  - 2. XLPE insulation, 600V.
  - 3. Shield: 100 percent aluminum/polyester foil with drain wire.
  - 4. PVC jacket with manufacturers identification.
  - 5. Standards: UL 1277 Type TC, UL 1581.
  - 6. Maximum overall diameter: 0.297-inches.
- C. Multiple Paired Cable: NEC Type ITC (Instrumentation Tray Cable), UL Type TC. for 4-20mA process instrumentation signals and use under NEC Article 727.
  - 1. Multiple paired (as noted on Drawings), twisted, shielded, No. 16 AWG, stranded tinned-copper conductors.
  - 2. XLPE insulation, 600V.
  - 3. Shield: 100 percent aluminum/polyester foil with drain wire. Pairs individually shielded.
  - 4. PVC jacket with manufacturers identification.
  - 5. Standards: UL 1277 Type TC, UL 1581.

## 2.4 CONTROL-CIRCUIT CONDUCTORS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - 1. General Cable: General Cable Corporation.
  - 2. Service Wire Co.
  - 3. Southwire Company.
- B. Class 1 Control Circuits: Stranded copper, Type XHHW-2, rated 600V, complying with UL 44 in raceway or Type TC, complying with UL 1277 in raceway.
- C. Minimum size: No. 14 AWG.

## 2.5 TERMINATIONS FOR INSTRUMENTATION AND CONTROL CONDUCTORS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - 1. 3M Electrical Products.
  - 2. Ideal Industries, Inc.
  - 3. TE Connectivity Ltd.
- B. Termination connectors for instrumentation and control conductors:
  - 1. Tin plated copper.
  - 2. Vinyl insulated.
  - 3. Flanged spade / locking fork with upturned leg ends.
  - 4. Crimp/compression installation.

## PART 3 - EXECUTION

### 3.1 INSTALLATION OF CONDUCTORS AND CABLES

- A. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for installation requirements and as supplemented or modified in this Section.
- B. Install Ethernet cabling and instrumentation wiring and cable in separate raceways from power or control wiring.
- C. Do not install bruised, kinked, scored, deformed, or abraded cable. Remove and discard cable if damaged during installation and replace it with new cable.
- D. Cold-Weather Installation: Bring cable to room temperature before de-reeling. Do not use heat lamps for heating.
- E. Industrial Ethernet Installation:

1. Cables may not be spliced and shall be continuous from terminal to terminal. Do not splice cable between termination, tap, or junction points.
2. Comply with TIA-568-C.2.
3. Do not untwist balanced twisted pair cables more than 1/2 inch at the point of termination to maintain cable geometry.

F. Instrumentation Cable Installation:

1. Cables may not be spliced and shall be continuous from terminal to terminal. Do not splice cable between termination, tap, or junction points.
2. Install terminal blocks at junction boxes for interconnecting shield drain wires.
3. Install heat shrink tubing at termination ends, extending 1-inch minimum over jacket end and 0.5-inch minimum over exposed conductor end.

G. Control-Circuit Conductor Installation:

1. Use insulated spade lugs for wire and cable connection to screw terminals.
2. A maximum of two spade lugs is allowed at screw terminals.
3. A maximum of two conductors is allowed at saddle-type terminals.
4. Splices are not allowed in push button control stations, control devices (i.e. pressure switches, flow switches, etc.), conduit bodies, etc.

H. Separation from EMI Sources:

1. Comply with BICSI TDMM and TIA-569-D recommendations for separating unshielded copper voice and data communications cable from potential EMI sources including electrical power lines and equipment.
2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
  - a. Electrical Equipment or Circuit Rating Less Than 2 kVA: A minimum of 5 inches.
  - b. Electrical Equipment or Circuit Rating between 2 and 5 kVA: A minimum of 12 inches.
  - c. Electrical Equipment or Circuit Rating More Than 5 kVA: A minimum of 24 inches.
3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
  - a. Electrical Equipment or Circuit Rating Less Than 2 kVA: A minimum of 2-1/2 inches.
  - b. Electrical Equipment or Circuit Rating between 2 and 5 kVA: A minimum of 6 inches.
  - c. Electrical Equipment or Circuit Rating More Than 5 kVA: A minimum of 12 inches.
4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:

- a. Electrical Equipment or Circuit Rating Less Than 2 kVA: No requirement.
  - b. Electrical Equipment or Circuit Rating between 2 and 5 kVA: A minimum of 3 inches.
  - c. Electrical Equipment or Circuit Rating More Than 5 kVA: A minimum of 6 inches.
- 5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or 5 HP and Larger: A minimum of 48 inches.
  - 6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches.

### 3.2 REMOVAL OF CONDUCTORS AND CABLES

- A. Remove abandoned conductors and cables. Abandoned conductors and cables are those installed that are not terminated at equipment and are not identified with a tag for future use.

### 3.3 GROUNDING

- A. For low-voltage control wiring and cabling, install equipment grounding conductor in all control raceways and comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."
- B. For instrumentation wiring, ground shield at one end only as recommended by instrument manufacturer and in accordance with Owner's standard.

### 3.4 IDENTIFICATION

- A. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- B. Identify each wire on each end and at each terminal with a number-coded identification tag. Each wire shall have a unique tag.

### 3.5 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
  - 1. Visually inspect cable jacket materials for UL or third-party certification markings.
  - 2. Visually inspect cable placement, cable termination, grounding and bonding, and labeling of all components.
- C. End-to-end cabling will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

END OF SECTION 260523



## SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes grounding and bonding systems and equipment.
- B. Section includes grounding and bonding systems and equipment, plus the following special applications:
  - 1. Underground distribution grounding.
  - 2. Ground bonding common with lightning protection system.
  - 3. Foundation steel electrodes.

#### 1.3 ACTION SUBMITTALS

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

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency and testing agency's field supervisor.
- B. Field quality-control reports.

#### 1.5 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.

## 2.2 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
1. Appleton - O-Z/Gedney; Emerson Electric Co., Automation Solutions.
  2. Burndy; Hubbell Incorporated, Construction and Energy.
  3. nVent (ERICO).

## 2.3 CONDUCTORS

- A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction. Insulation type to match corresponding 600V phase conductor insulation requirements. Type THWN-2 for wire sizes #10 AWG and smaller, Type XHHW-2 for wire sizes #8 AWG and larger.
- B. Bare Copper Conductors:
1. Solid Conductors: ASTM B3.
  2. Stranded Conductors: ASTM B8.
  3. Tinned Conductors: ASTM B33.

## 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: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.
- C. Bus-Bar Connectors: 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. Conduit Hubs: Mechanical type, terminal with threaded hub.
- G. Ground Rod Clamps: Mechanical type, copper or copper alloy, terminal with hex head bolt.
- H. Lay-in Lug Connector: Mechanical type, copper rated for direct burial terminal with set screw.
- I. U-Bolt Clamps: Mechanical type, copper or copper alloy, terminal listed for direct burial.
- J. Water Pipe Clamps:
1. Mechanical type, two pieces with stainless-steel bolts.

- a. Material: Die-cast zinc alloy.
  - b. Listed for direct burial.
2. U-bolt type with malleable-iron clamp and copper ground connector rated for direct burial.

## 2.5 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel, sectional type; 3/4 inch by 10 feet.

## 2.6 EXOTHERMIC WELDING

- A. Exothermic welding shall be by CADWELD process, or equal. Molds and powder shall be furnished by the same manufacturer and sized and selected per manufacturer's instructions for specific combination of conductors and connected items.
- B. Welds used indoors in occupied buildings or confined spaces shall be the low emission type, CADWELD EXOLON or equal.

# PART 3 - EXECUTION

## 3.1 APPLICATIONS

- A. Conductors: Install solid conductor for No. 10 AWG and smaller, and stranded conductors for No. 8 AWG and larger unless otherwise indicated.
- B. Underground Grounding Conductors: Install bare tinned-copper conductor, size as shown on Drawings.
  1. Bury at least 30 inches below grade.
  2. Duct-Bank Grounding Conductor: Bury 12 inches above duct bank when indicated as part of duct-bank installation.
- C. Equipment Grounding Conductors: Green-colored insulation.
- D. Conductor Terminations and Connections:
  1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
  2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
  3. Connections to Ground Rods at Test Wells: Bolted connectors.
  4. Connections to Structural Steel: Welded connectors.

## 3.2 GROUNDING AT THE SERVICE

- A. Equipment grounding conductors and grounding electrode conductors shall be connected to the ground bus. Install a main bonding jumper between the neutral and ground buses.

### 3.3 GROUNDING SEPARATELY DERIVED SYSTEMS

- A. Separately derived systems such as transformers or generators (if identified as such) shall bond neutral and ground together with a bonding jumper at the equipment in accordance with NEC 250.102. Connection to the grounding electrode system via the grounding electrode conductor shall be in accordance with NEC Table 250.66 or as shown on the Drawings.

### 3.4 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

- A. Comply with IEEE C2 grounding requirements.
- B. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches will extend above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches above to 6 inches below concrete. Seal floor opening with waterproof, nonshrink grout.
- C. Grounding Connections to Manhole and Handhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, stranded, hard-drawn copper bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields according to written instructions by manufacturer of splicing and termination kits.
- D. Comply with grounding details shown on Drawings.

### 3.5 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.
- B. Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.
- C. Metallic Fences: Comply with requirements of IEEE C2.
  - 1. Grounding Conductor: Bare, tinned copper, not less than No. 6 AWG.
  - 2. Gates: Shall be bonded to the grounding conductor with a flexible bonding jumper.
  - 3. Barbed Wire: Strands shall be bonded to the grounding conductor.

### 3.6 INSTALLATION

- A. Grounding Electrode 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.

1. Where conductors pass through floor slabs, walls, etc., they shall be installed in conduit or sleeved.
  2. Conductors subject to mechanical damage shall be protected by non-ferrous conduit to avoid a choke effect for fault currents.
- B. Ground Bonding Common with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.
- C. Ground Rods: Drive rods until tops are 2 inches 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.
- D. Test Wells: Install per Electrical Detail on Drawings.
- E. 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.
  3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.
- F. Grounding and Bonding for Piping:
1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
  2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
  3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.
- G. Grounding for Steel Building Structure: Install as shown on the Contract Drawings.
1. Locate attachment points not subject to mechanical damage, but accessible for inspection.
  2. Use exothermic weld process for wire sizes #1/0 AWG and larger.
  3. When wire size is smaller than #1/0, weld a pigtail of #1/0 AWG to structural steel then mechanically connect the two wires.

- H. Ground Ring: Install as shown on the Drawings.
  - 1. Bury ground ring not less than 24 inches from building's foundation.
  - 2. Lay all underground conductors slack, and where exposed to mechanical injury, protect by pipes or other substantial guards. If guards are iron pipe, or other magnetic material, electrically connect conductors to both ends of the guard.
- I. Concrete-Encased Grounding Electrode (Ufer Ground): Fabricate according to NFPA 70; and install as shown on Drawings.
- J. 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.

### 3.7 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. 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 each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, at ground test wells, and 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.
  - 4. Prepare As-Built dimensioned Drawings locating each test well, ground rod and ground-rod assembly, and other grounding electrodes. Identify each by letter in alphabetical

order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

- D. Grounding system will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.
- F. Report measured ground resistances that exceed the following values:
  - 1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10 ohms.
  - 2. Power and Lighting Equipment or System with Capacity of greater than 500 kVA: 5 ohms.
  - 3. Manhole Grounds: 10 ohms.
- G. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Engineer promptly and include recommendations to reduce ground resistance.

END OF SECTION 260526

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## SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes: support systems for raceways, boxes, and electrical equipment.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product used on the project.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following: channel support systems, conduit support hardware, and accessories.
  - 2. Include rated capacities and furnished specialties and accessories.

### PART 2 - PRODUCTS

#### 2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Aluminum Channel.
  - 1. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
  - 2. Channel Material: 6063-T5 aluminum alloy.
  - 3. Fittings and Accessories Material: 5052-H32 aluminum alloy.
- B. Stainless Steel Channel
  - 1. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
  - 2. Material for Channel, Fittings, and Accessories: Stainless steel, Type 316.
- C. Hot-dipped Galvanized Steel Channel
  - 1. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
  - 2. Material for Channel, Fittings, and Accessories: Hot-dipped galvanized steel.
- D. Nonmetallic Channel
  - 1. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.

2. Material for Channel: Ultraviolet resistant FRP
  3. Fittings, and Accessories: Stainless steel, Type 316 or compatible non-metallic.
- E. Accessories: conduit clamps, straps, hangers, rods, backplates, anchors, nuts, washers, etc. shall match channel material as listed in the MATERIALS APPLICATION Article. Use of galvanized steel components is only allowed with galvanized steel channel.
- F. Threaded rod: 3/8-inch minimum diameter.
- G. Expansion anchors: 3/8-inch minimum diameter. Equal to "Kwik Bolt", manufactured by McCulloch Industries; "Wej it" manufactured by Wej it Expansion Products; or "Kwik-Bolt II" manufactured by Hilti Fastening Systems.

### PART 3 - EXECUTION

#### 3.1 MATERIALS APPLICATION

- A. Dry, indoor, conditioned, non-process space: Hot-dipped galvanized steel.
- B. Outdoor, process areas, or areas shown on Drawings as "DUST", "DAMP", or "WET": Aluminum and/or stainless steel channel, depending upon load requirements.
- C. Areas shown on Drawings as "CORROSIVE": Nonmetallic.

#### 3.2 INSTALLATION APPLICATION

- A. Comply with the following standards as applicable for application and installation requirements of hangers and supports, except where requirements on Drawings or in this Section are stricter:
1. NECA 1: Standard for Good Workmanship in Electrical Construction.
  2. NECA 101: Standard for Installing Steel Conduits.
  3. NECA 102: Standard for Installing Aluminum Rigid Metal Conduits.
  4. NECA 105: Standard for Installing Metal Cable Tray Systems.
  5. NECA 111: Standard for Installing Nonmetallic Raceways.
- B. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.
- C. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."
- D. Attach support systems only to structural building components. Use concrete expansion anchors for attachment to concrete surfaces.
- E. Provide a minimum of 1/2-inch clearance between wall and equipment when installing surface mounted panel boxes, junction boxes, conduit, etc.

### 3.3 PAINTING

- A. Touchup: Comply with requirements in Section 099113 "Exterior Painting" or Section 099123 "Interior Painting" for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A780.

END OF SECTION 260529

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## SECTION 260533 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:

1. Metal conduits and fittings.
2. Nonmetallic conduits and fittings.
3. Metal wireways and auxiliary gutters.
4. Boxes, enclosures, and cabinets.
5. Handholes and boxes for exterior underground cabling.
6. Application Table.

- B. Related Requirements:

1. Section 260529 "Hangers and Supports for Electrical Systems" for channel support systems and miscellaneous mounting components.
2. Section 260543 "Underground Ducts and Raceways for Electrical Systems" for exterior ductbanks, manholes, and underground utility construction.

#### 1.3 DEFINITIONS

- A. ARC: Aluminum rigid conduit. See also RAC.
- B. RAC: Rigid aluminum conduit. See also ARC.
- C. National Electrical Code (NEC) / NFPA 70 conduit types:
  1. RMC – rigid metal conduit
  2. FMC – flexible metal conduit
  3. LFMC – liquidtight flexible metal conduit
  4. PVC – rigid polyvinyl chloride conduit
  5. LFNC – liquidtight flexible nonmetallic conduit
  6. EMT – electrical metallic tubing
  7. RNC – rigid nonmetallic conduit

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For conduits, wireways, fittings, boxes, hinged-cover enclosures, and cabinets used in this project.
- B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

### PART 2 - PRODUCTS

#### 2.1 METAL CONDUITS AND FITTINGS

##### A. Metal Conduit:

- 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. Anamet Electrical, Inc (Anaconda Sealtite).
  - b. Appleton - O-Z/Gedney; Emerson Electric Co., Automation Solutions.
  - c. Atkore International (Allied Tube & Conduit).
  - d. Patriot Aluminum Products, LLC.
  - e. Wheatland Tube Company.
- 2. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- 3. ARC: Comply with ANSI C80.5 and UL 6A.
- 4. LFMC: Sealtight®, Type UA, continuously interlocked flexible steel conduit with sunlight and chemical resistant PVC jacket and complying with UL 360.

##### B. Metal Fittings:

- 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. Anamet Electrical, Inc (Anaconda Sealtite).
  - b. Appleton - O-Z/Gedney; Emerson Electric Co., Automation Solutions.
  - c. Atkore International (Allied Tube & Conduit).
  - d. Patriot Aluminum Products, LLC.
  - e. Wheatland Tube Company.
- 2. Comply with NEMA FB 1 and UL 514B.
- 3. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- 4. Fittings, General: Listed and labeled for type of conduit, location, and use. Use cast aluminum fittings with ARC.
- 5. Conduit Bodies (C's, T's, LB's, etc.): Use mogul type (with rollers) as manufactured by Appleton for sizes 2-1/2-inch and larger.

6. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 1203 and NFPA 70.
  7. Fittings for LFMC: Three-piece screw-in type, malleable iron.
  8. Expansion Fittings: Material to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
  9. Conduit hub fittings: Grounding type by Myers Electric Products, Inc., or equal.
- C. Joint Compound for ARC: 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. Nonmetallic Conduit:

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. Cantex Inc.
2. Listing and Labeling: Nonmetallic conduit shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
3. RNC: Type EPC-40-PVC or Type EPC-80-PVC based upon Application Table in this Section, complying with NEMA TC 2 and UL 651 unless otherwise indicated.
4. LFNC-B: Comply with UL 1660, Type B.

### B. Nonmetallic Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - a. Cantex Inc.
2. Fittings, General: Listed and labeled for type of conduit, location, and use.
3. Fittings for RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.
  - a. Fittings for LFNC: Comply with UL 514B; dust-tight, liquid-tight, chemical resistant thermoplastic/nylon construction with tapered thread hub and neoprene O-ring gasket. Push-on fittings prohibited.
4. Solvents and Adhesives: As recommended by conduit manufacturer.

## 2.3 METAL WIREWAYS AND AUXILIARY GUTTERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Eaton (B-line).
  2. nVent (Hoffman).
  3. Schneider Electric USA (Square D).
- B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 4X stainless steel unless otherwise indicated, and sized according to NFPA 70.
1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- D. Wireway Covers: Hinged type and Flanged-and-gasketed type unless otherwise indicated.
- E. Finish: Manufacturer's standard enamel finish.

## 2.4 BOXES, ENCLOSURES, AND CABINETS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
1. Appleton - EGS; Emerson Electric Co., Automation Solutions.
  2. Eaton (Crouse-Hinds).
  3. nVent (Hoffman).
- B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.
- C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
- D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, aluminum, Type FD, with gasketed cover.
- E. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.
- F. NEMA 1 and NEMA 12 Pull and Junction Boxes:
1. Material: Sheet steel, minimum 14 gauge, without knockouts.
  2. Construction: Flanged box, galvanized with continuous weld seams that are ground smooth.
  3. Cover: Gasketed hinged, fastened with quick connect door clamp.
- G. NEMA 4X Pull and Junction Boxes:
1. Material: Type 316 stainless steel, minimum 14 gauge, without knockouts.
  2. Construction: Flanged box, continuous weld seam that are ground smooth.
  3. Cover: Gasketed, hinged, fastened with quick connect door clamp.



- H. NEMA 4X Chemical Area Pull and Junction Boxes: When Drawings classify the area as CORROSIVE, ultraviolet resistant fiberglass reinforced plastic (FRP) with stainless steel hardware and gasketed covers.
- I. NEMA 7/4 Pull and Junction Boxes: When Drawings classify the area for Class I, Division 1, Group D hazardous area, cast aluminum with stainless steel bolts; Type EJB-N4 as manufactured by Crouse-Hinds, or equal.

## 2.5 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

- A. Refer to Section 260543 “Underground Ducts and Raceways for Electrical Systems”.
- B. Refer to Electrical Detail Drawings for Ground Rod Test Well Station Box.

## PART 3 - EXECUTION

### 3.1 RACEWAY APPLICATIONS

- A. Refer to Table 260533-1 for specific raceway application requirements.

Table 260533-1 Raceway Application Guidelines	
Raceway Type	Location / Application
Aluminum Rigid Conduit (ARC)	Used for all indoor and outdoor applications, except where other types are listed.  All exposed, non-corrosive areas. All concealed, non-corrosive areas. Under slabs in slab on grade construction / stub-ups. Flexible connections shall be LFMC.  When installed underground or in contact with concrete, paint with two coats of bitumastic paint.
PVC Schedule 40	Concrete encased duct banks. Embedded in concrete slabs or structures.
PVC Schedule 80	Direct buried. Corrosive areas. Protection of grounding electrode conductors. Protection of lightning conductors Flexible connections shall be LFNC

- B. Minimum Raceway Size: 3/4-inch (21-mm) trade size.

### 3.2 BOX APPLICATIONS

- A. All boxes shall be metallic, unless specified herein or shown on Drawings.
- B. Use cast malleable iron boxes and conduit fittings for exposed switch, receptacle, and lighting outlets.
- C. Use pressed steel boxes for concealed switch, receptacle and lighting outlet.
- D. Pull boxes, junction boxes, cabinets, etc. shall be suitable for location and conform to the NEMA enclosure rating and material description as listed herein and on Drawings.
- E. Where no size is indicated for junction boxes, pull boxes, or terminal cabinets, size in accordance with NEC Article 314.

### 3.3 INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits.
- B. Do not install raceways or electrical items on any "explosion-relief" walls or rotating equipment.
- C. Complete raceway installation before starting conductor installation.
- D. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- E. Arrange conduit system to allow liquids such as water, condensation, etc. will drain away from equipment served. If conduit drainage is not possible, then plug conduits using conduit seals.
- F. Install no more than the equivalent of three 90-degree bends in any conduit run. Support within 12 inches (300 mm) of changes in direction.
- G. Make bends in raceway using large-radius preformed ells. Field bending shall be according to NFPA 70 minimum radii requirements. Use only equipment specifically designed for material and size involved.
- H. Support conduit within 12 inches (300 mm) of enclosures to which attached.
- I. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- J. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.
- K. 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 (35mm) trade size and insulated throat metal bushings on 1-1/2-inch (41-mm) trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits. Install Meyers grounding type hubs when conduits terminate at gasketed enclosures.

- L. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.
- M. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.
- N. Cut conduit perpendicular to the length. For conduits 2-inch (53-mm) trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.
- O. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.
- P. 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.
- Q. 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 using "Duxseal" or seal fitting at the following points:
  - 1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
  - 2. Where an underground service raceway enters a building or structure.
  - 3. Conduit extending from interior to exterior of building.
  - 4. Conduit extending into pressurized duct and equipment.
  - 5. Conduit extending into pressurized zones that are automatically controlled to maintain different pressure set points.
  - 6. Where otherwise required by NFPA 70.
- R. Comply with manufacturer's written instructions for solvent welding RNC and fittings.
- S. Install expansion joint fittings where necessary to compensate for thermal expansion and contraction.
- T. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches (1830 mm) of flexible conduit for equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
  - 1. Use LFMC.
- U. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.
- V. A maximum continuous run of conduit shall not exceed 300 feet and shall be reduced by 75 feet for each 90-degree elbow.

- W. Provide a 4-inch concrete housekeeping pad at all slab and grade penetrations. Provide a 45 degree, 3/4-inch chamfer at all exposed edges.
- X. Protect metallic finish conduit installed in contact with concrete or below grade with two coats of bitumastic paint, heat shrink tubing, or approved equivalent.
- Y. In hazardous locations, seal conduits terminating at boxes enclosing circuit opening equipment at the entrance to the enclosure with approved compound filled sealing fittings to prevent passage of explosive or combustible gases through the conduits. Similarly seal all conduits leading from or entering hazardous locations at points of exit or entrance. Seal exposed conduits passing through hazardous locations at both the entrance to and the exit from the hazardous locations. A sealing compound installation schedule shall be presented to the Engineer for approval. Sign off on each installation and present the compound installation schedule to the Engineer for final sign-off. Each fitting shall be legibly marked with red paint to indicate that the sealing compound has been installed.
- Z. Install conduit sealing and drain fittings in all hazardous (classified) areas designated Class 1, Division 1, and Class 1, Division 2.

### 3.4 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 PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 260533

## SECTION 260543 - UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Duct accessories.
  - 2. Precast concrete handholes.
  - 3. Polymer concrete handholes and boxes with polymer concrete cover.
  - 4. Precast manholes.
- B. Related Requirements
  - 1. Section 260533 "Raceways and Boxes for Electrical Systems" for conduit and fittings.
  - 2. Section 260553 "Identification for Electrical Systems" for underground warning tape.

#### 1.3 DEFINITIONS

- A. Direct Buried: Duct or a duct bank that is buried in the ground, without any additional casing materials such as concrete.
- B. Duct: A single duct or multiple ducts. Duct may be either installed singly or as component of a duct bank.
- C. Duct Bank:
  - 1. Two or more ducts installed in parallel, with or without additional casing materials.
  - 2. Multiple duct banks.
- D. RMC: Rigid metal conduit.
- E. Trafficways: Locations where vehicular or pedestrian traffic is a normal course of events.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include duct-bank materials, including spacers and miscellaneous components.
  - 2. Include accessories for manholes, handholes, and boxes.

B. Shop Drawings:

1. Precast Handholes or Manholes:

- a. Include plans, elevations, sections, details, and accessories.
- b. Include duct entry provisions, including locations and duct sizes.
- c. Include grounding details.
- d. Include dimensioned locations of cable rack inserts, pulling-in and lifting irons, and sumps.

C. Installation Working Drawings: For underground conduit routing.

1. Utilize the Contract AutoCAD drawing for base file.
2. Draw conduits and major pulling points in model space.
3. Draw associated text in paper space at a size not less than 0.1-inch.
4. Provide typewritten conduit schedules for easy cross reference.

1.5 INFORMATIONAL SUBMITTALS

- A. Buoyancy calculations for manholes. Calculations shall be signed and sealed by a qualified professional engineer.
- B. Field quality-control reports.

1.6 FIELD CONDITIONS

- A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions, and then only after arranging to provide temporary electrical service according to requirements indicated:
  1. Notify Owner no fewer than three days in advance of proposed interruption of electrical service.
  2. Do not proceed with interruption of electrical service without Owner's written permission.
- B. Ground Water: Assume ground-water level is at grade level unless a lower water table is noted on Drawings.

PART 2 - PRODUCTS

2.1 CONDUIT AND FITTINGS

- A. Comply with Section 260533 "Raceways and Boxes for Electrical Systems" for conduits and fittings.

## 2.2 DUCT ACCESSORIES

- A. Duct Spacers: Factory-fabricated, rigid, PVC interlocking spacers; sized for type and size of duct with which used, and selected to provide minimum duct spacing indicated while supporting duct during concreting or backfilling.
- B. Underground-Line Warning Tape: Comply with requirements for underground-line warning tape specified in Section 260553 "Identification for Electrical Systems."

## 2.3 PRECAST CONCRETE HANDHOLES AND BOXES

- A. Description: Factory-fabricated, reinforced-concrete, monolithically poured walls and bottom unless open-bottom enclosures are indicated. Frame and cover shall form top of enclosure and shall have load rating consistent with that of handhole or box. Comply with details shown on Drawings.
- B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - 1. Oldcastle Precast, Inc.
- C. Comply with ASTM C 858 for design and manufacturing processes.
- D. Joint Sealant: Asphaltic-butyl material with adhesion, cohesion, flexibility, and durability properties necessary to withstand maximum hydrostatic pressures at the installation location with the ground-water level at grade.
- E. Handholes 12 inches wide by 24 inches long and larger shall have inserts for cable racks and pulling-in irons installed before concrete is poured.

## 2.4 POLYMER CONCRETE HANDHOLES AND BOXES WITH POLYMER CONCRETE COVER

- A. Description: Molded of sand and aggregate, bound together with a polymer resin, and reinforced with steel or fiberglass or a combination of the two.
- B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - 1. Oldcastle Enclosure Solutions.
  - 2. Quazite; Hubbell Incorporated, Power Systems.
- C. Standard: Comply with SCTE 77. Comply with tier requirements in "Underground Enclosure Application" Article.
- D. Color: Green.
- E. Configuration: Units shall be designed for flush burial and have open bottom unless otherwise indicated.

- F. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
- G. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
- H. Cover Legend: Molded lettering, "ELECTRIC." or as indicated for each service.
- I. Handholes 12 inches wide by 24 inches long and larger shall have factory-installed inserts for cable racks and pulling-in irons.

## 2.5 PRECAST MANHOLES

- A. Description: One-piece units and units with interlocking mating sections, complete with accessories, hardware, and features.
- B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - 1. Oldcastle Precast, Inc.
- C. Comply with ASTM C 858.
- D. Structural Design Loading: Comply with requirements in "Underground Enclosure Application" Article.
- E. Ground Rod Sleeve: Provide a 3-inch PVC sleeve in manhole floors 2 inches from the wall adjacent to, but not underneath, the duct entering the structure.
- F. Joint Sealant: Asphaltic-butyl material with adhesion, cohesion, flexibility, and durability properties necessary to withstand maximum hydrostatic pressures at the installation location with the ground-water level at grade.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Coordinate layout and installation of duct, duct bank, manholes, handholes, and boxes with final arrangement of other utilities, site grading, and surface features as determined in the field. Notify Engineer if there is a conflict between areas of excavation and existing structures or archaeological sites to remain.
- B. Coordinate elevations of duct and duct-bank entrances into manholes, handholes, and boxes with final locations and profiles of duct and duct banks, as determined by coordination with other utilities, underground obstructions, and surface features. Revise locations and elevations as required to suit field conditions and to ensure that duct and duct bank will drain to manholes and handholes, and as approved by Engineer.



- C. Clear and grub vegetation to be removed, and protect vegetation to remain according to Section 311000 "Site Clearing." Remove and stockpile topsoil for reapplication according to Section 311000 "Site Clearing."

### 3.2 UNDERGROUND DUCT APPLICATION

- A. Direct Buried Duct: Type EPC-80-PVC rigid non-metallic conduit, with long radius sweep elbows.
- B. Concrete Encased Duct: Type EPC-40-PVC rigid non-metallic conduit, with long radius sweep elbows.
- C. Elbows: Same material as conduit, unless installation application noted elsewhere requires different material.
- D. Rigid Metal Conduit (RMC) type in accordance with Section 260533, "Raceways and Boxes for Electrical Systems" with two coats of bitumastic paint or PVC coated where:
  - 1. Direct buried conduit enters buildings, structures, and vaults (except manholes and handholes) – not less than a 10-foot length of conduit.
  - 2. Direct buried conduits run below floor slabs in slab-on-grade construction.
  - 3. Stub-ups outdoors or through concrete slabs.

### 3.3 EARTHWORK

- A. Excavation and Backfill: Comply with Section 312000 "Earthwork," but do not use heavy-duty, hydraulic-operated, compaction equipment.
- B. Restoration: Replace area immediately after backfilling is completed or after construction vehicle traffic in immediate area is complete.
- C. Restore surface features at areas disturbed by excavation and re-establish original grades unless otherwise indicated. Replace removed sod immediately after backfilling is completed.
- D. Restore areas disturbed by trenching, storing of dirt, cable laying, and other work. Restore vegetation and include necessary topsoiling, fertilizing, liming, seeding, sodding, sprigging, and mulching. Comply with Section 329200 "Turf and Grasses" and Section 329300 "Plants."
- E. Cut and patch existing pavement in the path of underground duct, duct bank, and underground structures according to "Cutting and Patching" Article in Section 017300 "Execution."

### 3.4 DUCT AND DUCT-BANK INSTALLATION

- A. Where indicated on Drawings, install duct, spacers, and accessories into the duct-bank configuration shown. Duct installation requirements in this Section also apply to duct bank.
- B. Install duct according to NEMA TCB 2.

- C. Separate underground copper signal conduits (instrumentation and telecommunication) from power conduits by a minimum of 12 inches unless noted otherwise. Keep crossing of these conduits to a minimum; cross at 90 degree angles.
- D. Slope: Pitch duct a minimum slope of 1:300 down toward manholes and handholes and away from buildings and equipment. Slope duct from a high point between two manholes, to drain in both directions.
- E. Curves and Bends: Use 5-degree angle couplings for small changes in direction. Use manufactured long sweep bends both horizontally and vertically, at other locations unless otherwise indicated.
  - 1. Duct shall have maximum of two 90-degree bends or the total of all bends shall be no more 180 degrees between pull points.
- F. Joints: Use solvent-cemented joints in duct and fittings and make watertight according to manufacturer's written instructions. Stagger couplings so those of adjacent duct do not lie in same plane.
- G. Building Wall Penetrations: Make a transition from underground duct to RMC at least 10 feet outside the building wall, without reducing duct line slope away from the building and without forming a trap in the line. Use fittings manufactured for RNC-to-RMC transition. Install RMC penetrations of building walls as specified in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."
- H. Sealing: Provide temporary closure at terminations of duct with pulled cables. Seal spare duct at terminations. Use sealing compound and plugs to withstand at least 15-psig hydrostatic pressure.
- I. Pulling Cord: Install 200-lbf- test nylon cord in empty ducts.
- J. Concrete-Encased Ducts and Duct Bank:
  - 1. Excavate trench bottom to provide firm and uniform support for duct. Prepare trench bottoms as specified in Section 312000 "Earthwork" for pipes less than 6 inches in nominal diameter.
  - 2. Depth: Install so top of duct envelope is as shown on detail Drawing.
  - 3. Support duct on duct spacers coordinated with duct size, duct spacing, and outdoor temperature.
  - 4. Spacer Installation: Place spacers close enough to prevent sagging and deforming of duct, with not less than four spacers per 20 feet of duct. Place spacers within 24 inches of duct ends. Stagger spacers approximately 6 inches between tiers. Secure spacers to earth and to duct to prevent floating during concreting. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.
  - 5. Minimum Space between Duct: 3 inches between edge of duct and exterior envelope wall, 2 inches between ducts for like services, and 4 inches between power and communications ducts, unless shown otherwise on Drawings.
  - 6. Elbows: Use manufactured duct elbows for stub-ups, at building entrances, and at changes of direction in duct unless otherwise indicated. Extend encasement throughout length of elbow.

7. Elbows: Use manufactured RMC elbows for stub-ups, at building entrances, and at changes of direction in duct run.
  - a. Couple RNC duct to RMC with adapters designed for this purpose, and encase coupling with 3 inches of concrete.
  - b. Stub-ups to Outdoor Equipment: Extend concrete-encased RMC horizontally a minimum of 60 inches from edge of base. Install insulated grounding bushings on terminations at equipment.
    - 1) Stub-ups shall be minimum 4 inches above finished floor and minimum 3 inches from conduit side to edge of slab
  - c. Stub-ups to Indoor Equipment: Extend concrete-encased RMC horizontally a minimum of 60 inches from edge of wall. Install insulated grounding bushings on terminations at equipment.
    - 1) Stub-ups shall be minimum 4 inches above finished floor and no less than 3 inches from conduit side to edge of slab
8. Reinforcement: Reinforce concrete-encased duct where crossing disturbed earth and where indicated. Arrange reinforcing rods and ties without forming conductive or magnetic loops around ducts or duct groups.
9. Forms: Use walls of trench to form side walls of duct bank where soil is self-supporting and concrete envelope can be poured without soil inclusions; otherwise, use forms.
10. Concrete Cover: Install a minimum of 3 inches of concrete cover between edge of duct to exterior envelope wall, 2 inches between duct of like services, and 4 inches between power and communications ducts.
11. Concreting Sequence: Pour each run of envelope between manholes or other terminations in one continuous operation.
  - a. Start at one end and finish at the other, allowing for expansion and contraction of duct as its temperature changes during and after the pour. Use expansion fittings installed according to manufacturer's written instructions, or use other specific measures to prevent expansion-contraction damage.
  - b. If more than one pour is necessary, terminate each pour in a vertical plane and install 3/4-inch reinforcing-rod dowels extending a minimum of 18 inches into concrete on both sides of joint near corners of envelope.
12. Pouring Concrete: Comply with requirements in "Concrete Placement" Article in Section 033000 "Cast-in-Place Concrete." Place concrete carefully during pours to prevent voids under and between duct and at exterior surface of envelope. Do not allow a heavy mass of concrete to fall directly onto ducts. Allow concrete to flow around duct and rise up in middle, uniformly filling all open spaces. Do not use power-driven agitating equipment unless specifically designed for duct-installation application.

K. Direct-Buried Duct and Duct Bank:

1. Excavate trench bottom to provide firm and uniform support for duct. Comply with requirements in Section 312000 "Earthwork" for preparation of trench bottoms for pipes less than 6 inches in nominal diameter.
2. Width: Excavate trench 12 inches wider than duct on each side.

3. Width: Excavate trench 3 inches wider than duct on each side.
4. Depth: Install top of duct as shown on detail Drawing.
5. Support ducts on duct spacers coordinated with duct size, duct spacing, and outdoor temperature.
6. Spacer Installation: Place spacers close enough to prevent sagging and deforming of duct, with not less than four spacers per 20 feet of duct. Place spacers within 24 inches of duct ends. Stagger spacers approximately 6 inches between tiers. Secure spacers to earth and to ducts to prevent floating during concreting. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.
7. Install duct with a minimum of 3 inches between ducts for like services and 6 inches between power and communications duct, unless shown otherwise on Drawings.
8. Elbows: Install manufactured duct elbows for stub-ups, at building entrances, and at changes of direction in duct direction unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.
9. Install manufactured RMC elbows for stub-ups, at building entrances, and at changes of direction in duct.
  - a. Couple RNC duct to RMC with adapters designed for this purpose, and encase coupling with 3 inches of concrete.
  - b. Stub-ups to Outdoor Equipment: Extend concrete-encased RMC horizontally a minimum of 60 inches from edge of base. Install insulated grounding bushings on terminations at equipment.
    - 1) Stub-ups shall be minimum 4 inches above finished floor and minimum 3 inches from conduit side to edge of slab
  - c. Stub-ups to Indoor Equipment: Extend concrete-encased GRC horizontally a minimum of 60 inches from edge of wall. Install insulated grounding bushings on terminations at equipment.
    - 1) Stub-ups shall be minimum 4 inches above finished floor and no less than 3 inches from conduit side to edge of slab
10. After installing first tier of duct, backfill and compact. Start at tie-in point and work toward end of duct run, leaving ducts at end of run free to move with expansion and contraction as temperature changes during this process. Repeat procedure after placing each tier. After placing last tier, hand place backfill to 4 inches over duct and hand tamp. Firmly tamp backfill around ducts to provide maximum supporting strength. Use hand tamper only. After placing controlled backfill over final tier, make final duct connections at end of run and complete backfilling with normal compaction. Comply with requirements in Section 312000 "Earthwork" for installation of backfill materials.
  - a. Place minimum 3 inches of sand as a bed for duct. Place sand to a minimum of 6 inches above top level of duct.
  - b. Place minimum 6 inches of engineered fill above concrete encasement of duct.
- L. Underground-Line Warning Tape: Bury underground line specified in Section 260553 "Identification for Electrical Systems" above all concrete-encased duct and direct buried conduits (ducts) as shown on detail Drawings. Align tape parallel to and within 3 inches of

centerline of duct bank. Provide an additional warning tape for each 12-inch increment of duct-bank width over a nominal 18 inches. Space additional tapes 12 inches apart, horizontally.

### 3.5 INSTALLATION OF CONCRETE MANHOLES, HANDHOLES, AND BOXES

#### A. Precast Concrete Handhole and Manhole Installation:

1. Comply with ASTM C 891 unless otherwise indicated.
2. Install units level and plumb and with orientation and depth coordinated with connecting duct, to minimize bends and deflections required for proper entrances.
3. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.

#### B. Elevations:

1. Manhole Roof: Install with rooftop at least 15 inches below finished grade.
2. Manhole Frame: In paved areas and trafficways, set frames flush with finished grade. Set other manhole frames 1 inch above finished grade.
3. Handhole Covers: In paved areas and trafficways, set surface flush with finished grade. Set covers of other handholes 1 inch above finished grade.
4. Where indicated, cast handhole cover frame integrally with handhole structure.

#### C. Drainage: Install drains in bottom of manholes where indicated. Coordinate with drainage provisions indicated.

#### D. Manhole Access: Circular opening in manhole roof; sized to match cover size.

1. Manholes with Fixed Ladders: Offset access opening from manhole centerlines to align with ladder.
2. Install chimney, constructed of precast concrete collars and rings, to support cast-iron frame to connect cover with manhole roof opening. Provide moisture-tight masonry joints and waterproof grouting for frame to chimney.

#### E. Dampproofing: Apply dampproofing to exterior surfaces of manholes and handholes after concrete has cured at least three days. Dampproofing materials and installation are specified in Section 071113 "Bituminous Dampproofing." After ducts are connected and grouted, and before backfilling, dampproof joints and connections, and touch up abrasions and scars. Dampproof exterior of manhole chimneys after mortar has cured at least three days.

#### F. Hardware: Install removable hardware, including pulling eyes, cable stanchions, and cable arms, and insulators, as required for installation and support of cables and conductors and as indicated.

#### G. Fixed Manhole Ladders: Arrange to provide for safe entry with maximum clearance from cables and other items in manholes.

#### H. Field-Installed Bolting Anchors in Manholes and Concrete Handholes: Do not drill deeper than 3-7/8 inches for manholes and 2 inches for handholes, for anchor bolts installed in the field. Use a minimum of two anchors for each cable stanchion.

### 3.6 INSTALLATION OF HANDHOLES AND BOXES OTHER THAN PRECAST CONCRETE

- A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting duct, to minimize bends and deflections required for proper entrances. Use box extension if required to match depths of duct, and seal joint between box and extension as recommended by manufacturer.
- B. Unless otherwise indicated, support units on a 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.
- C. Elevation: In paved areas and trafficways, set cover flush with finished grade. Set covers of other handholes 1 inch above finished grade.
- D. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in enclosure.
- E. Field cut openings for duct 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.

### 3.7 GROUNDING

- A. Ground underground ducts and utility structures according to Section 260526 "Grounding and Bonding for Electrical Systems."

### 3.8 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
  - 1. Demonstrate capability and compliance with requirements on completion of installation of underground duct, duct bank, and utility structures.
  - 2. Pull solid aluminum or wood test mandrel through duct to prove joint integrity and adequate bend radii, and test for out-of-round duct. Provide a minimum 12-inch- long mandrel equal to duct size minus 1/4 inch. If obstructions are indicated, remove obstructions and retest.
  - 3. Test manhole and handhole grounding to ensure electrical continuity of grounding and bonding connections. Measure and report ground resistance as specified in Section 260526 "Grounding and Bonding for Electrical Systems."
- B. Correct deficiencies and retest as specified above to demonstrate compliance.
- C. Prepare test and inspection reports.

### 3.9 CLEANING

- A. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of duct until duct cleaner indicates that duct is clear of dirt and debris. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.
- B. Clean internal surfaces of manholes, including sump.
  - 1. Sweep floor, removing dirt and debris.
  - 2. Remove foreign material.

END OF SECTION 260543

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## SECTION 260544 - SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

### 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. Sleeves for raceway and cable penetration of non-fire-rated construction walls and floors.
  - 2. Sleeve-seal systems.
  - 3. Sleeve-seal fittings.
  - 4. Grout.
  - 5. Silicone sealants.
- B. Not all components specified in this Section are necessarily utilized on this project.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product used on the project.

### PART 2 - PRODUCTS

#### 2.1 SLEEVES

- A. Wall Sleeves for Penetrations Through Exterior Walls Above and Below Grade: 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.
- C. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.
- D. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.
- E. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

F. Sleeves for Rectangular Openings:

1. Material: Galvanized sheet steel.
2. Minimum Metal Thickness:
  - a. For sleeve cross-section rectangle perimeter less than 50 inches and with no side larger than 16 inches, thickness shall be 0.052 inch.
  - b. For sleeve cross-section rectangle perimeter 50 inches or more and one or more sides larger than 16 inches, thickness shall be 0.138 inch.

2.2 SLEEVE-SEAL SYSTEMS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
1. Sealing Elements: EPDM rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
  2. Pressure Plates: Stainless steel.
  3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

2.3 SLEEVE-SEAL FITTINGS

- A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit shall have plastic or rubber waterstop collar with center opening to match piping OD.

2.4 GROUT

- A. Description: Nonshrink; 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.

2.5 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.

- B. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

## PART 3 - EXECUTION

### 3.1 GENERAL

- A. Comply with details shown on Contract Drawings.

### 3.2 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

- A. Comply with NECA 1.
- B. Comply with NEMA VE 2 for cable tray and cable penetrations.
- C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:
  - 1. Interior Penetrations of Non-Fire-Rated Walls and Floors:
    - a. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 079200 "Joint Sealants."
    - b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.
  - 2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
  - 3. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable unless sleeve seal is to be installed or unless seismic criteria require different clearance.
  - 4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
- D. Sleeves for Conduits Penetrating Non-Fire-Rated 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.
- E. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- F. Aboveground, Exterior-Wall Penetrations: Seal penetrations using [steel] [cast-iron] 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.

- G. 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-SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.
- B. 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 that cause sealing elements to expand and make watertight seal.

### 3.4 SLEEVE-SEAL-FITTING INSTALLATION

- A. Install sleeve-seal fittings in new walls and slabs as they are constructed.
- B. 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.
- C. Secure nailing flanges to concrete forms.
- D. Using grout, seal the space around outside of sleeve-seal fittings.

END OF SECTION 260544

## SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:

1. Color and legend requirements for raceways, conductors, and warning labels and signs.
2. Labels.
3. Bands and tubes.
4. Tapes and stencils.
5. Tags.
6. Signs.
7. Cable ties.
8. Paint for identification.
9. Fasteners for labels and signs.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product used on this project. Note that not all products listed may be used on this project.
  1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for electrical identification products.
- B. Delegated-Design Submittal: For arc-flash hazard study.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Comply with ASME A13.1 and IEEE C2.
- B. Comply with NFPA 70.
- C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.
- D. Comply with ANSI Z535.4 for safety signs and labels.

- E. Comply with NFPA 70E and Section 260573.19 "Arc-Flash Hazard Analysis" requirements for arc-flash warning labels.
- F. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.
- G. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
  - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

## 2.2 COLOR AND LEGEND REQUIREMENTS

- A. Color-Coding for Identification, 600 V or Less: Use colors listed below for conductors.
  - 1. Color shall be factory applied or field applied for sizes larger than No. 8 AWG if authorities having jurisdiction permit.
  - 2. Colors for 208/120-V Circuits:
    - a. Phase A: Black.
    - b. Phase B: Red.
    - c. Phase C: Blue.
    - d. Neutral: White.
  - 3. Colors for 240/120-V Circuits (Single Phase):
    - a. Phase A: Black.
    - b. Phase B: Red.
    - c. Neutral: White.
  - 4. Colors for 240 $\Delta$ /120-V Circuits (Three Phase, Four Wire, high leg, center tap):
    - a. Phase A: Black.
    - b. Phase B: Orange (high leg).
    - c. Phase C: Blue
    - d. Neutral: White.
  - 5. Colors for 480/277-V Circuits:
    - a. Phase A: Brown.
    - b. Phase B: Orange.
    - c. Phase C: Yellow.
    - d. Neutral: Gray.
  - 6. Color for Equipment Grounds: Green.
  - 7. Colors for Isolated Grounds: Green with two or more yellow stripes.
- B. Warning Label Colors:
  - 1. Identify system voltage with black letters on an orange background.

- C. Warning labels and signs shall include, but are not limited to, the following legends:
1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
  2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."
- D. Equipment Identification and Source Nameplates:
1. Black letters on a white field.
  2. Engraved, laminated plastic, not less than 1/16-inch thick by 3/4-inch by 2-1/2-inch with 3/16-inch high lettering.
  3. Provide for all electrical equipment furnished under Divisions 26, 27, 28 and all equipment control panels furnished under other Divisions. Equipment includes but is not limited to switchgear, switchboards, motor control centers, panelboards, transformers, disconnect switches, separately mounted motor controllers, transfer switches, control panels, control stations, named terminal cabinets, etc. Correspond identification designation of the equipment with Drawings.
  4. Include power source information, i.e. "FED FROM MCC-2", as part of identification nameplate or provide a separate nameplate.
- E. Device Identification Labels:
1. Black letters on a white field or clear field.
  2. Labels shall be self-adhesive type and machine generated with 1/4-inch high letters.
  3. Provide for all receptacles, wall switches, lighting fixtures, photo cells, emergency lights, exit lights, instruments, etc. shall be identified with the panel and circuit to which it is connected.
  4. Label to include the source panelboard and branch circuit number, i.e. "LP-2/4" or "LP-2 #4" to indicate panelboard LP-2, branch circuit number 4.

## 2.3 LABELS

- A. Vinyl Wraparound Labels: Preprinted, flexible labels laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing label ends.
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. Brady Corporation.
    - b. Panduit Corp.
- B. Snap-around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeves, with diameters sized to suit diameters and that stay in place by gripping action.
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. Brady Corporation.
  - b. Panduit Corp.
- C. Self-Adhesive Wraparound Labels: Preprinted, 3-mil- thick, polyester vinyl flexible label with acrylic pressure-sensitive adhesive.
  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. Brady Corporation.
    - b. Brother International Corporation.
    - c. Panduit Corp.
  2. Self-Lamination: Clear; UV-, weather- and chemical-resistant; self-laminating, protective shield over the legend. Labels sized such that the clear shield overlaps the entire printed legend.
  3. Marker for Labels: Machine-printed, permanent, waterproof, black ink recommended by printer manufacturer.
- D. Self-Adhesive Labels: Polyester Vinyl, thermal, transfer-printed, 3-mil- thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for intended use and location.
  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. Brady Corporation.
    - b. Brother International Corporation.
    - c. Panduit Corp.
  2. Minimum Nominal Size:
    - a. 3-1/2 by 5 inches for equipment.
    - b. As required by Section 260573 "Power System Studies".

## 2.4 BANDS AND TUBES

- A. Snap-around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeves, 2 inches long, with diameters sized to suit diameters and that stay in place by gripping action.
  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. Brady Corporation.
    - b. Panduit Corp.



- B. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tubes with machine-printed identification labels, sized to suit diameter and shrunk to fit firmly. Full shrink recovery occurs at a maximum of 200 deg F. Comply with UL 224.
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. Brady Corporation.
    - b. Panduit Corp.

## 2.5 TAPES AND STENCILS

- A. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.
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. Ideal Industries, Inc.
    - b. Panduit Corp.
- B. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; not less than 3 mils thick by 1 to 2 inches wide; compounded for outdoor use.
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. Brady Corporation.
- C. Tape and Stencil: 4-inch- wide black stripes on 10-inch centers placed diagonally over orange background and are 12 inches wide. Stop stripes at legends.
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. Seton Identification Products; a Brady Corporation company.
- D. Floor Marking Tape: 2-inch- wide, 5-mil pressure-sensitive vinyl tape, with yellow and black stripes and clear vinyl overlay.
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. Seton Identification Products; a Brady Corporation company.

E. Underground-Line Warning Tape:

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. Brady Corporation.
  - b. Ideal Industries, Inc.
  - c. Seton Identification Products; a Brady Corporation company.
2. Tape:
  - a. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines by either conductive or inductive location techniques.
  - b. Printing on tape shall be permanent and shall not be damaged by burial operations.
  - c. Tape material and ink shall be chemically inert and not subject to degradation when exposed to acids, alkalis, and other destructive substances commonly found in soils.
3. Color and Printing:
  - a. Comply with ANSI Z535.1, ANSI Z535.2, ANSI Z535.3, ANSI Z535.4, and ANSI Z535.5.
  - b. Inscriptions for Red-Colored Tapes: "ELECTRIC LINE, HIGH VOLTAGE".
  - c. Inscriptions for Orange-Colored Tapes: "TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE" as applicable.
4. Standard Detectable Tape:
  - a. Detectable three-layer laminate, consisting of a printed pigmented polyolefin film, a solid aluminum-foil core, and a clear protective film that allows inspection of the continuity of the conductive core; bright colored, compounded for direct-burial service.
  - b. Width: 6 inches.
  - c. Overall Thickness: 5 mils.
  - d. Foil Core Thickness: 0.35 mil.

- F. Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height shall be 1 inch.

2.6 TAGS

- A. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch, with stamped legend, punched for use with self-locking cable tie fastener.
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. Brady Corporation.
- B. Nonmetallic Preprinted Tags: Polyethylene tags, 0.023 inch thick, color-coded for phase and voltage level, with factory printed permanent designations; punched for use with self-locking cable tie fastener.
  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. Brady Corporation.
    - b. Panduit Corp.
- C. Write-on Tags:
  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. Seton Identification Products; a Brady Corporation company.
  2. Polyester Tags: 0.015 inch thick, with corrosion-resistant grommet and cable tie for attachment.
  3. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

## 2.7 SIGNS

- A. Baked-Enamel Signs:
  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. Marking Services, Inc.
  2. Preprinted aluminum signs, high-intensity reflective, punched or drilled for fasteners, with colors, legend, and size required for application.
  3. 1/4-inch grommets in corners for mounting.
  4. Nominal Size: 7 by 10 inches.
- B. Metal-Backed Butyrate Signs:
  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. Brady Corporation.
    - b. Marking Services, Inc.

2. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs, with 0.0396-inch galvanized-steel backing, punched and drilled for fasteners, and with colors, legend, and size required for application.
3. 1/4-inch grommets in corners for mounting.
4. Nominal Size: 10 by 14 inches.

C. Laminated Acrylic or Melamine Plastic Signs (Nameplates):

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. Brady Corporation.
  - b. Marking Services, Inc.
2. Engraved legend.
3. Thickness:
  - a. For signs up to 20 sq. in., minimum 1/16 inch thick.
  - b. For signs larger than 20 sq. in., 1/8 inch thick.
  - c. Engraved legend with black letters on white face.
  - d. Punched or drilled for mechanical fasteners with 1/4-inch grommets in corners for mounting as applicable.
  - e. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.8 CABLE TIES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  1. Ideal Industries, Inc.
  2. Panduit Corp.
- B. 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 Deg F according to ASTM D638: 12,000 psi.
  3. Temperature Range: Minus 40 to plus 185 deg F.
  4. Color: Black.

2.9 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Retain paint system applicable for surface material and location (exterior or interior).

- B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

### 3.2 INSTALLATION

- A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.
- B. Install identifying devices before installing acoustical ceilings and similar concealment.
- C. Verify identity of each item before installing identification products.
- D. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.
- E. Apply identification devices to surfaces that require finish after completing finish work.
- F. Install signs and nameplates with approved legend to facilitate proper identification, operation, and maintenance of electrical systems and connected items.
- G. Vinyl Wraparound Labels:
  - 1. Secure tight to surface of raceway or cable at a location with high visibility and accessibility.
  - 2. Attach labels that are not self-adhesive type with clear vinyl tape, with adhesive appropriate to the location and substrate.
- H. Snap-around Labels: Secure tight to surface at a location with high visibility and accessibility.
- I. Self-Adhesive Wraparound Labels: Secure tight to surface at a location with high visibility and accessibility.
- J. Self-Adhesive Labels:
  - 1. On each item, install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual.
  - 2. Unless otherwise indicated, provide a single line of text with 1/2-inch- high letters on 1-1/2-inch- high label; where two lines of text are required, use labels 2 inches high.

- K. Snap-around Color-Coding Bands: Secure tight to surface at a location with high visibility and accessibility.
- L. Heat-Shrink, Preprinted Tubes: Secure tight to surface at a location with high visibility and accessibility.
- M. Marker Tapes: Secure tight to surface at a location with high visibility and accessibility.
- N. Self-Adhesive Vinyl Tape: Secure tight to surface at a location with high visibility and accessibility.
  - 1. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding.
- O. Tape and Stencil: Comply with requirements in painting Sections for surface preparation and paint application.
- P. Floor Marking Tape: Apply stripes to finished surfaces following manufacturer's written instructions.
- Q. Underground Line Warning Tape:
  - 1. During backfilling of trenches, install continuous underground-line warning tape directly above cable or raceway at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench exceeds 16 inches overall.
  - 2. Install underground-line warning tape for direct-buried cables and cables in raceways.
- R. Metal Tags:
  - 1. Place in a location with high visibility and accessibility.
  - 2. Secure using UV-stabilized cable ties.
- S. Nonmetallic Preprinted Tags:
  - 1. Place in a location with high visibility and accessibility.
  - 2. Secure using UV-stabilized cable ties.
- T. Write-on Tags:
  - 1. Place in a location with high visibility and accessibility.
  - 2. Secure using UV-stabilized cable ties.
- U. Baked-Enamel Signs:
  - 1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
  - 2. 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.

V. Metal-Backed Butyrate Signs:

1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
2. Unless otherwise indicated, provide a single line of text with 1/2-inch- high letters on 1-1/2-inch- high sign; where two lines of text are required, use labels 2 inches high.

W. Laminated Acrylic or Melamine Plastic Signs:

1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
2. Unless otherwise indicated, provide a single line of text with 1/2-inch- high letters on 1-1/2-inch- high sign; where two lines of text are required, use labels 2 inches high.

X. Cable Ties: General purpose, for attaching tags, except as listed below:

1. Outdoors: UV-stabilized nylon.
2. In Spaces Handling Environmental Air: Plenum rated.

Y. Equipment Nameplates:

1. Nameplates shall be screw mounted to NEMA 1 enclosures.
2. Nameplates shall be bonded to all other enclosure types using an epoxy or similar waterproof adhesive.

### 3.3 IDENTIFICATION SCHEDULE

- A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.
- B. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations of high visibility. Identify by system and circuit designation.
- C. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use vinyl wraparound labels to identify the phase.
- D. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use self-adhesive labels with the conductor or cable designation, origin, and destination.
- E. Control-Circuit Conductor Termination Identification: For identification at terminations, provide self-adhesive labels with the conductor designation.
- F. Conductors to Be Extended in the Future: Attach write-on tags to conductors.
- G. Locations of Underground Lines: Underground-line warning tape for power, lighting, communication, and control wiring and optical-fiber cable.
- H. Instructional Signs: Self-adhesive labels, including the color code for grounded and ungrounded conductors.

- I. Arc Flash Warning Labeling: Self-adhesive labels.
- J. Operating Instruction Signs: Laminated acrylic or melamine plastic signs.
- K. Emergency Operating Instruction Signs: Laminated acrylic or melamine plastic signs with white legend on a red background with minimum 3/8-inch- high letters for emergency instructions at equipment used for power transfer.
- L. Equipment Identification Labels: Plastic (phenolic type) nameplates. Conform nameplate information with previous Article, "COLOR AND LEGEND REQUIREMENTS".
- M. Device Identification: Self-adhesive labels. Label devices in conformance with previous Article, "COLOR AND LEGEND REQUIREMENTS".
- N. Junction and Pull Box Voltage Identification: Sign/nameplate with white legend on a red background with minimum 1-inch high letters. Identify operating voltage, i.e. 480 Volts.
- O. Panelboard Identification
  - 1. Provide equipment identification nameplates as previously described.
  - 2. Label branch circuit phase and neutral wires with associated pole number using vinyl cloth wrap around labels.
  - 3. Install typed as built circuit directories giving location and nature of load served.

END OF SECTION 260553



## SECTION 260573 - POWER SYSTEM STUDIES

### 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 a computer-based study for:
  - 1. Short circuit report.
  - 2. Protective device coordination report.
  - 3. Motor starting report.
  - 4. Arc flash report.
  - 5. Harmonic analysis report.
- B. Study encompasses the power distribution system of the JEA Rivertown Water Treatment Plant. Facility is located at 7612 Longleaf Pine Parkway in St. Johns County, Florida.
- C. Study includes the electric utility company's protective devices, emergency generators, service entrance equipment and distribution to 208/120V panelboards. All power distribution to that point whether existing or new is included. Equipment included, but not limited to:
  - 1. Substations and distribution.
  - 2. Switchgear, switchboards, and panelboards.
  - 3. Motor control centers.
  - 4. Variable frequency controllers.
  - 5. Disconnect switches.
  - 6. Transfer switches.
  - 7. 480V control panels.
  - 8. 208/120V panelboards.
- D. The local electric utility is Florida Power & Light (FPL). **Power company telephone number is (386) 329-5158.**
- E. Obtain all data necessary to perform the study. Data included, but not limited to:
  - 1. Up to date one-line diagrams.
  - 2. Equipment data.
  - 3. Cable sizes and lengths.
  - 4. Existing protective device settings.
  - 5. Electric utility information: available fault current, protective device equipment information and settings, X/R ratios, transformer impedances and ratings.

### 1.3 DEFINITIONS

- A. Boundary, Arc Flash: When an arc flash hazard exists, an approach limit from an arc source at which the incident energy equals  $1.2 \text{ cal/cm}^2$  ( $5 \text{ J/cm}^2$ ).
- B. Boundary, Limited Approach: An approach limit at a distance from an exposed energized electrical conductor or circuit part within which a shock hazard exists.
- C. Boundary, Restricted Approach: An approach limit at a distance from an exposed energized electrical conductor or circuit part within which there is an increased likelihood of electric shock, due to electrical arc-over combined with inadvertent movement.
- D. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed and salvaged, or removed and reinstalled. Existing to remain items shall remain functional throughout the construction period.
- E. Field Adjusting Agency: An independent electrical testing agency with full-time employees and the capability to adjust devices and conduct testing indicated and that is a member company of NETA.
- F. One-Line Diagram: A diagram that shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.
- G. Power System Analysis Software Developer: An entity that commercially develops, maintains, and distributes computer software used for power system studies.
- H. Power Systems Analysis Specialist: Professional engineer in charge of performing the study and documenting recommendations, licensed in the state where Project is located.
- I. Preliminary Short Circuit Report: Report that includes the maximum available utility fault current, proposed equipment, and existing equipment to determine if new equipment may be released for manufacturing and existing equipment is adequate for the calculated short circuit levels.
- J. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion of the circuit from the system.
- K. SCCR: Short-circuit current rating.
- L. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.
- M. Single-Line Diagram: See "One-Line Diagram."
- N. Supplier: The person, firm or corporation identified as such to provide the power system study and means the Supplier or its authorized agent. See also Power Systems Analysis Specialist.

#### 1.4 ACTION SUBMITTALS

- A. Supplier qualifications per Quality Assurance paragraph. Submit prior to starting study. Include the following:
  - 1. Brief description of each qualifying study.
  - 2. Name of owner of installation on which study was performed with address, telephone number, and contact person.
  - 3. Date of study.
  - 4. Any other information indicating the firm's experiences and ability to perform the work and business status.
- B. Preliminary Power System Study Report. Report must be approved prior to release for manufacture of major electrical equipment including but not limited to switchgear, switchboards, distribution panels, and motor control centers. Fault data from the utility must be included and not assumed or submittal will be rejected.
- C. Final Power System Study Report. Report must be approved prior to energization of new major electrical equipment. Revise study as required for changes during construction.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data:
  - 1. For Power Systems Analysis Software Developer.
  - 2. For Power System Analysis Specialist.
  - 3. For Field Adjusting Agency.
- B. If requested, Product Certificates: For power system study software, certifying compliance with IEEE 399, IEEE 1584 and NFPA 70E.
- C. Field quality-control reports.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Final power system study updated with any changes made after equipment start-up.
- B. Digital computer files with full read-write access of the complete power system model and library.

#### 1.7 QUALITY ASSURANCE

- A. Perform Study using commercially developed and distributed software designed specifically for power system analysis.
- B. Software algorithms shall comply with requirements of standards and guides specified in this Section.
- C. Manual calculations are unacceptable.

D. Power System Analysis Software Qualifications:

1. Design computer program to perform short-circuit studies or have a function, component, or add-on module designed to perform short-circuit studies.
2. Develop computer program under the charge of a licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.
3. Complies with IEEE 399, IEEE 141, IEEE 242, IEEE 519, IEEE 1015, and IEEE 1584 as applicable to the project scope.

E. Power Systems Analysis Specialist Qualifications: Professional engineer licensed in the state where Project is located and has regularly engaged in this electrical engineering study specialty for minimum of five years and has performed at least three projects of similar complexity to this project within the last three years. Perform all elements of the study under the direct supervision and control of this professional engineer. Specialist shall be professionally independent of the manufacturers, suppliers, and installers of the equipment under evaluation.

F. Power System Study Certification: Report shall be signed and sealed by Power Systems Analysis Specialist.

G. Field Adjusting Agency Qualifications:

1. Employer of a NETA ETT-Certified Technician Level III or NICET Electrical Power Testing Level III certification responsible for all field adjusting of the Work.
2. A member company of NETA.
3. Acceptable to authorities having jurisdiction.

## PART 2 - PRODUCTS

### 2.1 POWER SYSTEM ANALYSIS SOFTWARE DEVELOPERS

A. Acceptable Software:

1. SKM System Analysis, Inc.: Power\*Tools
2. Operation Technology, Inc.: ETAP (Electrical Transient Analyzer Program)
3. EasyPower, Inc.: EasyPower
4. Or equal.

### 2.2 POWER SYSTEM STUDY REPORT GENERAL REQUIREMENTS

- A. Except for one-line diagrams, standard 8 ½-in by 11-in pages, with total pages numbered.
- B. Electronic PDF format copy with electronic bookmarks for each section.
- C. Signed and sealed by a professional engineer registered in the state in which the project is located.

D. Organized in the following order:

1. Executive Summary
2. Short Circuit Analysis
3. Short Circuit Computer Printout
4. Protective Device Coordination
5. Motor Starting
6. Arc Flash Hazard Analysis
7. Harmonic Analysis
8. Utility Data
9. Modeled One Line Diagrams

E. Information on one-line diagrams, legible when printed at 11-in x 17-in. Show the following:

1. Protective device designations and ampere ratings.
2. Conductor types, sizes, and lengths.
3. Transformer kilovolt ampere (kVA), impedance, and voltage ratings.
4. Motor and generator designations and kVA ratings.
5. Switchgear, switchboard, motor-control center, and panelboard designations and ratings.
6. Derating factors and environmental conditions.
7. Any revisions to electrical equipment required by the study.

F. Identifiers between the one-line diagram, short circuit study, coordination study, and arc flash study to be the same.

G. Include copies of correspondence with electric utility under utility data section of report. Correspondence to include names and contact information.

## 2.3 EXECUTIVE SUMMARY

- A. Include summary of distribution system, information received from electric utility, major assumptions, adequacy of equipment to safely clear or close on any fault, identify problem areas and recommendations for resolving problem areas.

## 2.4 SHORT CIRCUIT

- A. Comply with IEEE 399 and IEEE 551 (new 3002 series).
- B. Include normal utility powered configuration, on-site generation configuration, and alternate modes of operation (i.e. alternate utility configuration, bus ties closed).
- C. Include minimum and maximum possible fault conditions. Address three-phase bolted as well as ground fault conditions.
- D. Consider the fault contribution of all motors operating during the maximum demand condition of the motors.
- E. Calculate short-circuit momentary duties and interrupting duties based on an assumed bolted three-phase short circuit at each high and medium voltage switchgear bus and controller, low

voltage switchgear bus, switchboard, motor control center, distribution panelboard, pertinent branch circuit panelboard and other significant locations throughout the systems. Include the X/R ratios, asymmetry factors, KVA and symmetrical fault-current in the short circuit tabulations. Provide a ground fault current study for the same system areas. Include in tabulations fault impedance, X/R ratios, asymmetry factors, motor contribution, short circuit KVA, and symmetrical and asymmetrical fault-currents.

- F. Include representation of the site power system, the base quantities selected, impedance source data, calculation methods and tabulations, one-line diagrams, conclusions and recommendations.
- G. Identify available fault current at each bus and evaluate system elements including but not limited to equipment, protective devices, and cables.
- H. Base current transformers' ratio and burden calculations on a 10 percent maximum ratio error per IEEE C57.13. Identify current transformers that will not allow the protective devices to operate within acceptable IEEE error margins and recommend corrective action.
- I. List momentary, interrupting, and/or withstand rating of all key elements of the distribution system along with the maximum available fault current in tabular form and clearly indicate the adequacy of the element with PASS / FAIL designation.
- J. Short Circuit Computer Printout:
  - 1. Calculations shall be in sufficient detail for easy review.
  - 2. Back up calculations shall become part of the final report.

## 2.5 PROTECTIVE DEVICE COORDINATION

- A. Comply with IEEE 242 (new 3004 series).
- B. Utilize results from the short circuit study and balance the competing objectives of protection and continuity of service for the system specified, considering the basic factors of sensitivity, selectivity and speed.
- C. Show graphic indication of coordination between protective devices in the form of full color time-current coordination (TCC) plots with each protective device curve in a unique color for easy review.
- D. Provide separate TCC plots for each mode of operation. Provide separate TCC plots for "normal" and "stand by" operation. Show maximum fault values in each case. Both power sources shown on one plot is unacceptable.
- E. Provide separate TCC for phase over-current and ground fault.
- F. Show no more than six devices on one TCC. Of these six curves, two (the largest upstream device and the smallest downstream device) shall repeat curves shown on other coordination plots to provide cross-reference. Designate each TCC with a unique identifier and include each TCC identifier and descriptive title in the study's table of contents.

G. Include in each TCC the following as applicable:

1. TCC name and description.
2. One-line diagram.
3. Identifiers on one-line diagram and curves.
4. Significant motor starting characteristics.
5. Appropriate NEC protection points.
6. Appropriate ANSI/IEEE protection points.
7. Magnetizing inrush points of transformers.
8. Transformer damage curves.
9. Complete operating bands for low voltage circuit breaker trip devices and fuses.
10. Relay coil taps, time-dial settings and pickup settings.
11. Significant symmetrical and asymmetrical fault currents.
12. Power cable withstand curves.
13. Generator short circuit decrement and thermal limit curves.

H. Terminate device characteristic curve on TCC at a point reflecting the maximum symmetrical or asymmetrical fault current to which that device is exposed, based on the short circuit study.

I. Select each primary protective device for a delta-to-wye-connected transformer so the characteristic or operating band is within the transformer parameters; where feasible, include a parameter equivalent to 58 percent of the ANSI C37.91 withstand curve to afford protection for secondary line-to-ground faults.

J. Separate low voltage power circuit breakers from each other and the associated primary protective device, by a 16 percent current margin for coordination and protection in the event of line-to-line faults.

K. Separate protective relays by a 0.3-second time margin for the maximum 3 phase fault conditions to assure proper selectivity.

L. Optimize settings for breakers and relays to provide the most effective protection practicable for all modes and power sources.

M. Include at least all devices down to largest branch circuit and largest feeder circuit breaker in each motor control center and/or power distribution panelboard. Include all adjustable setting ground fault protective devices.

N. Provide tabulations of recommended settings for all protective devices. Where devices are existing, highlight any changes from the existing setting to the proposed recommended setting.

O. Provide all information required to program/set multifunction solid state relays.

## 2.6 MOTOR STARTING

A. Comply with IEEE 141 (new IEEE 3001 series) for recommended light flicker limits and IEEE 3002.7 for motor starting studies.

B. Provide motor starting study for all large electric drives (100 horsepower and larger). Include all operating modes.

- C. Identify any concerns about voltage drop or power inrush limitations due to the starting of motors.

## 2.7 ARC FLASH HAZARD

- A. Comply with IEEE 1584, NFPA 70, and NFPA 70E as applicable.
- B. Utilize short circuit and protective device coordination results to provide arc flash hazard analysis. Perform calculations in accordance with IEEE 1584 or NFPA 70E with the method identified within the report.
- C. Calculate the incident energy levels at each faulted bus for each mode of operation and for both maximum and minimum fault currents.
- D. Include calculations at line side and load side of main breakers, where applicable.
- E. Provide tabular report for all modes and conditions and include “worst case” summary. Use the “worst case” to generate the arc flash labels. Include:
  - 1. Fault location
  - 2. Arcing fault magnitude
  - 3. Protective device clearing time
  - 4. Duration of the arc
  - 5. Arc flash boundary
  - 6. Working distance
  - 7. Incident energy
  - 8. Electrode configuration
- F. Highlight any available incident energy over 40 cal/cm<sup>2</sup> and provide recommendations to mitigate the hazard.
- G. Arc Flash Labels:
  - 1. Machine printed, 4-in x 4-in (nominal), thermal transfer, high adhesion polyester.
  - 2. Provide UV resistant laminate for outdoor labels.
- H. Arc Flash Label Information:
  - 1. Equipment name.
  - 2. Identifier LINE or LOAD where equipment has potential different energy levels.
  - 3. Arc flash hazard information: arc flash boundary and incident energy in cal/cm<sup>2</sup>.
  - 4. Shock hazard information: limited approach and restricted approach boundaries.
  - 5. Personal Protective Equipment (PPE) requirements.
  - 6. Study Supplier, project number, and date.
- I. Provide arc flash label sample with preliminary report.
- J. Do not be print the labels until equipment is energized and protective devices set according to the approved final protective device coordination study.



## 2.8 HARMONIC ANALYSIS

- A. Comply with IEEE 519 and IEEE 3002.8.
- B. Provide a harmonic analysis for all major harmonic producing equipment to determine the harmonic currents and voltages of the electrical distribution system. Include utility and alternate power sources, if applicable.
- C. Provide a harmonic current and voltage profile for the complete electrical distribution system. At a minimum, the voltage profile shall include voltage values at the utility service point, and at each switchgear/switchboard and motor control center bus.
- D. Provide calculations for all operating modes and the following conditions:
  - 1. One profile for all duty equipment running with variable frequency controllers at full speed.
  - 2. One profile for all duty equipment running with variable frequency controllers at 60% speed.
- E. Include in the analysis:
  - 1. Explanation of analysis method.
  - 2. Explanation of analysis and recommendations to meet the specified limits.
  - 3. Calculations and/or computer printouts.
  - 4. Harmonic current and voltage profiles up to the fiftieth harmonic.

## PART 3 - EXECUTION

### 3.1 POWER SYSTEM DATA

- A. Obtain all data necessary for conduct of the study.
  - 1. Verify completeness of data supplied on one-line diagram. Call any discrepancies to Engineer's attention.
  - 2. For equipment included as Work of this Project, use characteristics submitted under provisions of action submittals and information submittals for this Project.
  - 3. For equipment that is existing to remain, obtain required electrical distribution system data by field investigation and surveys conducted by qualified technicians and engineers. Qualifications of technicians and engineers shall be as defined by NFPA 70E.
- B. Gather and tabulate the required input data to support the power system study.
- C. Field data gathering for existing systems shall be under direct supervision and control of the engineer in charge of performing the study and shall be by the engineer or its representative who holds NETA ETT-Certified Technician Level III or NICET Electrical Power Testing Level III certification.
- D. Data included, but are not limited to, the following:
  - 1. Product data for overcurrent protective devices and existing settings.

2. Electrical power utility impedance at the service and upstream protective device data.
3. Power sources and ties.
4. For switchgear, switchboards, panelboards, and motor control centers, ampacity and SCCR in amperes RMS symmetrical.
5. For transformers, kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in percent, and phase shift.
6. For reactors, manufacturer and model designation, voltage rating, and impedance.
7. For circuit breakers, trip units, and fuses, manufacturer and model designation. List type of breaker, type of trip, SCCR, current rating, and breaker settings.
8. For generators, short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
9. For busways, manufacturer and model designation, current rating, impedance, lengths, and conductor material.
10. For motors, horsepower and NEMA MG 1 code letter designation.
11. Conductor sizes, lengths, number, conductor material, shield parameters for medium voltage cable, and conduit material (magnetic or nonmagnetic).
12. For relays, manufacturer and model designation, current transformer ratios, potential transformer ratios, and relay settings.
13. Derating factors.

### 3.2 FIELD QUALITY CONTROL

- A. Do all testing and adjustment prior to the energization of new equipment.
- B. Test existing adjustable protective devices in accordance with NETA MTS.
- C. Test new adjustable protective devices in accordance with NETA ATS.
- D. Adjust existing and new protective devices according to approved coordination study.
- E. Testing and adjusting shall be by a full-time employee of the Field Adjusting Agency, who holds NETA ETT-Certified Technician Level III or NICET Electrical Power Testing Level III certification.
- F. After successful testing and adjustment, install calibration sticker with Field Adjusting Agency name, employee initials, and date of calibration at each relay or protective device.
- G. After energization, minor adjustments to settings may be required to commission the equipment.
- H. Submit field report and list any changes made during field adjustment or commissioning for update for record submittal of study.

### 3.3 ARC FLASH LABELING

- A. After the field adjustment of relays and protective devices, apply arc flash study labels.

- B. Apply arc flash labels on the front covers of the following equipment:
  - 1. Substations and distribution transformers
  - 2. Medium voltage switches
  - 3. Switchgear, switchboards, and panelboards
  - 4. Motor control centers
  - 5. Variable frequency controllers
  - 6. Disconnect switches
  - 7. Transfer switches
  - 8. 480V control panels
  - 9. 208/120V panelboards
- C. Apply arc-flash labels at each section for large equipment such as switchgear and motor control centers.
- D. Install LINE and LOAD arc-flash labels as applicable.
- E. Remove any previous arc flash study labels as applicable and install new labels under the direction of the Power System Analysis Specialist.

END OF SECTION 260573

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## SECTION 260923 - LIGHTING CONTROL DEVICES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Time switches.
  - 2. Outdoor photocells.
  - 3. Lighting contactors.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product used on this project.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For each type of lighting control device to include in operation and maintenance manuals.

### PART 2 - PRODUCTS

#### 2.1 DIAL-TIME SWITCHES

- A. Dial Time Switches: Comply with UL 917.
  - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  - 2. Contact Configuration: SPST, DPST, SPDT, or DPDT as shown on Drawings.
  - 3. Contact Rating: 20-A ballast load, 120-/240-V ac.
  - 4. Circuitry: Allows connection of a photoelectric relay as a substitute for the on-off function of a program.
  - 5. Astronomic time dial.

6. Eight-Day Program: Uniquely programmable for each weekday and holidays.
7. Skip-a-day mode.
8. Digital type with battery backup or electro-mechanical type with wound spring reserve to keep time during power failures.
9. Manufactured by Intermatic, Tork, or equal.

## 2.2 OUTDOOR PHOTOCELL

- A. Description: Configuration suitable for power duty with individual luminaires or with contactors as shown on the Drawings. Contacts rated for 2000 W incandescent or 1800 VA inductive or 600 VA LED. Complies with UL 773A.
1. Listed and labeled as defined in NFPA 70, by an agency NRTL, and marked for intended location and application.
  2. Light-Level ON/OFF: Turn ON 1.5 to 5 fc, Turn OFF 3 to 15 fc, with a time delay up to two minutes to prevent false operation.
  3. Housing: Die cast aluminum with ½-inch conduit stem.
  4. Failure Mode: Luminaire stays ON.
  5. Manufacturer: Tork Model 2115 (120VAC) or equal.

## 2.3 LIGHTING CONTACTORS

- A. Description: Electrically operated and mechanically held, combination-type lighting contactors with mounted in NEMA 1 enclosure (unless otherwise noted on Drawings) with number of poles as noted on the Drawings, complying with NEMA ICS 2 and UL 508.
1. Current Rating for Switching: Listing or rating consistent with type of load served, including tungsten filament, inductive, and high-inrush ballast (ballast with 15 percent or less THD of normal load current).
  2. Fault Current Withstand Rating: Equal to or exceeding the available fault current at the point of installation.
  3. Enclosure: Comply with NEMA 250.
  4. Operating Coil: 120VAC unless noted otherwise on Drawings.
  5. Provide with control and pilot devices as indicated on Drawings, matching the NEMA type specified for the enclosure.
  6. Manufacturer/Model: ASCO Bulletin 917C (600V, 20A) or equal.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine lighting control devices before installation. Reject lighting control devices that are wet, moisture damaged, or mold damaged.
- B. Examine walls and ceilings for suitable conditions where lighting control devices will be installed.

- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Comply with NECA 1.
- B. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression systems, and partition assemblies.
- C. Install and aim sensors in locations to achieve not less than 90-percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.
- D. Wiring Method: Comply with Section 260519 "Low-Voltage Electrical Power Conductors and Cables." And Section 260533 "Raceways and Boxes for Electrical Systems".
- E. Wiring within Enclosures: Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.
- F. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

### 3.3 IDENTIFICATION

- A. Identify components and power and control wiring according to Section 260553 "Identification for Electrical Systems."
  - 1. Identify controlled circuits in lighting contactors.
  - 2. Identify circuits or luminaires controlled by photoelectric and occupancy sensors at each sensor.
- B. Label time switches and contactors with a unique designation.

### 3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
  - 1. Operational Test: After installing time switches and sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation.
  - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Lighting control devices will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

END OF SECTION 260923

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## SECTION 262213 - LOW-VOLTAGE DISTRIBUTION TRANSFORMERS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Distribution, dry-type transformers.
  - 2. Transformer panel assemblies.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product used on this project.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type and size of transformer.
  - 2. Include rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features, and performance for each type and size of transformer.
- B. Shop Drawings:
  - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment.
  - 3. Include diagrams for power, signal, and control wiring.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.
- B. Source quality-control reports.
- C. Field quality-control reports.

## 1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For transformers to include in emergency, operation, and maintenance manuals.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Inspection: On receipt, inspect for and note any shipping damage to packaging and transformer.
  - 1. If manufacturer packaging is removed for inspection, and transformer will be stored after inspection, re-package transformer using original or new packaging materials that provide protection equivalent to manufacturer's packaging.
- B. Storage: Store in a warm, dry, and temperature-stable location in original shipping packaging.
- C. Temporary Heating: Apply temporary heat according to manufacturer's written instructions within the enclosure of each ventilated-type unit, throughout periods during which equipment is not energized and when transformer is not in a space that is continuously under normal control of temperature and humidity.
- D. Handling: Follow manufacturer's instructions for lifting and transporting transformers.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Eaton.
  - 2. General Electric / ABB.
  - 3. Square D / Schneider Electric.
- B. Source Limitations: Obtain all transformers from single manufacturer.

### 2.2 DISTRIBUTION TRANSFORMERS

- A. Comply with the following Standards:
  - 1. NEMA ST 20.
  - 2. UL 1561.
  - 3. US Department of Energy Efficiency Standards for Low Voltage Distribution Transformers.

B. General Description:

1. Dry type, two winding. Configuration, kVA, and voltage shown on Drawings.
2. Windings: Copper.
3. Temperature Rise: 80 degrees C.

C. Taps for transformers 15 kVA and larger: Full capacity, two 2.5 percent above and four 2.5 percent below.

D. Grounding: Provide ground-bar kit or a ground bar installed on the inside of the transformer enclosure.

E. Enclosures:

1. Indoor: NEMA 250, Type 1 or 2, ventilated. Standard enclosure type.
2. Outdoor Enclosure or identified for NEMA 4X enclosures on Drawings: TENV, stainless steel enclosure. All stainless steel hardware.

## 2.3 TRANSFORMER PANEL ASSEMBLY

A. Comply with UL 1062 for unit substations.

B. General Description: Unit assembly with combination of two winding dry type transformer and panel. Includes main primary circuit breaker and secondary panel section with main circuit breaker. Configuration, kVA, and voltage shown on Drawings.

1. Windings: Copper, epoxy-resin encapsulated.
2. Temperature Rise: 115 degrees C.
3. Taps: Full capacity, two 5 percent below.

C. Grounding: Include provisions for connection to grounding electrode system. Include copper equipment ground bar in panel distribution section.

D. Provide ground-bar kit or a ground bar installed on the inside of the transformer enclosure.

E. Enclosures:

1. Indoor: Standard enclosure type NEMA 3R, painted steel.
2. Outdoor Enclosure or identified for NEMA 4X enclosures on Drawings: NEMA 3R, stainless steel.

F. Circuit Breakers and Panel Section:

1. Copper bus.
2. Plug-on type circuit breakers.
3. Main primary breaker sized per manufacturer's standard, minimum 18kA interrupting rating at 480V.
4. Secondary main breaker sized per manufacturer's standard, minimum 10kA interrupting rating at 240V.

## 2.4 IDENTIFICATION

- A. Nameplates: Engraved, laminated-acrylic or melamine plastic signs for each transformer, mounted with corrosion-resistant screws. Nameplates and label products are specified in Section 260553 "Identification for Electrical Systems."

## 2.5 SOURCE QUALITY CONTROL

- A. Test and inspect transformers according to IEEE C57.12.01 and IEEE C57.12.91.
  - 1. Resistance measurements of all windings at rated voltage connections and at all tap connections.
  - 2. Ratio tests at rated voltage connections and at all tap connections.
  - 3. Phase relation and polarity tests at rated voltage connections.
  - 4. No load losses, and excitation current and rated voltage at rated voltage connections.
  - 5. Impedance and load losses at rated current and rated frequency at rated voltage connections.
  - 6. Applied and induced tensile tests.
  - 7. Regulation and efficiency at rated load and voltage.
  - 8. Insulation-Resistance Tests:
    - a. High-voltage to ground.
    - b. Low-voltage to ground.
    - c. High-voltage to low-voltage.
  - 9. Temperature tests.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for each transformer.
- B. Verify that field measurements are as needed to maintain working clearances required by NFPA 70 and manufacturer's written instructions.
- C. Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed.
- D. Verify that ground connections are in place and requirements in Section 260526 "Grounding and Bonding for Electrical Systems" have been met. Maximum ground resistance shall be 5 ohms at location of transformer.
- E. Environment: Enclosures shall be rated for the environment in which they are located. Covers for NEMA 250, Type 4X enclosures shall not cause accessibility problems.
- F. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Install wall-mounted transformers level and plumb with wall brackets fabricated by transformer manufacturer.
  - 1. Coordinate installation of wall-mounted and structure-hanging supports with actual transformer provided.
- B. Install transformers level and plumb on a concrete base with vibration-dampening supports. Locate transformers away from corners and not parallel to adjacent wall surface.
- C. Construct concrete bases according to Section 033000 "Cast-in-Place Concrete" and anchor floor-mounted transformers according to manufacturer's written instructions and requirements in Section 260529 "Hangers and Supports for Electrical Systems."
  - 1. Coordinate size and location of concrete bases with actual transformer provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.
- D. Secure transformer to concrete base according to manufacturer's written instructions.
- E. Secure covers to enclosure and tighten all bolts to manufacturer-recommended torques to reduce noise generation.
- F. Remove shipping bolts, blocking, and wedges.

### 3.3 CONNECTIONS

- A. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- B. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- C. 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.
- D. Provide flexible connections at all conduit and conductor terminations and supports to eliminate sound and vibration transmission to the building structure.

### 3.4 IDENTIFICATION

- A. Comply with Section 260553 "Identification for Electrical Systems"
  - 1. Identify equipment by name designation and fed from source with nameplates.
  - 2. Color code wiring.
  - 3. Identify panel branch circuit numbers and on panel phase and neutral wires.
  - 4. Provide as built typed panel directory.

### 3.5 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Dry-Type Transformer Field Tests:
  - 1. Visual and Mechanical Inspection.
    - a. Inspect physical and mechanical condition.
    - b. Inspect anchorage, alignment, and grounding.
    - c. Verify that resilient mounts are free and that any shipping brackets have been removed.
    - d. Verify the unit is clean.
    - e. Perform specific inspections and mechanical tests recommended by manufacturer.
    - f. Verify that as-left tap connections are as specified.
  - 2. Electrical Tests:
    - a. Measure resistance at each winding, tap, and bolted connection.
    - b. Perform insulation-resistance tests winding-to-winding and each winding-to-ground. Apply voltage according to manufacturer's published data. In the absence of manufacturer's published data, comply with NETA ATS, Table 100.5.
    - c. Verify correct secondary voltage, phase-to-phase and phase-to-neutral, after energization and prior to loading.
- C. Transformer Panel Assembly Field Tests:
  - 1. Perform visual, mechanical, and electrical tests as specified herein for dry-type transformers as applicable.
- D. Remove and replace units that do not pass tests or inspections and retest as specified above.
- E. Infrared Scanning: Two months after Substantial Completion, perform an infrared scan of transformer connections.
  - 1. Use an infrared-scanning device designed to measure temperature or detect significant deviations from normal values. Provide documentation of device calibration.
  - 2. Perform two follow-up infrared scans of transformers, one at four months and the other at 11 months after Substantial Completion.
  - 3. Prepare a certified report identifying transformer checked and describing results of scanning. Include notation of deficiencies detected, remedial action taken, and scanning observations after remedial action.
- F. Test Labeling: On completion of satisfactory testing of each unit, attach a dated and signed "Satisfactory Test" label to tested component.

### 3.6 ADJUSTING

- A. Record transformer secondary voltage at each unit for at least 48 hours of typical occupancy period. Adjust transformer taps to provide optimum voltage conditions at secondary terminals.

Optimum is defined as not exceeding nameplate voltage plus 5 percent and not being lower than nameplate voltage minus 3 percent at maximum load conditions. Submit recording and tap settings as test results.

- B. Output Settings Report: Prepare a written report recording output voltages and tap settings.

### 3.7 CLEANING

- A. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

END OF SECTION 262213

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## SECTION 262416 - PANELBOARDS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Distribution panelboards.
  - 2. Lighting and appliance branch-circuit panelboards.

#### 1.3 DEFINITIONS

- A. ATS: Acceptance testing specification.
- B. GFCI: Ground-fault circuit interrupter.
- C. GFEP: Ground-fault equipment protection.
- D. HID: High-intensity discharge.
- E. MCCB: Molded-case circuit breaker.
- F. SPD: Surge protective device.
- G. VPR: Voltage protection rating.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of panelboard used on this project.
  - 1. Include materials, switching and overcurrent protective devices, SPDs, accessories, and components indicated.
  - 2. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each panelboard and related equipment.
  - 1. Include dimensioned plans, elevations, sections, and details.
  - 2. Show tabulations of installed devices with nameplates, conductor termination sizes, equipment features, and ratings.

3. Detail enclosure types including mounting and anchorage, environmental protection, knockouts, corner treatments, covers and doors, gaskets, hinges, and locks.
4. Detail bus configuration, current, and voltage ratings.
5. Short-circuit current rating of panelboards and overcurrent protective devices.
6. Include evidence of NRTL listing for SPD as installed in panelboard.
7. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
8. Include wiring diagrams for power, signal, and control wiring.
9. Key interlock scheme drawing and sequence of operations.
10. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Include selectable ranges for each type of overcurrent protective device. Include an Internet link for electronic access to downloadable PDF of the coordination curves.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.
- B. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
  1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
  2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

#### 1.7 QUALITY ASSURANCE

- A. Manufacturer Qualifications: ISO 9001 or ISO 9002 certified.

#### 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.
- B. Handle and prepare panelboards for installation according to NECA 407 and NEMA PB 1.

## 1.9 FIELD CONDITIONS

### A. Environmental Limitations:

1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
  - a. Ambient Temperature: Not exceeding 23 deg F to plus 104 deg F.
  - b. Altitude: Not exceeding 6600 feet.

### B. Service Conditions: NEMA PB 1, usual service conditions, as follows:

1. Ambient temperatures within limits specified.
2. Altitude not exceeding 6600 feet.

### C. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:

1. Notify Owner no fewer than three days in advance of proposed interruption of electric service.
2. Do not proceed with interruption of electric service without Owner's written permission.
3. Comply with NFPA 70E.

## PART 2 - PRODUCTS

### 2.1 COMMON REQUIREMENTS

- A. Single manufacturer for all panelboards.
- B. Ratings and schedule shown on Drawings. Series connected short circuit ratings are not acceptable.
- C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- E. Comply with NEMA PB 1.
- F. Comply with NFPA 70.
- G. Enclosures: Surface-mounted, dead-front cabinets.

1. Rated for environmental conditions at installed location.
    - a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
    - b. Outdoor and Process Locations: NEMA 250, Type 4X.
  2. Height: 84 inches maximum.
  3. Wiring Accessibility (Covers):
    - a. NEMA 1 Enclosure: Provide door-in-door construction.
    - b. NEMA 4X Enclosure: Provide NEMA 1 panel without cover trim, mounted in a NEMA 4X enclosure. When available, 3-point latch door for NEMA 4X enclosure.
  4. Finishes:
    - a. NEMA 1 Panels and Trim: Steel and galvanized steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
    - b. NEMA 1 Back Boxes: Same finish as panels and trim.
    - c. NEMA 4X: Type 316 stainless steel.
- H. Phase, Neutral, and Ground Buses:
1. Material: Tin-plated copper.
    - 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. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
  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. Split Bus: Vertical buses divided into individual vertical sections, if identified on Drawings.
- I. 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 deg 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: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device, if identified on the Drawings.

- J. Future Devices: Panelboards or load centers shall have mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices as shown on the Drawings.
- K. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals. Assembly listed by an NRTL for 100 percent interrupting capacity.
  - 1. Panelboards and overcurrent protective devices rated 240 V or less shall have short-circuit ratings as shown on Drawings, but not less than 10,000 A rms symmetrical.
  - 2. Panelboards and overcurrent protective devices rated above 240 V and less than 600 V shall have short-circuit ratings as shown on Drawings, but not less than 14,000 A rms symmetrical.

## 2.2 PERFORMANCE REQUIREMENTS

- A. Surge Suppression: Factory installed as an integral part of indicated panelboards, complying with UL 1449 SPD Type 2.

## 2.3 DISTRIBUTION (POWER) PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Eaton - Pow R Line Series Panelboards.
  - 2. General Electric; by ABB – Spectra Series Panelboards.
  - 3. Schneider Electric USA (Square D) – I Line Series Panelboards.
- B. Panelboards: NEMA PB 1, distribution type.
- C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.
  - 1. For doors more than 36 inches high, provide two latches, keyed alike.

## 2.4 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Eaton – Pow R Line Series.
  - 2. General Electric; by ABB – Type AQ or AE.
  - 3. Schneider Electric USA (Square D) – Type NQ or NF.
- B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- C. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.
- D. Doors: Door-in-door construction with concealed hinges; secured with multipoint latch with tumbler lock; keyed alike. 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.

## 2.5 CIRCUIT BREAKERS

- A. Manufactured by panelboard manufacturer.
- B. Circuit breaker type: molded case, bolt-in.
- C. MCCB: Comply with UL 489, with interrupting capacity to meet available fault currents.
  - 1. Thermal-Magnetic Circuit Breakers:
    - a. Inverse time-current element for low-level overloads.
    - b. Instantaneous magnetic trip element for short circuits.
    - c. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
  - 2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
  - 3. Electronic Trip Circuit Breakers:
    - a. RMS sensing.
    - b. Field-replaceable rating plug or electronic trip.
    - c. 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. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6-mA trip).
  - 5. GFEP Circuit Breakers: Class B ground-fault protection (30-mA trip).
  - 6. MCCB Features and Accessories:
    - a. Standard frame sizes, trip ratings, and number of poles.
    - b. Breaker handle indicates tripped status.
    - c. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
    - d. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and HID lighting circuits; Type HACR for switching air conditioning loads.
    - e. Rating Plugs: Three-pole breakers with ampere ratings greater than 250 amperes shall have interchangeable rating plugs or electronic adjustable trip units.
    - f. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in off position.

## 2.6 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: Typed circuit directory mounted inside panelboard door with transparent plastic protective cover.
  - 1. Circuit directory shall identify specific purpose with detail sufficient to distinguish it from all other circuits.

## 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. Receive, inspect, handle, and store panelboards according to NECA 407 and NEMA PB 1.1.
- C. Examine panelboards before installation. Reject panelboards that are damaged, rusted, or have been subjected to water saturation.
- D. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- E. 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. Comply with NECA 1.
- C. Install panelboards and accessories according to NECA 407 and NEMA PB 1.1.
- D. Equipment Mounting:
  - 1. Attach panelboard to the vertical finished or structural surface behind the panelboard.
- E. Mount top of trim 72 inches above finished floor unless otherwise indicated.

- F. Mount panelboard cabinet plumb and rigid without distortion of box.
- G. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- H. Mount surface-mounted panelboards to allow a ½-inch minimum air space between box and mounting surface.
- I. Install overcurrent protective devices and controllers not already factory installed.
  - 1. Set field-adjustable, circuit-breaker trip ranges.
  - 2. Tighten bolted connections and circuit breaker connections using calibrated torque wrench or torque screwdriver per manufacturer's written instructions.
- J. Make grounding connections and bond neutral for services and separately derived systems to ground. Make connections to grounding electrodes, separate grounds for isolated ground bars, and connections to separate ground bars.
- K. Install filler plates in unused spaces.
- L. Close all unused or abandoned opening using knockout closure or similar device. Remove cut off wire stubs for removed circuits.

### 3.3 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems."
  - 1. Identify branch circuit numbers on phase and neutral wires.
- B. Create a directory to indicate installed circuit loads after balancing panelboard loads; incorporate Owner's final room designations. Obtain approval before installing. Handwritten directories are not acceptable. Install directory inside panelboard door.
- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
  - 1. Nameplate includes panel designation and source information.
- D. Device Nameplates: Label each branch circuit device in power panelboards with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- E. Install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems" identifying source of remote circuit.



### 3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Acceptance Testing Preparation:
  - 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
  - 2. Test continuity of each circuit.
- C. Tests and Inspections:
  - 1. Perform each visual and mechanical inspection and electrical test for molded case breakers stated in NETA ATS, Paragraph 7.6 Circuit Breakers. Do not perform optional tests. Certify compliance with test parameters.
  - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
  - 3. Perform the following infrared scan tests and inspections and prepare reports:
    - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each panelboard. Remove front panels so joints and connections are accessible to portable scanner.
    - b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each panelboard 11 months after date of Substantial Completion.
    - c. Instruments and Equipment:
      - 1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
- D. Panelboards will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results, with comparisons of the two scans. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

### 3.5 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges as specified in Section 260573.16 "Power System Studies."
- C. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes. Prior to making circuit changes to achieve load balancing, inform Engineer of effect on phase color coding.
  - 1. Measure loads during period of normal facility operations.

2. Perform circuit changes to achieve load balancing outside normal facility operation schedule or at times directed by the Engineer. Avoid disrupting services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
3. After changing circuits to achieve load balancing, recheck loads during normal facility operations. Record load readings before and after changing circuits to achieve load balancing.
4. Tolerance: Maximum difference between phase loads, within a panelboard, shall not exceed 20 percent.

### 3.6 PROTECTION

- A. Temporary Heating: Prior to energizing panelboards, apply temporary heat to maintain temperature according to manufacturer's written instructions.

### 3.7 CLEANING

- A. Remove all rubbish and debris from inside and around the equipment. Vacuum clean interior.

END OF SECTION 262416

## SECTION 262419 - MOTOR CONTROL CENTERS

### 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 MCCs for use with ac circuits rated 600 V and less, with combination controllers and having the following factory-installed components:
  - 1. Surge protection devices..
  - 2. Feeder-tap units.
  - 3. Measurement and control.
  - 4. Auxiliary devices.
  - 5. Panelboards.
  - 6. Transformers.
- B. Related Requirements
  - 1. Section 260573 "Power System Studies" for short circuit, coordination, and arc flash. The preliminary short circuit study submittal must be approved by the Engineer prior to review of the motor control center submittal.
  - 2. Section 264313 "Surge Protection for Low-Voltage Electrical Power Circuits" for performance requirements of motor control center manufacturer provided SPDs.

#### 1.3 DEFINITIONS

- A. CPT: Control power transformer.
- B. MCC: Motor-control center.
- C. MCCB: Molded-case circuit breaker.
- D. MCP: Motor-circuit protector.
- E. OCPD: Overcurrent protective device.
- F. PT: Potential transformer.
- G. SPD: Surge protective device.
- H. SCR: Silicon-controlled rectifier.

- I. VFC: Variable-frequency controller.
- J. 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.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for MCCs.
  - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories for each cell of the MCC.
- B. Shop Drawings: For each MCC, manufacturer's approval drawings as defined in UL 845. In addition to requirements specified in UL 845, include dimensioned plans, elevations, and sections; and conduit entry locations and sizes, mounting arrangements, and details, including required clearances and service space around equipment.
  - 1. Show tabulations of installed devices, equipment features, and ratings. Include the following:
    - a. Each installed unit's type and details.
    - b. Factory-installed devices.
    - c. Enclosure types and details.
    - d. Nameplate legends.
    - e. Short-circuit current (withstand) rating of complete MCC, and for bus structure and each unit.
    - f. Features, characteristics, ratings, and factory settings of each installed controller and feeder device, and installed devices.
    - g. Specified optional features and accessories.
  - 2. Schematic and Connection Wiring Diagrams: For power, signal, and control wiring for each installed controller.
  - 3. Nameplate legends.
  - 4. Vertical and horizontal bus capacities.
  - 5. Features, characteristics, ratings, and factory settings of each installed unit.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.
- B. Field quality-control reports.
- C. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed, and arrange to demonstrate that switch settings for motor running overload protection suit actual motors to be protected.

## 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For MCCs, all installed devices, and components to include in emergency, operation, and maintenance manuals.
  - 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
  - 2. Manufacturer's Record Drawings: As defined in UL 845. In addition to requirements specified in UL 845, include field modifications and field-assigned wiring identification incorporated during construction by manufacturer, Contractor, or both.
  - 3. Manufacturer's written instructions for testing and adjusting circuit breaker and MCP trip settings.
  - 4. Manufacturer's written instructions for setting field-adjustable overload relays.
  - 5. Manufacturer's written instructions for testing, adjusting, and reprogramming reduced-voltage, solid-state controllers.
  - 6. Manufacturer's written instructions for testing, adjusting, and reprogramming microprocessor control modules.
  - 7. Manufacturer's written instructions for setting field-adjustable timers, controls, and status and alarm points.

## 1.7 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. Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
  - 2. Control Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.
  - 3. Indicating Lights: Two of each type and color installed.
  - 4. Auxiliary Contacts: Furnish one spare(s) for each size and type of magnetic controller installed.
  - 5. Power Contacts: Furnish three spares for each size and type of magnetic contactor installed.

## 1.8 QUALITY ASSURANCE

- A. Source Limitations: Obtain MCCs and controllers of a single type from single source from single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, and marked for intended use.
- C. UL Compliance: MCCs shall comply with UL 845 and shall be listed and labeled by a qualified testing agency.

## 1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver MCCs in shipping splits of lengths that can be moved past obstructions in delivery paths.
- B. Handle MCCs according to the following:
  - 1. NECA 402, "Recommended Practice for Installing and Maintaining Motor Control Centers."
  - 2. NEMA ICS 2.3, "Instructions for the Handling, Installation, Operation, and Maintenance of Motor Control Centers Rated Not More Than 600 Volts."
- C. If stored in space that is not permanently enclosed and air conditioned, remove loose packing and flammable materials from inside MCCs; install temporary electric heating, with at least 250 W per vertical section.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. General Electric / ABB.
  - 2. Eaton.
  - 3. Schneider Electric USA (Square D).

### 2.2 SYSTEM DESCRIPTION

- A. NEMA Compliance: Fabricate and label MCCs to comply with NEMA ICS 18.
- B. Ambient Environment Ratings:
  - 1. Ambient Temperature Rating: Not less than 0 deg F and not exceeding 104 deg F, with an average value not exceeding 95 deg F over a 24-hour period.
  - 2. Ambient Storage Temperature Rating: Not less than minus 4 deg F and not exceeding 140 deg F
  - 3. Humidity Rating: Less than 95 percent (noncondensing).
  - 4. Altitude Rating: Not exceeding 6600 feet, or 3300 feet if MCC includes solid-state devices.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

### 2.3 PERFORMANCE REQUIREMENTS

- A. Capacities and Characteristics: Current, Voltage, Phase, Enclosure, and Short Circuit as shown on the Drawings.

1. Wiring Class: II S, Type B.
2. Bus: Tin plated copper

## 2.4 MOTOR CONTROL CENTER ENCLOSURES

- A. Indoor Enclosures: Freestanding steel cabinets unless otherwise indicated. NEMA 250, Type as indicated on the Drawings.
- B. Enclosure Finish for Indoor Units: Factory-applied finish in manufacturer's standard gray finish over a rust-inhibiting primer on treated metal surface.

## 2.5 ASSEMBLY

- A. Structure:
  1. Units up to and including Size 3 shall have drawout mountings with connectors that automatically line up and connect with vertical-section buses while being racked into their normal, energized positions.
  2. Units in Type B and Type C MCCs shall have pull-apart terminal strips for external control connections.
- B. Compartments: Modular; individual lift-off doors with concealed hinges and quick-captive screw fasteners.
  1. Interlock compartment door to require that the disconnecting means is "off" before door can be opened or closed, except by operating a concealed release device.
  2. Compartment construction shall allow for removal of units without opening adjacent doors, disconnecting adjacent compartments, or disturbing operation of other units in MCC.
  3. The same-size compartments shall be interchangeable to allow rearrangement of units, such as replacing three single units with a unit requiring three spaces, without cutting or welding.
- C. Owner's Metering Compartment (Power Monitor): A separate customer metering compartment and section with front hinged door, metering, and current transformers for each meter. Current transformer secondary wiring shall be terminated on shorting-type terminal blocks.
- D. Interchangeability: Compartments constructed to allow for removal of units without opening adjacent doors, disconnecting adjacent compartments, or disturbing operation of other units in MCC; same-size compartments to permit interchangeability and ready rearrangement of units, such as replacing three single units with a unit requiring three spaces, without cutting or welding.
- E. Wiring Spaces:
  1. Vertical wireways in each vertical section for vertical wiring to each unit compartment; supports to hold wiring in place.
  2. Horizontal wireways in bottom and top of each vertical section for horizontal wiring between vertical sections; supports to hold wiring in place.

F. Provisions for Future:

1. Compartments marked "future" shall be bused, wired and equipped with guide rails or equivalent, and ready for insertion of drawout units.
2. Compartments marked "spare" shall include provisions for connection to the vertical bus.

G. Control Power Transformers:

1. 120-V ac; obtained from CPT integral with controller; with primary and secondary fuses. Ground secondary of CPT The CPT shall be of sufficient capacity to operate integral devices and remotely located pilot, indicating, and control devices.

a. CPT Spare Capacity: As required or shown on Drawings.

H. Factory-Installed Wiring: Factory installed, with bundling, lacing, and protection included. Use flexible conductors for No. 8 AWG and smaller, for conductors across hinges, and for conductors for interconnections between shipping units.

1. Wiring Class: NEMA ICS 18, Class II-S, Type B, for starters larger than Size 3.
2. Control and Load Wiring: Factory installed, with bundling, lacing, and protection included. Use flexible conductors for No. 8 AWG and smaller, for conductors across hinges, and for conductors for interconnections between shipping units.

I. Bus:

1. Main Horizontal and Equipment Ground Buses: Uniform capacity for entire length of MCC's main and vertical sections. Provide for future extensions.
2. Vertical Phase and Equipment Ground Buses: Uniform capacity for entire usable height of vertical sections, except for sections incorporating single units.
3. Phase- and Neutral-Bus Material: Tin plated, hard-drawn copper of 98 percent minimum conductivity, with mechanical connectors for outgoing conductors.
4. Ground Bus: Tin plated, hard-drawn copper of 98 percent minimum conductivity, with pressure connector for ground conductors, minimum size 1/4-by-2 inches. Equip with mechanical connectors for outgoing conductors.
5. Bus-Bar Insulation: Factory-applied, flame-retardant, tape wrapping of individual bus bars or flame-retardant, spray-applied insulation. Insulation temperature rating shall not be less than 105 deg C.

## 2.6 SURGE PROTECTION DEVICES

- A. Comply with performance requirements and features in Section 264313 "Surge Protection for Low-Voltage Electrical Power Circuits", Type 2 SPD.

## 2.7 MAGNETIC CONTROLLERS

- A. Controller Units: Combination controllers. Minimum compartment height 12-inches. Minimum starter size: NEMA 1. IEC type is not acceptable. Refer to Drawings for horsepower and control requirements.



B. Disconnects:

1. MCP:

- a. UL 489, with interrupting capacity complying with available fault currents, instantaneous-only circuit breaker with front-mounted, field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.
- b. Lockable Handle: For three padlocks and interlocks with cover in closed position.

C. Controllers: Comply with UL 508.

- 1. Full-Voltage Magnetic Controllers: Electrically held, full voltage, NEMA ICS 2, general purpose, Class A.

D. Overload Relays:

1. Solid-State Overload Relays:

- a. Switch or dial selectable for motor-running overload protection.
- b. Sensors in each phase.
- c. Class 10/20 selectable tripping characteristic selected to protect motor against voltage and current unbalance and single phasing.
- d. UL 1053 Class II ground-fault protection, with start and run delays to prevent nuisance trip on starting.

2. External overload reset push button.

2.8 CONTROLLER-MOUNTED AUXILIARY DEVICES

A. Control-Circuit and Pilot Devices: Factory installed in controller enclosure cover unless otherwise indicated. Comply with NEMA ICS 5.

1. Push Buttons, Pilot Lights, and Selector Switches: Heavy-duty, oiltight type.

- a. Push Buttons: Unguarded types; momentary contact unless otherwise indicated.
- b. Pilot Lights: LED types;; push to test.
- c. Selector Switches: Rotary type.

B. Elapsed-Time Meters: Heavy duty with digital readout in hours; nonresettable.

C. Auxiliary Dry Contacts: In addition to contacts shown on Drawings provide two spare Reversible NC/NO.

D. Control Relays:

- 1. Time Delay: Auxiliary and adjustable solid-state time-delay relays.
- 2. Phase-Failure, Phase-Reversal, and Undervoltage and Overvoltage Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connections and adjustable undervoltage, overvoltage, and time-delay settings.

## 2.9 MEASUREMENT AND CONTROL DEVICES

- A. Instrument Transformers: IEEE C57.13, NEMA EI 21.1, and the following:
1. PTs: IEEE C57.13; 120 V, 60 Hz, single secondary; disconnecting type with integral fuse mountings. Burden and accuracy shall be consistent with connected metering and relay devices.
  2. Current Transformers: IEEE C57.13; 5 A, 60 Hz, secondary; bar or window type; single secondary winding and secondary shorting device. Burden and accuracy shall be consistent with connected metering and relay devices.
  3. CPTs: Dry type, mounted in separate compartments for units larger than 3 kVA.
  4. Current Transformers for Neutral and Ground-Fault Current Sensing: Connect secondary wiring to ground overcurrent relays, via shorting terminals, for selective tripping of main and tie circuit breaker. Coordinate with feeder circuit-breaker and ground-fault protection.
- B. Multifunction Digital-Metering Monitor (Power Monitor): Microprocessor-based unit suitable for three- or four-wire systems and with the following features:
1. Listed or recognized by a nationally recognized testing laboratory.
  2. Inputs from sensors or 5-A current-transformer secondaries, and potential terminals rated to 600 V.
  3. Switch-selectable digital display of the following values with the indicated maximum accuracy tolerances:
    - a. Phase Currents, Each Phase: Plus or minus 1 percent.
    - b. Phase-to-Phase Voltages, Three Phase: Plus or minus 1 percent.
    - c. Phase-to-Neutral Voltages, Three Phase: Plus or minus 1 percent.
    - d. Three-Phase Real Power (Megawatts): Plus or minus 2 percent.
    - e. Three-Phase Reactive Power (Megavars): Plus or minus 2 percent.
    - f. Power Factor: Plus or minus 2 percent.
    - g. Frequency: Plus or minus 0.5 percent.
    - h. Accumulated Energy, Megawatt Hours: Plus or minus 2 percent; accumulated values unaffected by power outages up to 72 hours.
  4. Mounting: Display and control unit flush or semiflush mounted in instrument compartment door.
- C. Control Power Fuses: Primary and secondary fuses for current-limiting and overload protection of transformer and fuses for protection of control circuits.

## 2.10 FEEDER TAP UNITS

- A. MCCBs (to 1200 A): Fixed mounted, with inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger. Comply with UL 489, and NEMA AB 3, with interrupting capacity to comply with available fault currents.
1. Adjustable, Instantaneous-Trip Circuit Breakers (Less than 400A): Magnetic trip element with front-mounted, field-adjustable trip setting.

2. Electronic Trip Circuit Breakers (400A and larger): Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:
  - a. Instantaneous trip.
  - b. Long- and short-time pickup levels.
  - c. Long- and short-time time adjustments.
  - d. Ground-fault pickup level, time delay, and  $I^2t$  response.
3. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.

## 2.11 SOURCE QUALITY CONTROL

- A. MCC Testing: Test and inspect MCCs according to requirements in NEMA ICS 18.
- B. MCCs will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

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

### 3.2 INSTALLATION

- A. NEMA Industrial Control and Systems Standards: Comply with parts of NEMA ICS 2.3 for installation and startup of MCCs.
- B. Floor Mounting: Install MCCs on 4-inch nominal-thickness concrete base. Comply with requirements for concrete base specified in Section 033000 "Cast-in-Place Concrete."
  1. 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 concrete base.
  2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
  3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  4. Install anchor bolts to elevations required for proper attachment to supported equipment.
- C. Install fuses in control circuits if not factory installed. Comply with requirements in Section 262813 "Fuses."

- D. Comply with NECA 1.

### 3.3 IDENTIFICATION

- A. Comply with requirements in Section 260553 "Identification for Electrical Systems" for identification of MCC, MCC components, and control wiring.
  - 1. Identify field-installed conductors, interconnecting wiring, and components.
  - 2. Install required warning signs.
  - 3. Label MCC and each cubicle with engraved nameplate.
  - 4. Label each enclosure-mounted control and pilot device.
  - 5. Mark up a set of manufacturer's connection wiring diagrams with field-assigned wiring identifications and return to manufacturer for inclusion in Record Drawings.

### 3.4 CONTROL WIRING INSTALLATION

- A. Install wiring between enclosed controllers and remote devices and facility's SCADA system. Comply with requirements in Section 260523 "Control-Voltage Electrical Power Cables."
- B. Bundle, train, and support wiring in enclosures.
- C. Connect selector switches and other automatic-control selection devices where applicable.
  - 1. Connect selector switches to bypass only those manual- and automatic-control devices that have no safety functions when switch is in manual-control position.
  - 2. Connect selector switches within enclosed controller circuit in both manual and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

### 3.5 CONNECTIONS

- A. Comply with requirements for installation of conduit in Section 260533 "Raceways and Boxes for Electrical Systems." Drawings indicate general arrangement of conduit, fittings, and specialties.
- B. Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."

### 3.6 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- B. Perform tests and inspections with the assistance of a factory-authorized service representative.
- C. Acceptance Testing Preparation:
  - 1. Test insulation resistance for each enclosed controller, component, connecting supply, feeder, and control circuit.

2. Test continuity of each circuit.

D. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
4. Perform the following infrared (thermographic) scan tests and inspections and prepare reports:
  - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each multipole enclosed controller. Remove front panels so joints and connections are accessible to portable scanner.
  - b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each multipole enclosed controller 11 months after date of Substantial Completion.
  - c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Submit calibration record for device.
5. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
6. Mark up a set of manufacturer's drawings with all field modifications incorporated during construction and return to manufacturer for inclusion in Record Drawings.

E. MCCs will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports.

### 3.7 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform Perform startup service.

1. Complete installation and startup checks according to NETA Acceptance Testing Specification and manufacturer's written instructions.

### 3.8 ADJUSTING

- A. Set field-adjustable switches, auxiliary relays, time-delay relays, timers, and overload relay pickup and trip ranges.
- B. Adjust the trip settings of MCPs and thermal-magnetic circuit breakers with adjustable, instantaneous trip elements. Initially adjust to six times the motor nameplate full-load amperes and attempt to start motors several times, allowing for motor cool-down between starts. If tripping occurs on motor inrush, adjust settings in increments until motors start without tripping. Do not exceed eight times the motor full-load amperes (or 11 times for NEMA Premium

Efficient motors if required). Where these maximum settings do not allow starting of a motor, notify Engineer before increasing settings.

- C. Set field-adjustable switches and program microprocessors for required start and stop sequences in reduced-voltage, solid-state controllers.
- D. Set field-adjustable circuit-breaker trip ranges as specified in Section 260573.16 "Power System Studies."

### 3.9 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain enclosed controllers.

END OF SECTION 262419

## SECTION 262505 – 480V CONTROL PANELS

### 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 480 volt industrial control panels required by other Divisions with the following features:
  - 1. Enclosure.
  - 2. Main circuit breaker.
  - 3. Motor controllers.
  - 4. Control and monitoring devices.
  - 5. Accessories.
  - 6. Identification.
- B. Related Requirements:
  - 1. Division 26 for electrical work
  - 2. Division 27 for communications wiring
  - 3. Division 40 for process automation requirements

#### 1.3 DEFINITIONS

- A. CPT: Control power transformer
- B. GFCI: Ground-fault circuit interrupter
- C. MCCB: Molded-case circuit breaker
- D. MCP: Motor circuit protector
- E. NEC: National Electrical Code
- F. RVSS: Reduced voltage soft start
- G. RVAT: Reduced voltage autotransformer start
- H. SCCR: Short-circuit current rating
- I. SPD: Surge protective device

- J. UL: Underwriter's Laboratories
- K. VFC: Variable frequency motor controller. See VFD
- L. VFD: Variable frequency drive. Used interchangeably with the term VFC.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each control panel.
  - 1. Include materials, switching and overcurrent protective devices, SPDs, accessories, and components indicated.
  - 2. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each control panel.
  - 1. Include dimensioned plans, elevations, sections, and details.
  - 2. Bill of materials with part numbers, cross-referenced to plans.
  - 3. Nameplate schedule.
  - 4. Conduit entrance locations and mounting details.
  - 5. Power and control schematics.
  - 6. Certification for compliance with UL 508A.
  - 7. Identification per NEC 409.110.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Startup reports.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following if applicable:
  - 1. Manufacturer's written instructions for testing and adjusting thermal-magnetic circuit breaker and motor-circuit protector trip settings.
  - 2. Manufacturer's written instructions for setting field-adjustable overload relays.
  - 3. Manufacturer's written instructions for testing, adjusting, and reprogramming microprocessor control modules.
  - 4. Manufacturer's written instructions for setting field-adjustable timers, controls, and status and alarm points.
  - 5. Load-Current and Overload-Relay Heater List: Compile after motors have been installed and arrange to demonstrate that selection of heaters suits actual motor nameplate, full-load currents.
  - 6. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed and arrange to demonstrate that switch settings for motor-running overload protection suit actual motors to be protected.



## 1.7 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. Control fuses: Equal to 10 percent of total quantity installed for each size and type, but no fewer than two of each size and type.
  - 2. Power fuses: Equal to 10 percent of total quantity installed for each size and type, but no fewer than three of each size and type.
  - 3. Corrosion Inhibitor: Equal to 100 percent of total number of control panels. (One spare per panel.)

## 1.8 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Accredited by NETA.
  - 1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

## 1.9 DELIVERY, STORAGE, AND HANDLING

- A. Store control panels indoors in clean, dry space with uniform temperature to prevent condensation. Protect control panels from exposure to dirt, fumes, water, corrosive substances, and physical damage.
- B. If stored in space that is not permanently enclosed and air conditioned, remove loose packing and flammable materials from inside enclosures and install temporary electric heating, with at least 50 W per enclosure.

## 1.10 FIELD CONDITIONS

- A. Ambient Environment Ratings: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
  - 1. Ambient Temperature: Not less than 23 deg F and not exceeding 104 deg F.
  - 2. Altitude: Not exceeding 6600 feet for electromagnetic and manual devices.

## 1.11 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace control panels that fail in materials or workmanship within specified warranty period.
- B. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace SPD that fails in materials or workmanship within specified warranty period.
  - 1. SPD Warranty Period: Five years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 GENERAL REQUIREMENTS

- A. Product Selection for Restricted Space: Drawings indicate maximum dimensions for control panels clearances between control panels and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with NEMA 250: Enclosures for Electrical Equipment (1000 Volts Maximum).
- D. Comply with NEMA ICS 6: Industrial Control and Systems: Enclosures.
- E. Comply with UL 1203 for control panels located in hazardous (classified) locations.
- F. Comply with NFPA 70.
- G. Comply with UL 508A.
- H. Complete and fully functional control to manually or automatically operate the control system as specified herein and in other applicable sections of these specifications. Include manufacturer's recommended safety devices to protect operators. All control devices, unless specified otherwise, mounted in the Control Panel.
- I. The control panel shall operate on a power supply of 480 volts, 3-phase, 60 hertz unless otherwise noted.
- J. Control panel consists of a main circuit breaker, motor circuit protector (MCP) and motor controller for each motor, and a 120-volt control power transformer (fused on primary and secondary) along with other devices specified. Mount all control components in one common enclosure.
- K. Operation of motors will be manually or automatically. Stagger control of multiple motors to prevent simultaneous motor starting.
- L. All electronic control equipment (i.e. controllers, isolators, signal boosters, transmitters, PLC's, etc.) shall be as specified in Division 40.
- M. Control panels containing PLC's shall contain UPS or battery ride-through for the PLC in accordance with Division 40 specifications.
- N. SCCR: Control panels with main breakers shall have SCCR of 65kA, unless specifically noted elsewhere.

### 2.2 ENCLOSURES

- A. Enclosures: Surface-mounted, dead-front cabinets rated for environmental conditions at installed location. Unless noted elsewhere, NEMA rating shall be NEMA 4X, Type 316 stainless steel, minimum 14 gauge.

- B. Construction: The door shall be mounted via continuous stainless steel hinged and provided with a pad-lockable vault type 3-point latch. The enclosure shall be equipped with a door and shall incorporate a removable back panel on which control components shall be mounted. Back panel shall be secured to enclosure with collar studs. Door(s) shall be interlocked with main circuit breaker and provided with pad-locking provision.
- C. All motor branch circuit breakers, motor starters and control relays shall be of highest industrial quality, securely fastened to the removable back panels with screws and lock washers. Back panels shall be tapped to accept all mounting screws. Self-tapping screws shall not be used to mount any component.
- D. Operating handle for main circuit breaker: flange mounted.
- E. Outdoor enclosures shall be provided with sun shields. Provide sun shields on fronts, sides, and tops of enclosures subject to direct and extended sun exposure.
- F. Provide additional temperature control if required to meet UL temperature rating of internal components. If forced air ventilation is required, the enclosure shall be pressurized. Air filters shall be of commercially available types and sizes.
- G. All operating control and instruments shall be securely mounted on the exterior door. All controls and instruments shall be clearly labeled to indicate function. All exterior mounted equipment shall be NEMA 4X.
- H. Print storage pockets shall be provided on the inside of each panel. Pocket shall be of sufficient size as required to hold all prints necessary to service the equipment.

## 2.3 COMPONENTS

- A. Main Breaker: Thermal-magnetic air circuit breaker, Schneider Electric/Square D PowerPact (65kAIC) or equal.
- B. MCP: Molded case motor circuit protector with adjustable magnetic trip only, Schneider Electric/Square D "Mag-Gard" or equal.
- C. Motor Controller:
  - 1. Full Voltage Motor Starting: Open frame, across-the-line, NEMA-rated magnetic motor starter, Schneider Electric/Square D Class 8536 or equal. Solid state overloads with Class 10/20 selectable tripping. Submersible motors shall use Class 10 trip curve.
  - 2. Reduced voltage motor starting: RVSS or VFD.
- D. Overload relays shall be self-powered solid-state type and provide the following features: tamper guard over trip adjustment setting, ambient insensitive, harmonic immunity, phase loss and phase unbalance protection, manual reset, and push-to-test.
- E. Overload reset buttons shall be mounted on dead front door.
- F. Normally open and normally closed auxiliary motor overload contacts wired to terminal blocks shall be provided for each motor starter within the control panel.

- G. SPD: The control panel shall be provided with a surge protective device (SPD) rated for 100kA per mode (200 kA per phase) for the incoming power and listed per UL 1449. SPD shall be mounted within the control panel enclosure. Lead lengths shall not be longer than 12 inches from the main circuit breaker.
- H. Control Power Transformer: 480-120V CPT, fused on primary and secondary sides, capacity as required.

## 2.4 CONTROL DEVICES AND ACCESSORIES

### A. Control Operators and Indicators:

1. Heavy duty type, full size (30.5mm), NEMA 4X or 7 as required.
2. Each motor shall include Hand-Off-Auto selector switches to permit override of automatic control and manual actuation of shutdown.

### B. Indicating Lights:

1. LED, full size (30.5mm), full voltage and push-to-test type.
2. Indicators shall be provided for individual motor run and an indicator for each failure condition.

### C. Elapsed Time Meters (ETM):

1. Six (6) digit, non-reset elapsed time meter to indicate the total running time of each motor in "hours" and "tenth of hours". Series T50 as manufactured by the ENM Company or equal.
2. Provide an ETM for each motor.

### D. Failure Alarm Horn and Beacon Light:

1. Alarm horn: weatherproof rated with gasket (Federal Signal Corporation, Cat. #350 or equal) for NEMA 4X applications.
2. Alarm beacon: Red lens and solid-state flasher (Ingam Products Inc. LRX-40 or equal) for NEMA 4X applications.
3. All lift station pump control panels shall include alarm horn and light for summary alarm condition.
4. Silence and reset pushbuttons shall also be furnished. A common failure reset pushbutton shall be provided to reset the alarm conditions (reset shall occur only if fault condition has been cleared).

### E. Relays:

1. Control relays shall be 10 amp rated contacts (minimum), 11 pin with mounting base, 3PDT (minimum), with LED indicators to show relay status, relays shall be manufactured by Potter Brumfield or equal.
2. Timing relays shall be solid state, with pin (octal) and bases, relays shall be T-series as manufactured by Diversified Electronics Inc. or equal.
3. Intrinsically safe relays shall be solid state type with 5 amp output contacts, suitable for use on 120 volt, 60 hertz power supply and shall be Factory Mutual approved for devices in Class 1, Division 1 hazardous atmospheres. Intrinsically safe relays shall be Gems Solid

State Safe-Pak as manufactured by Gems Sensors, Division of Transamerica Delaval, Inc. or equal.

- F. A duplex GFCI utility receptacle (circuit breaker protected) providing 120 volts, 60 Hertz, single phase current shall be mounted on the side of the enclosure.
- G. Auxiliary contacts shall be provided for remote run indication and indication of each status and alarm condition. Additional controls shall be provided as specified herein and as required by the associated process mechanical equipment section, Division 40 and as shown on the Drawings.
- H. Alternators shall be provided to sequence lead/lag motors, alternators shall be 008-120-13SP or 009-120-23AP as manufactured by Sta-con, or equal.
- I. A phase monitor shall be provided for the control panel, monitors shall be model SUA-440-ASA as manufactured by Diversified Electronics Inc., or equal.
- J. Corrosion Inhibitor Emitter: Inclusion of an industrial corrosion inhibitor emitter, selected by the manufacturer, to protect internal components of control panel from corrosion for up to one year.
- K. Breather assemblies, to maintain interior pressure and release condensation in Type 4X] or Type 7 enclosures installed outdoors or in unconditioned interior spaces subject to humidity and temperature swings.
- L. Space heaters, with NC auxiliary contacts, to mitigate condensation in Type 4X enclosures installed outdoors or in unconditioned interior spaces subject to humidity and temperature swings.

## 2.5 WIRING

- A. Power and control wire shall be 600 Volt class, Type MTW insulated stranded copper and shall be of the sizes required for the current to be carried, but not smaller than No. 14 AWG. All wiring shall be enclosed in PVC wire trough with slotted side openings and removable cover.
- B. Wiring shall be stranded copper, minimum size #14 AWG (except for shielded instrumentation cable), with 600 Volt, 90 degree C, flame retardant, Type MTW thermoplastic insulation.
- C. All interconnecting wires between panel mounted equipment and external equipment shall be terminated at numbered terminal blocks.
- D. Terminal blocks shall be 600 Volt heavy duty rated, tubular clamp type. Terminal strips shall be Allen Bradley catalog #1492-CA-1 or equal.
- E. A copper ground bar with sufficient terminals for all field and panel ground connections shall be provided.
- F. All signal wiring entering and exiting the control panel shall be provided with surge protection. Surge protection shall be as specified in Division 40.
- G. An 8-inch (minimum) clear space within the enclosure shall be provided horizontally along the entire top and bottom of the control panel. A 4-inch (minimum) clear space within the enclosure shall be provided vertically along the entire sides of the control panel. No devices, terminals, etc.

shall be installed within this space, the space shall be provided for field conduit and wiring access only.

## 2.6 IDENTIFICATION

- A. All control panel wiring shall be numbered at both ends with type written heat shrinkable wire markers.
- B. The control diagrams and overload tables shall be laminated to the inside of the door except where door space is limited the laminated documents shall be in the print storage pocket.
- C. The control panel shall be provided with nameplates identifying each component, selector switches, pilot lights, etc. Nameplates shall be permanently affixed using an epoxy process (inner door nameplates shall be fastened with stainless steel screws). Nameplates shall be laminated plastic, engraved black letters with a white background.
- D. All control panels shall be provided with two nameplates located on the exterior door. The first nameplate shall identify the control panel name. The second nameplate shall identify the power source.
- E. Where applicable provide a nameplate which reads as follows "CAUTION - THIS PANEL CONTAINS A VOLTAGE FROM AN EXTERNAL SOURCE." Letters shall be black on a high visibility yellow background.
- F. Each terminal at terminal blocks shall be individually labeled.
- G. Incoming phase conductor terminals shall be clearly identified. All wiring within the control panel shall be color coded or coded using electrical tape in sizes where colored insulation is not available. The following coding shall be used.

System	Wire	Color
Incoming line voltage	Phase conductors	Black
	Ground	Green
	Neutral (as required)	Gray
Internal control voltage	AC	Red
Internal control voltage	DC	Blue
External source	All	Yellow

## 2.7 FACTORY TESTS

- A. Inspect and test control panel for correct operation. Test each circuit for continuity, short circuits, and ground faults.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Comply with NECA 1.
- B. Inspect anchorage, alignment, grounding, and clearances.
- C. Compare equipment nameplate data for compliance with Drawings and Specifications.
- D. Verify that electrical wiring installation complies with manufacturer's written installation requirements.
- E. Motor Overload Relays: Select and set overloads on the basis of full-load current rating as shown on motor nameplate. Adjust setting value for special motors as required by NFPA 70 for motors that are high-torque, high-efficiency, and so on.
- F. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

### 3.2 STARTUP SERVICE

- A. Complete startup checks according to manufacturer's written instructions.
- B. Verify motor running protection is appropriate for actual motors installed.
- C. Test control panel with all field wiring connected. Set adjustable set points and time delays for proper operation of equipment. Adjust as required.
- D. Perform infrared inspection of panel interior during periods of maximum possible loading. Remove all necessary covers prior to the inspection. Comply with the recommendations of NFPA 70B, "Testing and Test Methods" Chapter, "Infrared Inspection" Article.
- E. Prepare test and inspection reports.
- F. Install a set of legible "as built" control panel drawings (11x17 or 8.5 x 11), in the storage pocket.

### 3.3 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain equipment.

END OF SECTION 262505

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## SECTION 262726 - WIRING DEVICES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:

1. Industrial specification-grade receptacles, 125 V, 20 A.
2. GFCI receptacles, 125 V, 20 A.
3. Hazardous (classified) location receptacles.
4. Industrial specification-grade toggle switches, 120/277 V, 20 A.
5. Wall plates.

#### 1.3 DEFINITIONS

- A. AFF: Above finished floor.
- B. AFG: Above finished grade.
- C. GFCI: Ground-fault circuit interrupter.
- D. Pigtail: Short lead used to connect a device to a branch-circuit conductor.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product used on this project.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing-label warnings and instruction manuals that include labeling conditions.

## 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 NFPA 70.
- C. RoHS compliant.
- D. Comply with NEMA WD 1.
- E. Device Color:
  - 1. White: Devices located in administrative office areas, conference rooms, breakrooms, restrooms, and control rooms.
  - 2. Gray: Devices located in electrical rooms, mechanical rooms, outdoors, and process areas.
- F. Wall Plate Color: For non-metallic covers, match device color.
- G. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

### 2.2 INDUSTRIAL SPECIFICATION-GRADE RECEPTACLES, 125 V, 20 A

- A. Duplex Receptacles, 125 V, 20 A:
  - 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. Eaton (Wiring Devices - Arrow Hart), Series 5362.
  - 2. Description: Two-pole, three-wire, and self-grounding.
  - 3. Configuration: NEMA WD 6, Configuration 5-20R.
  - 4. Standards: Comply with UL 498 and FS W-C-596.
- B. Weather- and Corrosion-Resistant Duplex Receptacles, 120V, 20A (WP or CR):
  - 1. Manufacturers:
    - a. Pass & Seymour;
    - b. Crouse-Hinds;
    - c. Appleton.
  - 2. Description: Two-pole, three-wire, with cover.
  - 3. Configuration: NEMA WD 1 and WD 5, Configuration 5-20R.
  - 4. Standards: Comply with UL 514A; NEMA FB-1.

5. Marking: Listed and labeled as complying with NFPA 70, "Receptacles in Damp or Wet and Corrosive Locations" Article.
6. Cover: TayMac Corp #10310G.

## 2.3 GFCI RECEPTACLES, 125 V, 20 A

### A. Duplex GFCI Receptacles, 125 V, 20 A (GFCI):

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. Arrow-Hart (Eaton), Series GF 5342..
2. Description: Integral GFCI with "Test" and "Reset" buttons and LED indicator light. Two-pole, three-wire, and self-grounding.
3. Configuration: NEMA WD 6, Configuration 5-20R.
4. Type: Feed through.
5. Standards: Comply with UL 498, UL 943 Class A, and FS W-C-596.

## 2.4 HAZARDOUS (CLASSIFIED) LOCATION RECEPTACLES

### A. Hazardous (Classified) Locations Receptacles (XP):

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. Appleton, EFS175-2023 or EFSC175-2023 with cap ECP-1523.
2. Description: Pin and sleeve receptacle with matching connector.
3. NEC Hazardous Area: Class I, Divisions 1 and 2.
4. Raintight.
5. Voltage: 250 V ac.
6. Hertz: 60 Hz.
7. Amperage: 20 A.
8. Wires and Poles: Two wire, three pole.
9. Standards: Comply with NEMA FB 11 and UL 1203.

## 2.5 INDUSTRIAL SPECIFICATION-GRADE TOGGLE SWITCHES, 120/277 V, 20 A

### A. Switches, 120/277 V, 20 A:

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. Single pole: Arrow-Hart (Eaton), Series 1991.
  - b. Double pole: Arrow-Hart (Eaton), Series 1992.

- c. Three way: Arrow-Hart (Eaton), Series 1993.
  - d. Four way: Arrow-Hart (Eaton), Series 1994.
2. Standards: Comply with UL 20 and FS W-S-896.

## 2.6 WALL PLATES

- A. Single Source: Obtain wall plates from same manufacturer of wiring devices.
- B. Single and combination types shall match corresponding wiring devices.
  - 1. Plate-Securing Screws: Metal with head color to match plate finish.
  - 2. Material for administrative office areas, conference rooms, breakrooms, restrooms, and control rooms: Smooth, high-impact thermoplastic or nylon.
  - 3. Material for flush mounted devices in electrical rooms, mechanical rooms, and indoor process areas: Type 302 (18-8) high nickel stainless steel.
  - 4. Material for surface mounted device plates shall be the same material as the box.
- C. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant, die-cast aluminum with lockable cover.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Comply with NECA 1.
- B. Device Mounting Heights (as measured to the center of the device box):
  - 1. Switches and occupancy sensors: 48" AFF, located on strike side of door.
  - 2. Wall receptacles, unless otherwise noted on Drawings:
    - a. Process areas and shops: 36" AFF
    - b. Administration office areas: 18" AFF
    - c. Corridors and hallways: 18" AFF
    - d. Electrical and mechanical rooms: 18" AFF
    - e. Restrooms: 18" AFF
    - f. Exterior walls: 18" AFG
  - 3. Where walls are unplastered brick or masonry, adjust mounting height above so one horizontal edge of device box lines up with a horizontal joint in the masonry.
- C. 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 wall plates after finish painting is complete.

D. Conductors:

1. Do not strip insulation from conductors until right 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 comply with NFPA 70, Article 300, without pigtails.
4. Existing Conductors:
  - a. Cut back and pigtail, or replace all damaged conductors.
  - b. Straighten conductors that remain and remove corrosion and foreign matter.
  - c. Pigtailing existing conductors is permitted, provided the outlet box is large enough.

E. Device Installation:

1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
5. 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. Do not overlap conductors.
6. Use a torque screwdriver when a torque is recommended or required by manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.

F. Receptacle Orientation:

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

G. 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.

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

### 3.2 GFCI RECEPTACLES

- A. Install non-feed-through GFCI receptacles where protection of downstream receptacles is not required.

### 3.3 IDENTIFICATION

- A. Comply with Section 260553 "Identification for Electrical Systems."
- B. Identify each receptacle with panelboard identification and circuit number. Use hot, stamped, or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

### 3.4 FIELD QUALITY CONTROL

- A. Test Instruments: Use instruments that comply with UL 1436.
- B. Test Instrument for Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.
- C. Tests for Receptacles:
  - 1. Line Voltage: Acceptable range is 105 to 132 V.
  - 2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is unacceptable.
  - 3. Ground Impedance: Values of up to 2 ohms are acceptable.
  - 4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
  - 5. Using the test plug, verify that the device and its outlet box are securely mounted.
  - 6. Tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault-current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.
- D. Wiring device will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

END OF SECTION 262726

## SECTION 262813 - FUSES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:

1. Cartridge fuses rated 600 V ac and less for use in the following:
  - a. Control circuits.
  - b. Motor-control centers.
  - c. Panelboards.
  - d. Switchboards.
  - e. Enclosed controllers.
  - f. Enclosed switches.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product used on the project. Note that not all products listed may be used on this project. Include construction details, material descriptions, dimensions of individual components. Include the following for each fuse type indicated:
  1. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
  2. Current-limitation curves for fuses with current-limiting characteristics.
  3. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse. Submit in PDF format.
  4. Coordination charts and tables and related data.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  1. Bussmann, an Eaton business.
  2. Littelfuse, Inc.

3. Mersen USA.

- B. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.

## 2.2 CARTRIDGE FUSES

- A. Characteristics: NEMA FU 1, current-limiting, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.
1. Type RK-1: 250 or 600-V, zero- to 600-A rating, 200 kAIC, time delay.
  2. Type RK-5: 250 or 600-V, zero- to 600-A rating, 200 kAIC, time delay.
  3. Type CC: 600-V, zero- to 30-A rating, 200 kAIC, fast acting, or time delay.
  4. Type CD: 600-V, 31- to 60-A rating, 200 kAIC, fast acting, or time delay.
  5. Type J: 600-V, zero- to 600-A rating, 200 kAIC, time delay.
  6. Type L: 600-V, 601- to 6000-A rating, 200 kAIC, time delay.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with NEMA FU 1 for cartridge fuses.
- D. Comply with NFPA 70.
- E. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.
- B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.
- C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.
- D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.



### 3.2 FUSE APPLICATIONS

#### A. Cartridge Fuses:

1. Fused Disconnect Switches: Class RK5, time delay.
2. Power Electronics Circuits: Class J, high speed.
3. Control Transformer Circuits: Class CC, time delay, control transformer duty.
4. Provide open-fuse indicator fuses or fuse covers with open fuse indication.

### 3.3 INSTALLATION

- #### A.
- Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

### 3.4 IDENTIFICATION

- #### A.
- Install labels complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems" and indicating fuse replacement information inside of door of each fused switch and adjacent to each fuse block, socket, and holder.

END OF SECTION 262813

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## SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Fusible switches.
  - 2. Nonfusible switches.
  - 3. Molded-case circuit breakers (MCCBs).
  - 4. Enclosures.

#### 1.3 DEFINITIONS

- A. SPDT: Single pole, double throw.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include nameplate ratings, dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
  - 1. Enclosure types and details for types other than NEMA 250, Type 1.
  - 2. Current and voltage ratings.
  - 3. Short-circuit current ratings (interrupting and withstand, as appropriate).
  - 4. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.

### PART 2 - PRODUCTS

#### 2.1 GENERAL REQUIREMENTS

- A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single manufacturer.

- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by UL or a NRTL if approved by the Owner and/or Engineer, and marked for intended location and application.
- C. Comply with NFPA 70.

## 2.2 FUSIBLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. General Electric; by ABB.
  - 2. Eaton.
  - 3. Schneider Electric USA (Square D).
- B. Type HD, Heavy Duty:
  - 1. Single throw.
  - 2. Three pole.
  - 3. 600-V ac.
  - 4. Ampacity as shown on Drawings.
  - 5. UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified fuses.
  - 6. Lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- C. Accessories:
  - 1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
  - 2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
  - 3. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
  - 4. Lugs: Suitable for number, size, and conductor material.
  - 5. Service-Rated Switches: Labeled for use as service equipment.

## 2.3 NONFUSIBLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. General Electric, by ABB.
  - 2. Eaton.
  - 3. Schneider Electric USA (Square D).
- B. Type HD, Heavy Duty, Three Pole, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

- C. Type HD, Heavy Duty, Three Pole, Double Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- D. Accessories:
  - 1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
  - 2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
  - 3. Lugs: Suitable for number, size, and conductor material.

## 2.4 MOLDED-CASE CIRCUIT BREAKERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. General Electric, by ABB.
  - 2. Eaton.
  - 3. Schneider Electric USA (Square D).
- B. Circuit breakers shall be constructed using glass-reinforced insulating material. Current carrying components shall be completely isolated from the handle and the accessory mounting area.
- C. Circuit breakers shall have a toggle operating mechanism with common tripping of all poles, which provides quick-make, quick-break contact action. The circuit-breaker handle shall be over center, be trip free, and reside in a tripped position between on and off to provide local trip indication. Circuit-breaker escutcheon shall be clearly marked on and off in addition to providing international I/O markings. Equip circuit breaker with a push-to-trip button, located on the face of the circuit breaker to mechanically operate the circuit-breaker tripping mechanism for maintenance and testing purposes.
- D. The maximum ampere rating and UL, IEC, or other certification standards with applicable voltage systems and corresponding interrupting ratings shall be clearly marked on face of circuit breaker. Circuit breakers shall be rated as indicated on the Drawings. Series ratings are unacceptable.
- E. MCCBs shall be equipped with a device for locking in the isolated position.
- F. Standard: Comply with UL 489 with interrupting capacity to comply with available fault currents.
- G. Thermal-Magnetic Circuit Breakers: Inverse time-current thermal element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
- H. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.

- I. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:
  - 1. Instantaneous trip.
  - 2. Long- and short-time pickup levels.
  - 3. Long- and short-time time adjustments.
  - 4. Ground-fault pickup level, time delay, and I-squared t response.
- J. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller, and let-through ratings less than NEMA FU 1, RK-5.
- K. Ground-Fault Circuit-Interrupter (GFCI) Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (5-mA trip).
- L. Ground-Fault Equipment-Protection (GFEP) Circuit Breakers: With Class B ground-fault protection (30-mA trip).
- M. Features and Accessories:
  - 1. Standard frame sizes, trip ratings, and number of poles.
  - 2. Lugs: Suitable for number, size, trip ratings, and conductor material.
  - 3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.
  - 4. Ground-Fault Protection: Comply with UL 1053; integrally mounted, self-powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.

## 2.5 ENCLOSURES

- A. Enclosed Switches and Circuit Breakers: UL 489, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.
- B. Enclosure Finish: The enclosure shall be finished with gray baked enamel paint or Owner approved color and paint, electrodeposited on cleaned, phosphatized steel (NEMA 250 Type 1); gray baked enamel paint or Owner approved color and paint, electrodeposited on cleaned, phosphatized galvanized steel (NEMA 250 Types 3R, 12); a brush finish on Type 316 stainless steel (NEMA 250 Type 4,4X);copper-free cast aluminum alloy (NEMA 250 Types 7, 9).
- C. Conduit Entry: NEMA 250 Types 4, 4X, and 12 enclosures shall contain no knockouts. NEMA 250 Types 7 and 9 enclosures shall be provided with threaded conduit openings in both endwalls.
- D. Operating Mechanism: The circuit-breaker operating handle shall be externally operable with the operating mechanism being an integral part of the box, not the cover. The cover interlock mechanism shall have an externally operated override. The override shall not permanently disable the interlock mechanism, which shall return to the locked position once the override is

released. The tool used to override the cover interlock mechanism shall not be required to enter the enclosure in order to override the interlock.

- E. Enclosures designated as NEMA 250 Type 4, 4X stainless steel, 12, or 12K shall have a dual cover interlock mechanism to prevent unintentional opening of the enclosure cover when the circuit breaker is ON and to prevent turning the circuit breaker ON when the enclosure cover is open.
- F. NEMA 250 Type 7/9 enclosures shall be furnished with a breather and drain kit to allow their use in outdoor and wet location applications.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.

#### 3.2 PREPARATION

- A. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
  - 1. Notify Owner no fewer than seven days in advance of proposed interruption of electric service.
  - 2. Indicate method of providing temporary electric service.
  - 3. Do not proceed with interruption of electric service without Owner's written permission.
  - 4. Comply with NFPA 70E.

#### 3.3 ENCLOSURE ENVIRONMENTAL RATING APPLICATIONS

- A. Enclosed Switches and Circuit Breakers: Provide enclosures at installed locations with the following environmental ratings as noted on the Drawings.

#### 3.4 INSTALLATION

- A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.
- C. Install fuses in fusible devices.
- D. Comply with NFPA 70 and NECA 1.

### 3.5 IDENTIFICATION

- A. Comply with requirements in Section 260553 "Identification for Electrical Systems."
  - 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
  - 2. Label each enclosure with engraved metal or laminated-plastic nameplate.

### 3.6 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections for Switches:
  - 1. Visual and Mechanical Inspection:
    - a. Inspect physical and mechanical condition.
    - b. Inspect anchorage, alignment, grounding, and clearances.
    - c. Verify that the unit is clean.
    - d. Verify blade alignment, blade penetration, travel stops, and mechanical operation.
    - e. Verify that fuse sizes and types match the Specifications and Drawings.
    - f. Verify that each fuse has adequate mechanical support and contact integrity.
    - g. Inspect bolted electrical connections for high resistance using one of the two following methods:
      - 1) Use a low-resistance ohmmeter.
        - a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.
      - 2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.
        - a) Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.
    - h. Verify lubrication of moving current-carrying parts and moving and sliding surfaces.
  - 2. Electrical Tests:
    - a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
    - b. Measure contact resistance across each switchblade fuseholder. Drop values shall not exceed the high level of the manufacturer's published data. If manufacturer's



published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.

- c. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with switch closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 from the NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.
- d. Measure fuse resistance. Investigate fuse-resistance values that deviate from each other by more than 15 percent.
- e. Perform ground fault test, if applicable, according to NETA ATS 7.14 "Ground Fault Protection Systems, Low-Voltage."

C. Tests and Inspections for Molded Case Circuit Breakers:

1. Visual and Mechanical Inspection:

- a. Verify that equipment nameplate data are as described in the Specifications and shown on the Drawings.
- b. Inspect physical and mechanical condition.
- c. Inspect anchorage, alignment, grounding, and clearances.
- d. Verify that the unit is clean.
- e. Operate the circuit breaker to ensure smooth operation.
- f. Inspect bolted electrical connections for high resistance using one of the two following methods:
  - 1) Use a low-resistance ohmmeter.
    - a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.
  - 2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.
    - a) Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.
- g. Inspect operating mechanism, contacts, and chutes in unsealed units.
- h. Perform adjustments for final protective device settings in accordance with the coordination study.

2. Electrical Tests:

- a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.

- b. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with circuit breaker closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 from the NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.
  - c. Perform a contact/pole resistance test. Drop values shall not exceed the high level of the manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
  - d. Perform insulation resistance tests on all control wiring with respect to ground. Applied potential shall be 500-V dc for 300-V rated cable and 1000-V dc for 600-V rated cable. Test duration shall be one minute. For units with solid state components, follow manufacturer's recommendation. Insulation resistance values shall be no less than two megohms.
  - e. Determine the following by primary current injection:
    - 1) Long-time pickup and delay. Pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
    - 2) Short-time pickup and delay. Short-time pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
    - 3) Ground-fault pickup and time delay. Ground-fault pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
    - 4) Instantaneous pickup. Instantaneous pickup values shall be as specified and within manufacturer's published tolerances.
  - f. Test functionality of the trip unit by means of primary current injection. Pickup values and trip characteristics shall be as specified and within manufacturer's published tolerances.
  - g. Perform minimum pickup voltage tests on shunt trip and close coils in accordance with manufacturer's published data. Minimum pickup voltage of the shunt trip and close coils shall be as indicated by manufacturer.
  - h. Verify correct operation of auxiliary features such as trip and pickup indicators; zone interlocking; electrical close and trip operation; trip-free, anti-pump function; and trip unit battery condition. Reset all trip logs and indicators. Investigate units that do not function as designed.
  - i. Verify operation of charging mechanism. Investigate units that do not function as designed.
- 3. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
  - 4. Perform the following infrared scan tests and inspections and prepare an Initial and Follow-up report:
    - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each enclosed switch and circuit breaker. Remove front panels so joints and connections are accessible to portable scanner.

- b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each enclosed switch and circuit breaker 11 months after date of Substantial Completion.
  - c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
- 5. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports.
  - 1. Test procedures used.
  - 2. Include identification of each enclosed switch and circuit breaker tested and describe test results.
  - 3. List deficiencies detected, remedial action taken, and observations after remedial action.

### 3.7 ADJUSTING AND CLEANING

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges as specified in Section 260573.16 "Coordination Studies."

END OF SECTION 262816

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## SECTION 262913.03 - MANUAL AND MAGNETIC MOTOR CONTROLLERS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes the following equipment which may or may not be used on this project:
  - 1. Manual motor controllers.
  - 2. Enclosed full-voltage magnetic motor controllers.
  - 3. Combination full-voltage magnetic motor controllers.
  - 4. Enclosures.
  - 5. Accessories.
  - 6. Identification.

#### 1.3 DEFINITIONS

- A. CPT: Control power transformer.
- B. MCCB: Molded-case circuit breaker.
- C. MCP: Motor circuit protector.
- D. NC: Normally closed.
- E. OCPD: Overcurrent protective device.
- F. SCCR: Short-circuit current rating.
- G. SCPD: Short-circuit protective device.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: For each type of magnetic controller.
  - 1. Include plans, elevations, sections, and mounting details.

2. Indicate dimensions, weights, required clearances, and location and size of each field connection.
3. Wire Termination Diagrams and Schedules: Include diagrams for signal, and control wiring. Identify terminals and wiring designations and color-codes to facilitate installation, operation, and maintenance. Indicate recommended types, wire sizes, and circuiting arrangements for field-installed wiring, and show circuit protection features. Differentiate between manufacturer-installed and field-installed wiring.
4. Include features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

C. Product Schedule: List the following for each enclosed controller:

1. Each installed magnetic controller type.
2. NRTL listing.
3. Factory-installed accessories.
4. Nameplate legends.
5. SCCR of integrated unit.
6. For each combination magnetic controller include features, characteristics, ratings, and factory setting of the SCPD and OCPD.
  - a. Listing document proving Type 2 coordination.
7. For each series-rated combination state the listed integrated short-circuit current (withstand) rating of SCPD and OCPDs by an NRTL acceptable to authorities having jurisdiction.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.
- B. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For magnetic controllers to include in operation and maintenance manuals.
  1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
    - a. Routine maintenance requirements for magnetic controllers and installed components.
    - b. Manufacturer's written instructions for testing and adjusting circuit breaker and MCP trip settings.
    - c. Manufacturer's written instructions for setting field-adjustable overload relays.
    - d. Load-Current and Overload-Relay Heater List: Compile after motors have been installed, and arrange to demonstrate that selection of heaters suits actual motor nameplate full-load currents.

- e. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed, and arrange to demonstrate that switch settings for motor-running overload protection suit actual motors to be protected.

## 1.7 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Accredited by NETA.
  - 1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

## 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Store controllers indoors in clean, dry space with uniform temperature to prevent condensation. Protect controllers from exposure to dirt, fumes, water, corrosive substances, and physical damage.
- B. If stored in areas subject to weather, cover controllers to protect them from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and flammable materials from inside controllers; install temporary electric heating, with at least 50 W per controller.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- 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 use.
- B. UL Compliance: Fabricate and label magnetic motor controllers to comply with UL 508 and UL 60947-4-1.
- C. NEMA Compliance: Fabricate motor controllers to comply with ICS 2.

### 2.2 MANUAL MOTOR CONTROLLERS

- A. Fractional Horsepower Manual Controllers (FHPMC): "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off, on, or tripped.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Eaton.
    - b. General Electric / ABB.
    - c. Schneider Electric USA (Square D).
  - 2. Configuration: Non-reversing.

3. Overload Relays: Inverse-time-current characteristics; NEMA ICS 2, Class 10 tripping characteristics; heaters matched to nameplate full-load current of actual protected motor; external reset push button; bimetallic type.

## 2.3 ENCLOSED FULL-VOLTAGE MAGNETIC MOTOR CONTROLLERS

- A. Description: Across-the-line start, electrically held, for nominal system voltage of 600-V ac and less.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Eaton.
  2. General Electric / ABB.
  3. Schneider Electric USA (Square D).
- C. Standard: Comply with NEMA ICS 2, general purpose, Class A.
- D. Configuration: Two or three pole; single or three phase; Nonreversing unless shown otherwise on the Drawings. Sized per horsepower shown on Drawings, minimum size NEMA 1..
- E. Control Power:
  1. For on-board control power, obtain from line circuit or from integral CPT. The CPT shall have capacity to operate integral devices and remotely located pilot, indicating, and control devices.
- F. Overload Relays:
  1. Solid-State Overload Relay:
    - a. Switch or dial selectable for motor-running overload protection.
    - b. Sensors in each phase.
    - c. Class 10/20 selectable tripping characteristic.
    - d. Additional features: tamper guard over trip adjustment setting; ambient insensitive; harmonic immunity; phase loss and phase unbalance protection; manual reset; push-to-test.
    - e. Class II ground-fault protection shall comply with UL 1053 to interrupt low-level ground faults. The ground-fault detection system shall include circuitry that will prevent the motor controller from tripping when the fault current exceeds the interrupting capacity of the controller. Equip with start and run delays to prevent nuisance trip on starting, and a trip indicator.

## 2.4 COMBINATION FULL-VOLTAGE MAGNETIC MOTOR CONTROLLER

- A. Description: Factory-assembled, combination full-voltage magnetic motor controller consisting of the controller described in this article, indicated disconnecting means, SCPD and OCPD, in a single enclosure.



- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Eaton.
  - 2. General Electric / ABB.
  - 3. Schneider Electric USA (Square D).
- C. Standard: Comply with NEMA ICS 2, general purpose, Class A.
- D. Configuration: Two or three pole; single or three phase; Nonreversing unless shown otherwise on the Drawings. Sized per horsepower shown on Drawings, minimum size NEMA.
- E. Control Power:
  - 1. For on-board control power, obtain from line circuit or from integral CPT. The CPT shall have capacity to operate integral devices and remotely located pilot, indicating, and control devices.
- F. Overload Relays:
  - 1. Solid-State Overload Relay:
    - a. Switch or dial selectable for motor-running overload protection.
    - b. Sensors in each phase.
    - c. Class 10/20 selectable tripping characteristic. Additional features: tamper guard over trip adjustment setting; ambient insensitive; harmonic immunity; phase loss and phase unbalance protection; manual reset; push-to-test.
- G. MCP Disconnecting Means:
  - 1. UL 489 and NEMA AB 3, with interrupting capacity to comply with available fault currents, instantaneous-only circuit breaker with front-mounted, field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes. Minimum 65kA SCCR.
  - 2. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.

## 2.5 ENCLOSURES

- A. Comply with NEMA 250, type designations as indicated on Drawings, complying with environmental conditions at installed location.
- B. The construction of the enclosures shall comply with NEMA ICS 6.
- C. Controllers in hazardous (classified) locations shall comply with UL 1203.
- D. NEMA 4X enclosures shall be stainless steel.
- E. NEMA 7 enclosures shall be cast aluminum.

## 2.6 ACCESSORIES

- A. General Requirements for Control Circuit and Pilot Devices: NEMA ICS 5; factory installed in controller enclosure cover unless otherwise indicated.
  - 1. Push Buttons, Pilot Lights, and Selector Switches: Standard-duty, except as needed to match enclosure type. Heavy-duty or oil-tight where indicated in the controller schedule.
    - a. Push Buttons: As indicated in the controller schedule.
    - b. Pilot Lights: As indicated in the controller schedule. LED type.
  - 2. Elapsed Time Meters: Heavy duty with digital readout in hours; nonresettable.

## 2.7 IDENTIFICATION

- A. Controller Nameplates: Laminated acrylic or melamine plastic signs, as described in Section 260553 "Identification for Electrical Systems," for each compartment, mounted with corrosion-resistant screws.

# PART 3 - EXECUTION

## 3.1 EXAMINATION

- A. Examine areas and space conditions for compliance with requirements for motor controllers, their relationship with the motors, and other conditions affecting performance of the Work.

## 3.2 INSTALLATION

- A. Comply with NECA 1.
- B. Wall-Mounted Controllers: Install magnetic controllers on walls with tops at uniform height indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For controllers not at walls, provide freestanding racks complying with Section 260529 "Hangers and Supports for Electrical Systems" unless otherwise indicated.
- C. Floor-Mounted Controllers: Install controllers on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."
- D. Maintain minimum clearances and workspace at equipment according to manufacturer's written instructions and NFPA 70.
- E. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

- F. Setting of Overload Relays: Select and set overloads on the basis of full-load current rating as shown on motor nameplate. Adjust setting value for special motors as required by NFPA 70 for motors that are high-torque, high-efficiency, and so on.

### 3.3 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- B. Install Arc-Flash Warning Labels in compliance with requirements of Section 260573 "Power System Studies".

### 3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
  - 1. Comply with the provisions of NFPA 70B, "Testing and Test Methods" Chapter.
  - 2. Visual and Mechanical Inspection:
    - a. Compare equipment nameplate data with drawings and specifications.
    - b. Inspect physical and mechanical condition.
    - c. Inspect anchorage, alignment, and grounding.
    - d. Verify the unit is clean.
    - e. Inspect contactors:
      - 1) Verify mechanical operation.
      - 2) Verify contact gap, wipe, alignment, and pressure are according to manufacturer's published data.
    - f. Motor-Running Protection:
      - 1) Verify overload element rating is correct for its application.
      - 2) If motor-running protection is provided by fuses, verify correct fuse rating.
    - g. Inspect bolted electrical connections for high resistance using one of the two following methods:
      - 1) Use a low-resistance ohmmeter. Compare bolted connection resistance values with values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.
      - 2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method according to manufacturer's published data or NETA ATS Table 100.12. Bolt-torque levels shall be according to manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.

- h. Verify appropriate lubrication on moving current-carrying parts and on moving and sliding surfaces.
3. Electrical Tests:
- a. For the contactor and circuit breaker, perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with switch closed, and across each open pole. Insulation-resistance values shall be according to manufacturer's published data or NETA ATS Table 100.1. In the absence of manufacturer's published data, use Table 100.5. Values of insulation resistance less than those of this table or manufacturer's recommendations shall be investigated and corrected.
  - b. Measure fuse resistance. Investigate fuse-resistance values that deviate from each other by more than 15 percent.
  - c. Test motor protection devices according to manufacturer's published data.
  - d. Test circuit breakers as follows:
    - 1) Operate the circuit breaker to ensure smooth operation.
    - 2) For adjustable circuit breakers, adjust protective device settings according to the coordination study. Comply with coordination study recommendations.
  - e. Perform operational tests by initiating control devices.
4. Infrared Inspection: Perform the survey during periods of maximum possible loading. Remove all necessary covers prior to the inspection.
- a. Comply with the recommendations of NFPA 70B, "Testing and Test Methods" Chapter, "Infrared Inspection" Article.
  - b. After Substantial Completion, but not more than 60 days after Final Acceptance, perform infrared inspection of the electrical power connections of each motor controller.
  - c. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each motor controller 11 months after date of Substantial Completion.
  - d. Report of Infrared Inspection: Prepare a certified report that identifies the testing technician and equipment used, and lists the following results:
    - 1) Description of equipment to be tested.
    - 2) Discrepancies.
    - 3) Temperature difference between the area of concern and the reference area.
    - 4) Probable cause of temperature difference.
    - 5) Areas inspected. Identify inaccessible and unobservable areas and equipment.
    - 6) Load conditions at time of inspection.
    - 7) Photographs and thermograms of the deficient area.
    - 8) Recommended action.
  - e. Equipment: Inspect distribution systems with imaging equipment capable of detecting a minimum temperature difference of 1 deg C at 30 deg C. The equipment shall detect emitted radiation and convert detected radiation to a visual signal.

- f. Act on inspection results and recommended action, and considering the recommendations of NETA ATS, Table 100.18. Correct possible and probable deficiencies as soon as Owner's operations permit. Retest until deficiencies are corrected.
- C. Motor controller will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

### 3.5 SYSTEM FUNCTION TESTS

- A. System function tests shall prove the correct interaction of sensing, processing, and action devices. Perform system function tests after field quality control tests have been completed and all components have passed specified tests.
  - 1. Develop test parameters and perform tests for the purpose of evaluating performance of integral components and their functioning as a complete unit within design requirements and manufacturer's published data.
  - 2. Verify the correct operation of interlock safety devices for fail-safe functions in addition to design function.
  - 3. Verify the correct operation of sensing devices, alarms, and indicating devices.
- B. Motor controller will be considered defective if it does not pass the system function tests and inspections.
- C. Prepare test and inspection reports.

### 3.6 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain switchgear.

END OF SECTION 262913.03

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## SECTION 262923 - VARIABLE-FREQUENCY MOTOR CONTROLLERS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes separately enclosed, preassembled, combination VFCs, rated 600 V and less, for speed control of three-phase, squirrel-cage induction motors. This equipment may or may not be used on this project.
- B. Related Requirements:
  - 1. Section 262419 "Motor-Control Centers" for VFCs installed in motor-control centers.

#### 1.3 DEFINITIONS

- A. CPT: Control power transformer.
- B. LED: Light-emitting diode.
- C. NC: Normally closed.
- D. NO: Normally open.
- E. OCPD: Overcurrent protective device.
- F. PCC: Point of Common Coupling. Normally defined within IEEE 519 as the connection point between the Owner and the electric utility. For this project, PCC is defined as the closest upstream power distribution bus serving the local VFC, i.e. an Owner's motor control center, switchgear, switchboard, etc. within the facility.
- G. VFC: Variable-frequency motor controller. See VFD.
- H. VFD: Variable-frequency drive. Used interchangeably with the term VFC.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type and rating of VFC indicated.
  - 1. Include dimensions and finishes for VFCs.

2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For each VFC indicated.

1. Include mounting and attachment details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.
- B. Product Certificates: For each VFC from manufacturer.
- C. Confirmation that the motor characteristics (i.e. torque type, FLA, etc.) have been coordinated with the supplier of the driven equipment and that the VFCs being supplied are matched properly for the driven load.
- D. Source quality-control reports.
- E. Field quality-control reports.
- F. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For VFCs to include in emergency, operation, and maintenance manuals.
  1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
    - a. Manufacturer's written instructions for testing and adjusting thermal-magnetic circuit breaker and motor-circuit protector trip settings.
    - b. Manufacturer's written instructions for setting field-adjustable overload relays.
    - c. Manufacturer's written instructions for testing, adjusting, and reprogramming microprocessor control modules.
    - d. Manufacturer's written instructions for setting field-adjustable timers, controls, and status and alarm points.
    - e. Load-Current and Overload-Relay Heater List: Compile after motors have been installed, and arrange to demonstrate that selection of heaters suits actual motor nameplate, full-load currents.
    - f. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed, and arrange to demonstrate that switch settings for motor-running overload protection suit actual motors to be protected.



## 1.7 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. Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
  - 2. Control Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.
  - 3. Indicating Lights: Two of each type and color installed.
  - 4. Auxiliary Contacts: Furnish one spare(s) for each size and type of magnetic controller installed.
  - 5. Power Contacts: Furnish three spares for each size and type of magnetic contactor installed.

## 1.8 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Accredited by NETA.
  - 1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

## 1.9 DELIVERY, STORAGE, AND HANDLING

- A. If stored in space that is not permanently enclosed and air conditioned, remove loose packing and flammable materials from inside controllers and install temporary electric heating, with at least 250 W per controller.
- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for VFCs, including clearances between VFCs, and adjacent surfaces and other items.

## 1.10 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace VFCs that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Five years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

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

## 2.2 SYSTEM DESCRIPTION

### A. General Requirements for VFCs:

1. VFCs and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Comply with NEMA ICS 7, NEMA ICS 61800-2, and UL 508A.

### B. Application: Constant torque and/or variable torque as required by the driven-equipment process application.

### C. VFC Description: Variable-frequency motor controller, consisting of power converter that employs pulse-width-modulated inverter, factory built and tested in an enclosure, with integral disconnecting means and overcurrent and overload protection; listed and labeled by an NRTL as a complete unit; arranged to provide self-protection, protection, and variable-speed control of one or more three-phase induction motors by adjusting output voltage and frequency.

1. Units suitable for operation of NEMA MG 1, Design A and Design B motors, as defined by NEMA MG 1, Section IV, Part 30, "Application Considerations for Constant Speed Motors Used on a Sinusoidal Bus with Harmonic Content and General Purpose Motors Used with Adjustable-Voltage or Adjustable-Frequency Controls or Both."
2. Units suitable for operation of inverter-duty motors as defined by NEMA MG 1, Section IV, Part 31, "Definite-Purpose Inverter-Fed Polyphase Motors."
3. Listed and labeled for integrated short-circuit current (withstand) rating by an NRTL acceptable to authorities having jurisdiction.

### D. Design and Rating: Match load type, such as fans, blowers, and pumps; and type of connection used between motor and load such as direct or through a power-transmission connection.

### E. Output Rating: 480 Volts; three-phase; 00 to 60 Hz; power rated for 100% continuous current.

### F. Unit Operating Requirements:

1. Input AC Voltage Tolerance: Plus 10 and minus 10 percent of VFC input voltage rating.
2. Input AC Voltage Unbalance: Not exceeding 3 percent.
3. Input Frequency Tolerance: Plus or minus 3 percent of VFC frequency rating.
4. Minimum Efficiency: 97 percent at 60 Hz, full load.
5. Minimum Displacement Primary-Side Power Factor: 96 percent under any load or speed condition.
6. Minimum Short-Circuit Current (Withstand) Rating: 65 kA.
7. Ambient Temperature Rating: Not less than 32 deg F and not exceeding 104 deg F.
8. Humidity Rating: Less than 95 percent (noncondensing).
9. Altitude Rating: Not exceeding 3300 feet.
10. Vibration Withstand: Comply with NEMA ICS 61800-2.
11. Overload Capability: 110% overcurrent for variable torque loads, 150% per constant torque loads for 60 seconds; minimum of 1.8 times the base load current for three seconds.
12. Starting Torque: Minimum 100 percent of rated torque from 3 to 60 Hz.
13. Speed Regulation: Plus or minus 0.5 percent.
14. Output Carrier Frequency: Selectable; 0.5 to 15 kHz.
15. Stop Modes: Programmable; includes fast, free-wheel, and dc injection braking.

- G. Inverter Logic: Microprocessor based, isolated from all power circuits.
- H. Isolated Control Interface: Allows VFCs to follow remote-control signal over a minimum 40:1 speed range.
  - 1. Signal: Electrical.
- I. Self-Protection and Reliability Features:
  - 1. Surge Suppression: Factory installed as an integral part of the VFC, complying with UL 1449 SPD, Type 1 or Type 2.
  - 2. Surge Suppression: Field-mounted surge suppressors complying with Section 264313 "Surge Protection for Low-Voltage Electrical Power Circuits," UL 1449 SPD, Type 2.
  - 3. Loss of Input Signal Protection: Selectable response strategy, including speed default to a percent of the most recent speed, a preset speed, or stop; with alarm.
  - 4. Under- and overvoltage trips.
  - 5. Inverter overcurrent trips.
  - 6. VFC and Motor-Overload/Overtemperature Protection: Microprocessor-based thermal protection system for monitoring VFCs and motor thermal characteristics, and for providing VFC overtemperature and motor-overload alarm and trip; settings selectable via the keypad.
  - 7. Critical frequency rejection, with three selectable, adjustable deadbands.
  - 8. Instantaneous line-to-line and line-to-ground overcurrent trips.
  - 9. Loss-of-phase protection.
  - 10. Reverse-phase protection.
  - 11. Short-circuit protection.
  - 12. Motor-overtemperature fault.
  - 13. Ground fault protection.
  - 14. DC bus protection.
- J. Automatic Reset/Restart: Attempt three restarts after drive fault or on return of power after an interruption and before shutting down for manual reset or fault correction; adjustable delay time between restart attempts.
- K. Power-Interruption Protection: To prevent motor from re-energizing after a power interruption until motor has stopped, unless "Bidirectional Autospeed Search" feature is available and engaged.
- L. Bidirectional Autospeed Search: Capable of starting VFC into rotating loads spinning in either direction and returning motor to set speed in proper direction, without causing damage to drive, motor, or load.
- M. Torque Boost: Automatically varies starting and continuous torque to at least 1.5 times the minimum torque to ensure high-starting torque and increased torque at slow speeds.
- N. Motor Temperature Compensation at Slow Speeds: Adjustable current fall-back based on output frequency for temperature protection of self-cooled, fan-ventilated motors at slow speeds.
- O. Integral Input Disconnecting Means and OCPD: UL 489, thermal-magnetic circuit breaker with pad-lockable, door-mounted handle mechanism.

1. Disconnect Rating: Not less than 115 percent of VFC input current rating. Minimum short circuit interruptible rating: 65kA.

## 2.3 CONTROLS AND INDICATION

- A. Controls shall, as a minimum, perform the control logic indicated on the Contract Drawings and as specified herein.
- B. Status Lights: Door-mounted LED indicators displaying the following conditions:
  1. Power on.
  2. Run.
  3. Overvoltage.
  4. Line fault.
  5. Overcurrent.
  6. External fault.
- C. Panel-Mounted Operator Station: Manufacturer's standard front-accessible, sealed keypad and plain-English-language digital display; allows complete programming, program copying, operating, monitoring, and diagnostic capability.
  1. Keypad: In addition to required programming and control keys, include keys for HAND, OFF, and AUTO modes.
  2. Security Access: Provide electronic security access to controls through identification and password with at least three levels of access: View only; view and operate; and view, operate, and service.
    - a. Control Authority: Supports at least four conditions: Off, local manual control at VFC, local automatic control at VFC, and automatic control through a remote source.
- D. Historical Logging Information and Displays:
  1. Real-time clock with current time and date.
  2. Running log of total power versus time.
  3. Total run time.
  4. Fault log, maintaining last four faults with time and date stamp for each.
- E. Indicating Devices: Digital display and additional readout devices as required, mounted flush in VFC door and connected to display VFC parameters including, but not limited to:
  1. Output frequency (Hz).
  2. Motor speed (rpm).
  3. Motor status (running, stop, fault).
  4. Motor current (amperes).
  5. Motor torque (percent).
  6. Fault or alarming status (code).
  7. PID feedback signal (percent).
  8. DC-link voltage (V dc).
  9. Set point frequency (Hz).

10. Motor output voltage (V ac).

F. Control Signal and Communication Interfaces:

1. Input Signal Interface:

- a. Two (2) isolated process control speed reference interfaces to receive and isolate 0-10 volt or 4-20 mA DC signals.
- b. Dedicated terminal blocks for interface with remote operator and field devices.
- c. 120 VAC control to allow interface with remote contacts and with two or three wire control.
- d. Additional inputs as required by other Divisions and as shown on the Drawings.

2. Output Signal Interface:

- a. Two (2) analog output signals 0-10 volt or 4-20 mA DC for external metering.
- b. Run relay with an isolated set of form C contacts.
- c. Dry contact output (N.O.) to indicate protective function trip.
- d. Dry contact output (N.O.) to indicate common alarm.
- e. Additional outputs as required by other Divisions and as shown on the drawings.

3. SCADA System Control and Communication:

- a. Control: hardwired using discrete and analog wiring.
- b. Digital Communication: Profinet CAT6 cable.

2.4 LINE CONDITIONING AND FILTERING

- A. Input Line Conditioning: Based on the manufacturer's harmonic analysis study and report, provide input filtering, as required, to limit total demand (harmonic current) distortion and total harmonic voltage demand at the project defined point of common coupling to meet IEEE 519 recommendations for the PCC as defined on this project.
- B. Output Filtering: Passive dV/dT output filter to limit peak voltage at motor terminals to 150% or less of the DC bus voltage for motor leads 1000 feet or less.

2.5 ADDITIONAL FEATURES

- A. Flange mounted input circuit breaker. Handle height not to exceed NEC requirements when VFC is located on 4-inch high housekeeping pad.
- B. Internal cabinet space heaters to prevent condensation upon drive shutdown for 75 HP and larger drives.
- C. Copper ground bus.
- D. Separate door-mounted non-resettable elapsed time meter (0-99999.9 hour).
- E. Exposed buswork and copper parts, tin-plated.

- F. Conformal coated circuit boards for protection from hydrogen sulfide.
- G. Internal LED or fluorescent interior work light for large enclosures (floor mounted), switched with enclosure door.
- H. Finger safe terminals / barriers to all exposed current carrying parts that remain energized with the main power disconnect turned to OFF.
- I. Emergency stop pushbutton; red mushroom head and maintained.
- J. 120VAC control power for external control circuits, internal cooling fans, and motor space heaters, derived from internal control power transformer with primary and secondary fuse protection. Control circuitry isolated from power circuitry.
- K. Identification
  - 1. Typed sleeve type wire markers on all control wiring, labeled at each end.
  - 2. Legend plates or engraved nameplates for all pilot device and meters. Minimum 1/4-high lettering.
  - 3. Equipment identification nameplate, black letters on white background.

## 2.6 ENCLOSURES

- A. VFC Enclosures: NEMA 250, to comply with environmental conditions at installed location.
  - 1. Dry and Clean Indoor Locations: Type 1, gasketed.
  - 2. Outdoor and Process Locations: Type 4X Type 316 stainless steel..

## 2.7 SOURCE QUALITY CONTROL

- A. Testing: Test and inspect VFCs according to requirements in NEMA ICS 61800-2 or manufacturer's standards.
- B. VFCs will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas, surfaces, and substrates to receive VFCs, with Installer present, for compliance with requirements for installation tolerances, and other conditions affecting performance of the Work.
- B. Examine VFC before installation. Reject VFCs that are wet, moisture damaged, or mold damaged.

- C. Examine roughing-in for conduit systems to verify actual locations of conduit connections before VFC installation.
- D. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Wall-Mounting Controllers: Install with tops at uniform height and with disconnect operating handles not higher than 79 inches above finished floor, unless otherwise indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For controllers not on walls, provide freestanding racks complying with Section 260529 "Hangers and Supports for Electrical Systems."
- B. Floor-Mounting Controllers: Install VFCs on 4-inch nominal thickness concrete base. Comply with requirements for concrete base specified in Section 033000 "Cast-in-Place Concrete."
  - 1. 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 concrete base.
  - 2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
  - 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 4. Install anchor bolts to elevations required for proper attachment to supported equipment.
- C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- D. Install fuses in each fusible-switch VFC.
- E. Install fuses in control circuits if not factory installed. Comply with requirements in Section 262813 "Fuses."
- F. Install heaters in thermal-overload relays. Select heaters based on actual nameplate full-load amperes after motors are installed.
- G. Install, connect, and fuse thermal-protector monitoring relays furnished with motor-driven equipment.
- H. Comply with NECA 1.

### 3.3 CONTROL WIRING INSTALLATION

- A. Install wiring between VFCs and remote devices and facility's SCADA system. Comply with requirements in Section 260523 "Low-Voltage Electrical Control and Signal Cables."
- B. Bundle, train, and support wiring in enclosures.

- C. Connect selector switches and other automatic-control devices where applicable.
  - 1. Connect selector switches to bypass only those manual- and automatic-control devices that have no safety functions when switches are in manual-control position.
  - 2. Connect selector switches with control circuit in both manual and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor-overload protectors.

### 3.4 IDENTIFICATION

- A. Identify VFCs, components, and control wiring. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
  - 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
  - 2. Label each VFC with engraved nameplate.
  - 3. Label each enclosure-mounted control and pilot device.

### 3.5 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- B. Perform tests and inspections.
- C. Acceptance Testing Preparation:
  - 1. Test insulation resistance for each VFC element, bus, component, connecting supply, feeder, and control circuit.
  - 2. Test continuity of each circuit.
- D. Tests and Inspections:
  - 1. Inspect VFC, wiring, components, connections, and equipment installation. Test and adjust controllers, components, and equipment.
  - 2. Test insulation resistance for each VFC element, component, connecting motor supply, feeder, and control circuits.
  - 3. Test continuity of each circuit.
  - 4. Verify that voltages at VFC locations are within 10 percent of motor nameplate rated voltages. If outside this range for any motor, notify Engineer before starting the motor(s).
  - 5. Test each motor for proper phase rotation.
  - 6. Perform tests according to the Inspection and Test Procedures for Adjustable Speed Drives stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
  - 7. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
  - 8. Perform the following infrared (thermographic) scan tests and inspections, and prepare reports:



- a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each VFC. Remove front panels so joints and connections are accessible to portable scanner.
  - b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each VFC 11 months after date of Substantial Completion.
  - c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
- 9. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- E. VFCs will be considered defective if they do not pass tests and inspections.
- F. Prepare test and inspection reports, including a certified report that identifies the VFC and describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations made after remedial action.

### 3.6 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
  - 1. Complete installation and startup checks according to manufacturer's written instructions.
  - 2. Field test all hardwired discrete and analog connections and any software communication (Ethernet/IP, Profibus, ControlNet, Modibus, etc.) to the SCADA system. Verify at minimum the following:
    - a. Each alarm and control input/output functions correctly, in manual and automatic.
    - b. VFC can be started and stopped via SCADA.
    - c. VFC can be speed controlled via SCADA.

### 3.7 ADJUSTING

- A. Program microprocessors for required operational sequences, status indications, alarms, event recording, and display features. Clear events memory after final acceptance testing and prior to Substantial Completion.
- B. Set field-adjustable switches, auxiliary relays, time-delay relays, timers, or other adjustable devices.
- C. Set field-adjustable circuit-breaker trip ranges as specified in Section 260573 "Power System Studies."

### 3.8 PROTECTION

- A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions until controllers are ready to be energized and placed into service.

- B. Replace VFCs whose interiors have been exposed to water or other liquids prior to Substantial Completion.

### 3.9 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, reprogram, and maintain VFCs.

### 3.10 CLEANING

- A. Remove all rubbish and debris from inside and around the equipment. Remove dirt, dust, or concrete spatter from the interior and exterior of the equipment using brushes, vacuum cleaner, or clean, lint-free rags. Do not use compressed air.
- B. Replace all cabinet ventilation filters upon commencement of the Contract warranty period.

END OF SECTION 262923

## SECTION 263213.13 - DIESEL EMERGENCY ENGINE GENERATORS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Refer to JEA Facilities Standards Section 26 32 13 Revised February 15, 2020 – Engine Generator Diesel, as the primary specification and requirements for engine generator set, enclosure, and appurtenance requirement. This document is intended to supplement, and not to supersede those requirements.
- B. 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 packaged diesel engine generators for emergency use with the following features:
  - 1. Diesel engine.
  - 2. Diesel fuel-oil system.
  - 3. Control and monitoring.
  - 4. Generator overcurrent and fault protection.
  - 5. Generator, exciter, and voltage regulator.
  - 6. Outdoor engine generator enclosure.
  - 7. Vibration isolation devices.
  - 8. Finishes.
- B. Related Requirements:
  - 1. Section 263613 "Enclosed Transfer Switches" for transfer switches, including sensors and relays to initiate automatic-starting and -stopping signals for engine generators.

#### 1.3 DEFINITIONS

- A. EPS: Emergency power supply.
- B. EPSS: Emergency power supply system.
- C. VFC: Variable Frequency Controller.
- D. Operational Bandwidth: The total variation, from the lowest to highest value of a parameter over the range of conditions indicated, expressed as a percentage of the nominal value of the parameter.

#### 1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
2. Include thermal damage curve for generator.
3. Include time-current characteristic curves for generator protective device.
4. Include fuel consumption in gallons per hour at 0.8 power factor at 0.5, 0.75, and 1.0 times generator capacity.
5. Include generator efficiency at 0.8 power factor at 0.5, 0.75, and 1.0 times generator capacity.
6. Include airflow requirements for cooling and combustion air in cubic feet per minute at 0.8 power factor, with air-supply temperature of 95 deg F. Provide Drawings indicating requirements and limitations for location of air intake and exhausts.
7. Include generator characteristics, including, but not limited to, kilowatt rating, efficiency, reactances, and short-circuit current capability.

B. Shop Drawings:

1. Include plans and elevations for engine generator and other components specified. Indicate access requirements affected by height of subbase fuel tank.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Identify fluid drain ports and clearance requirements for proper fluid drain.
4. Design calculations for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
5. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and supported equipment. Include base weights.
6. Include diagrams for power, signal, and control wiring. Complete schematic, wiring, and interconnection diagrams showing terminal markings for EPS equipment and functional relationship between all electrical components.
7. Complete generator enclosure details, platform and stair details, including structural calculations.

#### 1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer.

B. Source Quality-Control Reports: Including, but not limited to, the following:

1. Certified summary of prototype-unit test report.
2. Certified Test Reports: For components and accessories that are equivalent, but not identical, to those tested on prototype unit.
3. Certified Summary of Performance Tests: Certify compliance with specified requirement to meet performance criteria for sensitive loads.
4. Report of factory test on units to be shipped for this Project, showing evidence of compliance with specified requirements.
5. Report of sound generation.

6. Report of exhaust emissions showing compliance with applicable regulations.
  7. Certified Torsional Vibration Compatibility: Comply with NFPA 110.
- C. Field quality-control reports.
- D. Warranty: For special warranty.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For engine generators to include in emergency, operation, and maintenance manuals.
1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
    - a. List of tools and replacement items recommended to be stored at Project for ready access. Include part and drawing numbers, current unit prices, and source of supply.
    - b. Operating instructions laminated and mounted adjacent to generator location.
    - c. Training plan.

#### 1.7 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. Fuses: One for every 10 of each type and rating, but no fewer than one of each.
  2. Indicator Lamps: Two for every six of each type used, but no fewer than two of each.
  3. Filters: One set each of lubricating oil, fuel, and combustion-air filters.
  4. Tools: Each tool listed by part number in operations and maintenance manual.

#### 1.8 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.
- B. Testing Agency Qualifications: Accredited by NETA.
1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

#### 1.9 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of packaged engine generators and associated auxiliary components that fail in materials or workmanship within specified warranty period.
1. Warranty Period: Two (2) year standard standby generator warranty and an additional three (3) year comprehensive (parts and labor) standby generator warranty from date of

Final Acceptance. Labor, materials, and travel for the warranty period repair will be paid by manufacturer during normal business hours. Comprehensive warranty includes the following:

- a. Cooling System
- b. Thermostat Housing
- c. Water Manifold Housing
- d. Jacket Water Precooler
- e. Jacket Water Pump
- f. Thermostat
- g. Radiator & Fan
- h. Fuel System
- i. Steel Fuel Lines
- j. Fuel Shutoff Solenoid
- k. Fuel Injectors
- l. Fuel Transfer Pump & Housing
- m. Fuel Priming Pump
- n. Fuel Transfer Pump
- o. Lubrication System
- p. Pan, Pump Cooler
- q. Crankcase Breather
- r. Engine Oil Pump Drive
- s. Pre-lubrication Pump
- t. Electric System
- u. Battery Charger
- v. Control Module (ECM)
- w. Sensors: All Engine Sensors
- x. Wiring Harness and Connectors
- y. Starter
- z. Engine Alternator
- aa. Alternator End
- bb. Alternator, including Rotor, Stator, and Exciter
- cc. Generator Controls
- dd. Power Center
- ee. Air Induction & Exhaust
- ff. Exhaust Manifolds, Studs & Gaskets
- gg. Inlet Air Heater Relay
- hh. Intake Manifold
- ii. Turbochargers
- jj. Air-to-Air Aftercooler Cores
- kk. Muffler/Exhaust System
- ll. Exhaust Guards
- mm. Diesel Oxidation Catalyst
- nn. Short Block
- oo. Cylinder Block Casting
- pp. Crankshaft
- qq. Connecting Rod Assembly
- rr. Piston, Wrist Pin, Retainer Clip & Piston Rings
- ss. Idler and Timing Gears
- tt. Accessory Drive
- uu. Cylinder Head

- vv. Intake & Exhaust Valves
- ww. Valve Mechanism
- xx. Camshaft, Camshaft Bearings, Key, Gear
- yy. Front & Rear Covers
- zz. Front Cover / Plate / Housing / Gears & Gaskets
- aaa. Vibration Damper
- bbb. Flywheel Housing & Gasket
- ccc. Crankshaft Front & Rear Seal
- ddd. Optional After Treatment Coverage
- eee. Diesel Particulate Filter
- fff. Selective Catalytic Reduction
- ggg. Any additional manufactured components, having a manufacturer's part number, installed by an authorized dealer.
- hhh. 5-year warranty coverage also covers all authorized dealer overtime for warranty repairs and all rental equipment for equipment down longer than 48 hours.
- iii. Tank manufacturer shall provide its standard 30-year warranty.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Caterpillar, Inc.; Electric Power Division (Ring Power).
  - 2. Cummins Power Generation.
  - 3. Zabatt Power Systems (AKSA).
  - 4. Generac.
- B. Source Limitations: Obtain packaged engine generators and auxiliary components from single source from single manufacturer.
- C. Engine shall be a current model which has been in regular production for at least 3 years.

### 2.2 PERFORMANCE REQUIREMENTS

- A. The unit shall be sized to operate the plant at 110%. The unit shall be rated such that each pump, upon start-up, will not experience greater than 20% instantaneous voltage dip, also considering auxiliary power requirements.
- B. B11 Compliance: Comply with B11.19.
- C. NFPA Compliance:
  - 1. Comply with NFPA 37.
  - 2. Comply with NFPA 70.
  - 3. Comply with NFPA 110 requirements for Level 1 EPSS.

- D. UL Compliance: Comply with UL 2200.
- E. Engine Exhaust Emissions: Comply with EPA Tier 2 or 3 requirements and applicable state and local government requirements.
- F. Noise Emission: Comply with 86 dBA for maximum noise level at 15 feet due to sound emitted by engine generator, including engine, engine exhaust, engine cooling-air intake and discharge, and other components of installation.
- G. Environmental Conditions: Engine generator system shall withstand the following environmental conditions without mechanical or electrical damage or degradation of performance capability:
  - 1. Ambient Temperature: 7 to 105 deg F.
  - 2. Relative Humidity: Zero to 95 percent.
  - 3. Altitude: Sea level to 1000 feet.
- H. Unusual Service Conditions: Engine generator equipment and installation are required to operate under the following conditions:
  - 1. VFC loads with harmonic filters limiting THD to less than 5%.

## 2.3 ENGINE GENERATOR ASSEMBLY DESCRIPTION

- A. Manufactured and assembled in an ISO 9001 certified facility.
- B. Factory-assembled and -tested, water-cooled engine, with brushless generator and accessories.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. EPSS Class: Engine generator shall be classified as a Class 60 according to NFPA 110.
- E. Service Load: 937.5 kVA, 750 kW.
- F. Power Factor: 0.8, lagging.
- G. Frequency: 60 Hz
- H. Voltage: 480 V ac.
- I. Phase: Three-phase, four-wire wye.
- J. Induction Method: Turbocharged.
- K. Governor: Adjustable isochronous, with speed sensing.
- L. Mounting Frame: Structural steel framework to maintain alignment of mounted components without depending on concrete foundation. Provide lifting attachments sized and spaced to prevent deflection of base during lifting and moving.



1. Rigging Diagram: Inscribed on metal plate permanently attached to mounting frame to indicate location and lifting capacity of each lifting attachment and engine generator center of gravity.

M. Capacities and Characteristics:

1. Stationary Standby Power Output Site Ratings: 750 kW and 937.5 kVA at 0.8 power factor excluding power required for the continued and repeated operation of the unit and auxiliaries, with capacity as required to operate as a unit as evidenced by records of prototype testing.
2. Nameplates: For each major system component to identify manufacturer's name and address, and model and serial number of components.

N. Engine Generator Performance:

1. Steady-State Voltage Operational Bandwidth: 3 percent of rated output voltage, from no load to full load.
2. Transient Voltage Performance: Not more than 20 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within three seconds.
3. Steady-State Frequency Operational Bandwidth: 0.5 percent of rated frequency, from no load to full load.
4. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.
5. Transient Frequency Performance: Less than 5 percent variation for 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within five seconds.
6. Output Waveform: At no load, harmonic content measured line to line or line to neutral shall not exceed 5 percent total and 3 percent for single harmonics. Telephone influence factor, determined according to NEMA MG 1, shall not exceed 50 percent.
7. Sustained Short-Circuit Current: For a three-phase, bolted short circuit at system output terminals, system shall supply a minimum of 250 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to generator system components.
8. Start Time: Comply with NFPA 110, Type 10 system requirements.

O. Engine Generator Performance for Sensitive Loads:

1. Oversizing generator compared with the rated power output of the engine is permissible to meet specified performance.
  - a. Nameplate Data for Oversized Generator: Show ratings required by the Contract Documents rather than ratings that would normally be applied to generator size installed.
2. Steady-State Voltage Operational Bandwidth: 1 percent of rated output voltage, from no load to full load.
3. Transient Voltage Performance: Not more than 10 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within 0.5 second.

4. Steady-State Frequency Operational Bandwidth: Plus or minus 0.25 percent of rated frequency, from no load to full load.
5. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.
6. Transient Frequency Performance: Less than 2-Hz variation for 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within three seconds.
7. Output Waveform: At no load, harmonic content, measured line to neutral, shall not exceed 2 percent total with no slot ripple. Telephone influence factor, determined according to NEMA MG 1, shall not exceed 50 percent.
8. Sustained Short-Circuit Current: For a three-phase, bolted short circuit at system output terminals, system shall supply a minimum of 300 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to winding insulation or other generator system components.
9. Excitation System: Performance shall be unaffected by voltage distortion caused by nonlinear load.
  - a. Provide static excitation system for power source to voltage regulator, unless permanent magnet is recommended by the manufacturer for this application.
  - b. Silicon controlled rectifier construction.
  - c. Capacity for 150 percent of required excitation.
  - d. Capable of voltage build-up from residual magnetism.
  - e. Voltage level and gain control easily accessible for normal operating adjustments. Voltage adjustment range: plus minus 5 percent. Provide voltage adjustment instructions and wiring diagram permanently attached on inside of exciter assembly.
10. Start Time: Comply with NFPA 110, Type 10, system requirements.

- P. Engine-generator set models: Caterpillar C18 (Ring Power) or Cummins QSK23 (Cummins Power South)

## 2.4 DIESEL ENGINE

- A. Fuel: ASTM D 975 diesel fuel oil, Grade 2-D S15. The engine shall meet the required capacity when operating on ultra-low-sulfur no. 2 diesel fuel.
- B. Four cycle compression ignition engine.
- C. Rated Engine Speed: 1800 rpm.
- D. Lubrication System: Engine or skid mounted.
  1. Filter and Strainer: Rated to remove 90 percent of particles 5 micrometers and smaller while passing full flow.
  2. Thermostatic Control Valve: Control flow in system to maintain optimum oil temperature. Unit shall be capable of full flow and is designed to be fail-safe.

3. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without use of pumps, siphons, special tools, or appliances.
- E. Jacket Coolant Heater: Electric-immersion type, factory installed in coolant jacket system. Comply with NFPA 110 requirements for Level 1 equipment for heater capacity and with UL 499. Sized for Northeast Florida climate to maintain jacket water at 90 degrees F in and ambient temperature of 30 degrees F. Jacket water heater hoses shall be silicone type, with shut off valves, to allow swapping out of hoses without draining all the fluids.
- F. Cooling System: Closed loop, liquid cooled, with radiator factory mounted on engine generator mounting frame and integral engine-driven coolant pump.
1. Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer.
  2. Size of Radiator: Adequate to contain expansion of total system coolant, from cold start to 110 percent load condition.
  3. Radiator and oil cooler coils shall be 100% dipped in Bronze-Glow (Husky Gold Protectant) to provide additional protection on coils.
  4. Expansion Tank: Constructed of welded steel plate and rated to withstand maximum closed-loop coolant-system pressure for engine used. Equip with gage glass and petcock.
  5. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.
  6. Coolant Hose: Flexible assembly with inside surface of nonporous rubber and outer covering of aging-, UV-, and abrasion-resistant fabric.
    - a. Rating: 50-psig maximum working pressure with coolant at 180 deg F, and noncollapsible under vacuum.
    - b. End Fittings: Flanges or steel pipe nipples with clamps to suit piping and equipment connections.
- G. Silencer: Critical type, sized as recommended by engine manufacturer and selected with exhaust piping system to not exceed engine manufacturer's engine backpressure requirements.
1. Sound level measured at a distance of 15 feet from exhaust discharge after installation is complete shall be 86 dBA or less.
  2. Manufactured of 304L all welded stainless steel, side inlet type.
  3. Type 304 or 316 stainless steel angle iron cradle, the silencer shall be bolted or strapped to cradle and then bolted to the roof with horizontal mounting external on top of enclosure. Additional support members shall be mounted inside the roof of the enclosure as required.
  4. Sized for that the backpressure at rated capacity of the engine does not exceed one half the supplier's maximum allowable backpressure.
  5. Critical silencing Maxim "Model M51" or equal.
  6. Type 304L Schedule 10S stainless steel exhaust piping.
  7. Horizontal outlet, with 45-degree bevel cut with stainless steel expandable metal bird screen.
  8. Stainless steel flexible adapter, 18-inch minimum length, between the engine and the silencer.

- H. Air-Intake Filter: Heavy-duty, engine-mounted air cleaner with replaceable dry-filter element and "blocked filter" indicator.
- I. Starting System: 24 V electric, with negative ground.
  - 1. Components: Sized so they are not damaged during a full engine-cranking cycle, with ambient temperature at maximum specified in "Performance Requirements" Article. For engine-generator sets rated 750 kW and above, a redundant electric starting motor shall be provided.
  - 2. Cranking Motor: Heavy-duty unit that automatically engages and releases from engine flywheel without binding.
  - 3. Cranking Cycle: As required by NFPA 110 for system level specified.
  - 4. Battery: Lead acid, with capacity within ambient temperature range specified in "Performance Requirements" Article to provide five, ten second cranking cycles without recharging.
  - 5. Battery Cable: Size as recommended by engine manufacturer for cable length indicated. Include required interconnecting conductors and connection accessories.
  - 6. Battery Compartment: Factory fabricated of metal with acid-resistant finish and thermal insulation. Thermostatically controlled heater shall be arranged to maintain battery above 50 deg F, regardless of external ambient temperature within range specified in "Performance Requirements" Article. Include accessories required to support and fasten batteries in place. Provide ventilation to exhaust battery gases.
  - 7. Battery Stand: Factory-fabricated, two-tier metal with acid-resistant finish designed to hold the quantity of battery cells required and to maintain the arrangement to minimize lengths of battery interconnections.
  - 8. Battery-Charging Alternator: Factory mounted on engine with solid-state voltage regulation and 35-A minimum continuous rating.
  - 9. Battery Charger: Current-limiting, automatic-equalizing, and float-charging type designed for lead-acid batteries. Unit shall comply with UL 1236 and include the following features:
    - a. Operation: Equalizing-charging rate of 10 A shall be initiated automatically after battery has lost charge until an adjustable equalizing voltage is achieved at battery terminals. Unit shall then be automatically switched to a lower float-charging mode and shall continue to operate in that mode until battery is discharged again.
    - b. Automatic Temperature Compensation: Adjust float and equalize voltages for variations in ambient temperature from minus 40 deg F to 140 deg F to prevent overcharging at high temperatures and undercharging at low temperatures.
    - c. Automatic Voltage Regulation: Maintain constant output voltage regardless of input voltage variations up to plus or minus 10 percent.
    - d. Ammeter and Voltmeter: Flush mounted in door. Meters shall indicate charging rates.
    - e. Safety Functions: Sense abnormally low battery voltage and close contacts providing low battery voltage indication on control and monitoring panel. Sense high battery voltage and loss of ac input or dc output of battery charger. Either condition shall close contacts that provide a battery-charger malfunction indication at system control and monitoring panel.
    - f. Enclosure and Mounting: NEMA 250, Type 1 wall-mounted cabinet, mounted at rear of engine-generator set inside the enclosure.

## 2.5 DIESEL FUEL-OIL SYSTEM

- A. Comply with NFPA 30.
- B. Fuel-Oil Piping: Standard weight (Schedule 40) 316 stainless steel pipe and tubing with socket welded fittings per ASTM standards. Welding guarantee: 1 year minimum. Cast iron, aluminum, copper, and galvanized steel is not allowed for fuel-oil systems. No fuel lines shall be installed underground.
- C. Flexible Diesel Fuel Piping: Meets SAE 100R17 hose with stainless steel connections. Threaded connections with Hercules Chemical Company Inc. multipurpose heavy Teflon “Tape Dope” and “Magloc” and / or “Real-Tuff”.
- D. Main Fuel Pump: Mounted on engine to provide primary fuel flow under starting and load conditions.
- E. Fuel Filtering: Remove water and contaminants larger than 1 micron, upstream from the flexible connection at the engine-generator, with replaceable elements, manufactured by RACOR or approved equal.
- F. Manual stainless-steel fire-safe three-piece shutoff ball valve with Teflon seats and seals, located on the fuel supply line upstream from the flexible connection at the engine-generator, Contromatics, Jamesbury or Owner’s representative approved equal. No shutoff valves on any fuel return line.
- G. Anti-siphon valve above the shutoff valve.
- H. Relief-Bypass Valve: Automatically regulates pressure in fuel line and returns excess fuel to source.
- I. Subbase-Mounted, Double-Wall, Fuel-Oil Tank: Factory installed and piped, complying with UL 2085 fuel-oil tank, and sized for 72 hours of generator operation at 100% full load .
  - 1. Made of 3/16-inch-thick steel meeting UL 2085 and ULC Standard S601, pressure tested for 24 hours at 5 psig.
  - 2. Secondary Containment: The steel tank shall be wrapped with a minimum ¼-inch-thick Styrofoam insulation and impervious barrier of 30 MIL high density polyethylene membrane.
  - 3. Concrete Vault: Tank and secondary containment shall be encased in a 6-inch-thick reinforced concrete vault.
  - 4. Fuel-Tank Capacity: Minimum 133 percent of total fuel required for periodic maintenance operations between fuel refills, plus fuel for the hours of continuous operation indicated herein.
  - 5. Tank level indicator and manual fuel stick with gallons to inch laminated conversion chart.
  - 6. Leak detection in interstitial space.
  - 7. Vandal-resistant fill cap.
  - 8. Vent cap and emergency vent.
  - 9. Fill with camlock fitting and cap with aluminum or stainless-steel fittings and 5-gallon minimum overspill containment box.

10. Containment Provisions: 110% minimum capacity. Comply with requirements of authorities having jurisdiction.
  11. Bullet resistance test per JFC Section (79-7)
  12. Supplied with flood resistant tie-down brackets / hurricane hold down restraints.
  13. Sloped top to allow rainwater run-off.
  14. Stainless steel anchor bolts and washers.
  15. Placard set stating size fuel fill, emergency vent, combustible, no smoking and diesel on two sides and near fuel fill.
  16. Tank coatings approved by an Owner's representative.
  17. Manufactured by Phoenix Products, AMPS or Fidelity Manufacturing.
- J. Include the following controls;
1. Greenleaf Solar Gauge EFG-8000-I with EFG-420.1 4-20mA data converter. Fuel level monitoring in gallons, interstitial leak, hi and low fuel. EFG-8000-I mounted outside at eye level. EFC-420.1 data converter mounted inside the generator enclosure.
- K. Owner's representative must be notified by the supplier between 45 days and 30 days, and again between 72 hours and 48 hours in advance of above ground fuel storage tank shipments.
- L. Provide 90% of fuel for rated tank capacity prior to load bank test. Fuel treatment: Hydro Clean by Gulf Select.

## 2.6 CONTROL AND MONITORING

- A. Automatic-Starting System Sequence of Operation: When mode-selector switch on the control and monitoring panel is in the automatic position, remote-control contacts in the separate automatic transfer switches initiate starting and stopping of engine generator. When mode-selector switch is switched to the on position, engine generator starts. The off position of same switch initiates engine generator shutdown. When engine generator is running, specified system or equipment failures or derangements automatically shut down engine generator and initiate alarms.
- B. Manual-Starting System Sequence of Operation: Switching on-off switch on the generator control panel to the on position starts engine generator. The off position of same switch initiates engine generator shutdown. When engine generator is running, specified system or equipment failures or derangements automatically shut down engine generator and initiate alarms.
- C. Provide minimum run time control set for 30 minutes, with override only by operation of a remote emergency-stop switch.
- D. Comply with UL 508A.
- E. Configuration: Operating and safety indications, protective devices, basic system controls, and engine gages shall be grouped in a common control and monitoring panel mounted on the engine generator. Mounting method shall isolate the control panel from engine generator vibration. Panel shall be powered from the engine generator battery.

F. Control and Monitoring Panel:

1. Digital controller with integrated LCD display, controls, and microprocessor, capable of local and remote control, monitoring, and programming, with battery backup.
2. Analog control panel with dedicated gages and indicator lights for the instruments and alarms indicated below.
3. Instruments: Located on the control and monitoring panel and viewable during operation.
  - a. Engine lubricating-oil pressure gage.
  - b. Engine-coolant temperature gage.
  - c. DC voltmeter (alternator battery charging).
  - d. Running-time meter.
  - e. AC voltmeter.
  - f. AC ammeter.
  - g. AC frequency meter.
  - h. Generator-voltage-adjusting rheostat.
4. Controls and Protective Devices: Controls, shutdown devices, and common visual alarm indication as required by NFPA 110 for Level 1 system, including the following:
  - a. Cranking control equipment.
  - b. Run-Off-Auto switch.
  - c. Control switch not in automatic position alarm.
  - d. Overcrank alarm.
  - e. Overcrank shutdown device.
  - f. Low water temperature alarm.
  - g. High engine temperature pre-alarm.
  - h. High engine temperature.
  - i. High engine temperature shutdown device.
  - j. Overspeed alarm.
  - k. Overspeed shutdown device.
  - l. Low-fuel main tank.
    - 1) Low-fuel-level alarm shall be initiated when the level falls below that required for operation for the duration required for the indicated EPSS class.
  - m. Coolant low-level alarm.
  - n. Coolant low-level shutdown device.
  - o. Coolant high-temperature prealarm.
  - p. Coolant high-temperature alarm.
  - q. Coolant low-temperature alarm.
  - r. Coolant high-temperature shutdown device.
  - s. EPS load indicator.
  - t. Battery high-voltage alarm.
  - u. Low-cranking voltage alarm.
  - v. Battery-charger malfunction alarm.
  - w. Battery low-voltage alarm.
  - x. Lamp test.
  - y. Contacts for local and remote common alarm.
  - z. Low-starting air pressure alarm.
  - aa. Low-starting hydraulic pressure alarm.

- bb. Remote manual-stop shutdown device.
- cc. Air shutdown damper alarm when used.
- dd. Air shutdown damper shutdown device when used.
- ee. Generator overcurrent-protective-device not-closed alarm.
- ff. Controls for automatic exerciser, coordinated with the automatic transfer switch (ATS) specified in Section 26 36 13.

G. Connection to Datalink:

- 1. A separate terminal block, factory wired to Form C dry contacts, for each alarm and status indication.
- 2. Provide connections for datalink transmission of indications to remote data terminals via Ethernet.

H. The generator control panel shall be Cat 4.2, DSE 7310 or Cummins Power Command HMI 220.

I. Engine-Generator Interface to Owner's SCADA system with ET200S:

- 1. The following inputs for each engine-generator set shall be set up for the interface to a Siemens ET200S Distributed I/O Module. The ET200S module will feed the generator status information to the SCAD equipment over Profibus. Contacts from the generator shall be prewired and labeled to the ET200S. Connect Greenleaf EFC-420.1 data converter and transfer switch contacts. Digital inputs to ET200S are to be connected in this order:
  - a. Generator run (from generator)
  - b. Generator fault (from generator)
  - c. Fuel leak (from Greenleaf data converter)
  - d. Normal power available (from transfer switch)
  - e. Transfer switch normal (from transfer switch)
  - f. Transfer switch in emergency (from transfer switch)
  - g. Analog input to ET200S
  - h. Fuel lever (from Greenleaf data converter)
- 2. Engine-Generator to Owner's SCADA system with PLC S7-1200 or S7-300:
  - a. The following inputs for each engine-generator set shall be set up for the interface to a Siemens S7-1200 or S7-300 Distributed I/O Module in SCADA via Ethernet cable. The modules will feed the generator status information from the ST 200SP distributed I/O in the Generator to the SCADA equipment over Profibus. Contacts from the generator landed in the ET200SP per Drawings. The ET 200SP distributed I/O will communicate with SCADA via a shielded ethernet cable. Connect Greenleaf EFC-420.1 data converter and transfer switch contacts.
  - b. Digital inputs to ET200SP are to be connected per Drawings.
  - c. Analog inputs to ET200SP:
    - 1) Fuel Level (from Greenleaf Data Converter).
- 3. The following Bill of Material is the list of the devices to be provided and installed with the engine-generator:



Manufacturer	P/N	Description	Qty
Attabox	AH12106C	Enclosure, NEMA 4X, Polycarbonate, Clear cover	1
Attabox	BP1210A	Backpanel, 12 ga, Aluminum, Unpainted	1
Phoenix Contact	2907562	Circuit Breaker, UL 489 branch rated, C-Curve, 1-pole, 5A	1
Siemens	6AG1 155-6AA01-7BN0	Interface Module, SIPLUS ET200SP IM155-6PN Standard	1
Siemens	6AG1 131-6BF01-7BA0	Digital Input Module, SIPLUS ET200SP DI 8x24VDC ST	3
Siemens	6AG1 134-6GD00-7BA01	Analog Input Module, SIPLUS ET200SP AI 4xI 2-/4-Wire ST	1
Siemens	6AG1 193-6BP00-7DA0	Base Module, White	4
Citel	DS220S-24DC	Surge Protector, 24VDC	1
Phoenix Contact	2313931	Profinet Network Isolator	1
WAGO	2002-1406	Terminal, Push-In, 1-Circuit, Yellow	2
WAGO	2002-1404	Terminal, Push-In, 1 Circuit, Blue	2
WAGO	2002-1407	Terminal, Push-In, 1 Circuit, Green/Yellow, Grounding	1
WAGO	2002-1492	Terminal End Plate, Orange	3
WAGO	2002-400	Adjacent Jumper, 2-Way Continuous	2
WAGO	249-116	End Anchor, 6mm, Gray	2
WAGO	210-112	Din Rail, Galvanized, Slotted, 2m	1
Square D	PK5GTA	Equipment Ground Bar Kit	1
Siemens	6XV1 840-2AH10	Profinet Cable, Fast Connect	1
Siemens	6AG1 901-1BB10-7AA0	Profinet Connector, SIPLUS	2

4. The PLC will be powered from the 24VDC supply from SCADA to the ET200SP in a separate 3/4" conduit from the generator to the RTU cabinet.
5. Fourteen (14) #18 tinned MTW Blue SCADA digital input wire shall be provided for each unit and ran back to SCADA RTU cabinet.
6. Two (2) Profinet Cables from the I/O Panel to RTU shall be in 3/4" conduit from the generator to the RTU. Cable shall be Siemens 6XV 840-2AH10 with connector Siemens 6AG1 901-1BB10-7AA0 on each end of cable.
7. All field wiring shall connect directly to I/O base terminals using ferrules with end sleeves.
8. All mounding screws shall be drilled and tapped (no self-tapping screws are allowed).
9. All mounting screws shall be stainless steel.
10. Din rail shall be model 1492-DR9 or equivalent.
11. Two (2) TSP #18 shielded pair of analog inputs shall be provided for each and ran back to SCADA RTU cabinet. TSP wire shall be Belden 3072 Twinax.
12. Communication wire from the Generator to ATS and the RTU shall be 18ga tin-coated MTW copper wire.

J. Remote Alarm Annunciator: Comply with NFPA 110, Level 1. An LED indicator light labeled with proper alarm conditions shall identify each alarm event, and a common audible signal shall sound for each alarm condition. Silencing switch in face of panel shall silence signal without altering visual indication. Connect so that after an alarm is silenced, clearing of initiating

condition will reactivate alarm until silencing switch is reset. Cabinet and faceplate are surface- or flush-mounting type to suit mounting conditions indicated.

1. Overcrank alarm.
  2. Coolant low-temperature alarm.
  3. High engine temperature prealarm.
  4. High engine temperature alarm.
  5. Low lube oil pressure alarm.
  6. Overspeed alarm.
  7. Low-fuel main tank alarm.
  8. Low coolant level alarm.
  9. Low-cranking voltage alarm.
  10. Contacts for local and remote common alarm.
  11. Audible-alarm silencing switch.
  12. Air shutdown damper when used.
  13. Run-Off-Auto switch.
  14. Control switch not in automatic position alarm.
  15. Fuel tank derangement alarm.
  16. Fuel tank high-level shutdown of fuel-supply alarm.
  17. Lamp test.
  18. Low-cranking voltage alarm.
  19. Generator overcurrent protective device not closed.
- K. Supporting Items: Include sensors, transducers, terminals, relays, and other devices and include wiring required to support specified items. Locate sensors and other supporting items on engine or generator unless otherwise indicated.
- L. Remote Emergency-Stop Switch: Flush; wall mounted, unless otherwise indicated; and labeled. Push button shall be protected from accidental operation.
- M. The engine-generator unit shall be capable of interfacing with Owner's SCADA equipment.
- N. Two normally open dry contacts that will close when the engine is running and open when engine is stopped shall be provided.
- O. Furnish a remote emergency stop push button, placed by the pump control system, to shut engine down. The emergency stop shall be in a NEMA 4 enclosure, with mushroom handle and clear cover. Break glass E-stops are not allowed.

## 2.7 GENERATOR OVERCURRENT AND FAULT PROTECTION

- A. Overcurrent protective devices for the entire EPSS shall be coordinated to optimize selective tripping when a short circuit occurs. Coordination of protective devices shall consider both utility and EPSS as the voltage source.
1. Overcurrent protective devices for the EPSS shall be accessible only to authorized personnel.
- B. Generator Circuit Breaker: Insulated-case, electronic-trip type; 100 percent rated; complying with UL 489.

1. Tripping Characteristics: Adjustable long-time and short-time delay and instantaneous.
  2. Trip Settings: Selected to coordinate with generator thermal damage curve.
  3. Shunt Trip: Connected to trip breaker when engine generator is shut down by other protective devices.
  4. Mounting: Adjacent to or integrated with control and monitoring panel.
- C. Ground-Fault Indication: Comply with NFPA 70, "Emergency System" signals for ground fault.
1. Indicate ground fault with other engine generator alarm indications.
  2. Trip generator protective device on ground fault.

## 2.8 GENERATOR, EXCITER, AND VOLTAGE REGULATOR

- A. Comply with NEMA MG 1.
- B. Drive: Generator shaft shall be directly connected to engine shaft. Exciter shall be rotated integrally with generator rotor.
- C. Electrical Insulation: Class H.
- D. Stator windings: vacuum pressure impregnated (VPI) process.
- E. Stator-Winding Leads: Brought out to terminal box to permit future reconnection for other voltages if required. Provide six-lead alternator.
- F. Range: Provide broad range of output voltage by adjusting the excitation level.
- G. Construction shall prevent mechanical, electrical, and thermal damage due to vibration, overspeed up to 125 percent of rating, and heat during operation at 110 percent of rated capacity.
- H. Enclosure: Dripproof.
- I. Instrument Transformers: Mounted within generator enclosure.
1. Current Transformers: Mechanical and thermal limits coordinated with the momentary and short time ratings of the ATS. Thermal ratings based on a short-circuit duration of 1 second or greater. Minimum current transformer accuracy rating: C200.
  2. Voltage Transformers: Rated not less than 500VA. Capable of withstanding a secondary short-circuit for not less than 1 second. Primary and secondary fuses.
- J. Voltage Regulator: Solid-state type, separate from exciter, providing performance as specified and as required by NFPA 110.
1. Adjusting Rheostat on Control and Monitoring Panel: Provide plus or minus 5 percent adjustment of output-voltage operating band.
  2. Maintain voltage within 20 percent on one step, full load.
  3. Provide anti-hunt provision to stabilize voltage.
  4. Maintain frequency within 5 percent and stabilize at rated frequency within five seconds.
  5. Overexcitation protection shall be provided.

- K. Strip Heater: Thermostatically controlled unit arranged to maintain stator windings above dew point.
- L. Windings: Two-thirds pitch stator winding and fully linked amortisseur winding. Coil pitch, distribution and skew shall minimize total harmonic distortion (THD) to less than 5 percent.
- M. Subtransient Reactance: 12 percent, maximum.

## 2.9 OUTDOOR ENGINE GENERATOR ENCLOSURE

- A. Description: Walk-in, vandal-resistant, sound-attenuating, weatherproof enclosure with aluminum housing, wind resistant up to 150 mph without damage..
  - 1. Maximum sound level: 86 dBA at 15 feet from the enclosure.
  - 2. Minimum distance from engine-generator to end wall: 3'-0".
  - 3. Minimum side walk-around distance: 24".
  - 4. Minimum head clearance: 6 ft.
- B. Description: Prefabricated or pre-engineered, aluminum, walk-in enclosure, consisting of two sidewalls, two endwalls, louvers, doors and roof, all erected on a steel sub-base tank anchored to a concrete foundation.
- C. Structural Design and Anchorage: Comply with ASCE/SEI 7 and with all wind load and other requirements listed on Structural Sheet S-1 (Vult: 136 MPH, Vasd: 105 MPH, Risk Category: III/IV, Wind Exposure Category: C, Enclosure Classification: C, Internal Pressure Coefficient:  $\pm 0.18$ ).
- D. The enclosure shall be made of marine grade aluminum.
- E. Paint specification and color: Steel-Master 9500, 30% silicone alkyd enamel ultra-deep / clear tint base, Padmount Green color, distributed by Sherwin-Williams.
- F. Enclosure Finish: Enclosures shall be polished, without any advertising or labels on the exterior of any enclosure surface.
- G. Hinged Doors: With padlocking provisions and 316 stainless steel hardware. Doors shall have continuous hinges and three-point latch system.
- H. Punched louvered radiator core guard, flush with the enclosure panels in front of the radiator grill. Fixed punched louvered air intake ports on enclosure sides and rear. Louvers screened from the inside to prevent entry of rodents. Rain resistant louvers, as manufactured by Ruskin or Cesco. Vertical air turning plenums, or equal, shall be provided to prevent the entrance of rain when the unit is operating and the wind direction is at 90 degrees to the air intake at 120 mph. Air plenums designed for 86 dBA at 15 feet.
- I. Lifting eyes and spreader bar reinforcement for crane unloading.
- J. Space Heater: Thermostatically controlled and sized to prevent condensation.

- K. Lighting: Provide LED lighting, controlled by spring-wound timer light switch, with 50-fc average maintained. Fixtures shall be Columbia Lighting Model LXEM4-40ML-RFA-EDU or equivalent.
- L. Duplex, GFCI, weatherproof convenience receptacles: 2 minimum.
- M. 480-240/120V transformer and 240/120V, panelboard with branch circuits for lights, duplex receptacles, battery charger, jacket water heaters, louvers, etc. shall be included. The transformer and panelboard shall be sized for the required loads of the engine-generator and enclosure, with 20% spare capacity.
- N. Thermal Insulation: Manufacturer's standard materials and thickness selected in coordination with space heater to maintain winter interior temperature within operating limits required by engine generator components.
- O. All engine oil and coolant drains piped to the outside of the enclosure with shutoff valves and treaded stainless steel caps, labeled with aluminum labels and stainless steel rivets.
- P. Silencer Location: On top of the enclosure.
- Q. OSHA compliant aluminum stairs, platform landings and handrails as required to reach enclosure doors based on height of sub-base tank. Stair, platforms and handrails constructed in accordance with Section 055000, Metal Fabrications.
- R. Enclosure shall be Phoenix Products, Advanced Manufacturing & Power Systems, Inc. or Fidelity Manufacturing.

## 2.10 VIBRATION ISOLATION DEVICES

- A. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic restraint.
  - 1. Housing: Steel with resilient, vertical-limit stops to prevent spring extension due to wind loads or if weight is removed; factory-drilled baseplate bonded to 1/4-inch- thick, elastomeric isolator pad attached to baseplate underside; and adjustable equipment-mounting and -leveling bolt that acts as blocking during installation.
  - 2. Outside Spring Diameter: Not less than 80 percent of compressed height of the spring at rated load.
  - 3. Minimum Additional Travel: 50 percent of 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. Minimum Deflection: 1 inch.
- B. Comply with requirements in Section 233113 "Metal Ducts" for vibration isolation and flexible connector materials for exhaust shroud and ductwork.
- C. Vibration isolation devices shall not be used to accommodate misalignments or to make bends.

2.11 FINISHES (GENERATOR, ENGINE AND TANK)

- A. Painted prior to shipment to site.
- B. Manufacturer's standard finish over corrosion-resistant pretreatment and compatible primer, suitable for outdoors, and approved by Owner's representative.
- C. Stainless Steel Surfaces: Unpainted.

2.12 SOURCE QUALITY CONTROL

- A. Prototype Testing: Factory test engine generator using same engine model, constructed of identical or equivalent components and equipped with identical or equivalent accessories.
  - 1. Tests: Comply with NFPA 110, Level 1 Energy Converters and with IEEE 115.
- B. Project-Specific Equipment Tests: Before shipment, factory test engine generator and other system components and accessories manufactured specifically for this Project. Perform tests at 25%, 50%, 75% and 100% of rated load and power factor. Include the following tests:
  - 1. Test components and accessories furnished with installed unit that are not identical to those on tested prototype to demonstrate compatibility and reliability.
  - 2. Test generator, exciter, and voltage regulator as a unit.
  - 3. Full-load run.
  - 4. Maximum power.
  - 5. Voltage regulation.
  - 6. Transient and steady-state governing.
  - 7. Safety shutdown.
  - 8. Provide 14 days' advance notice of tests and opportunity for observation of tests by Owner's representative.
  - 9. Report factory test results within 10 days of completion of test.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas, equipment bases, and conditions, with Installer present, for compliance with requirements for installation and other conditions affecting packaged engine generator performance.
- B. Examine roughing-in for piping systems and electrical connections. Verify actual locations of connections before packaged engine generator installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:
  - 1. Notify Owner's representative no fewer than two working days in advance of proposed interruption of electrical service.
  - 2. Do not proceed with interruption of electrical service without Owner representative's written permission.

### 3.3 INSTALLATION

- A. Comply with NECA 1 and NECA 404.
- B. Comply with packaged engine generator manufacturers' written installation and alignment instructions and with NFPA 110.
- C. Equipment Mounting:
  - 1. Install packaged engine generators on cast-in-place concrete equipment bases. Comply with requirements for equipment bases and foundations shown on Structural drawings.
  - 2. Coordinate size and location of concrete bases for packaged engine generators. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.
- D. Install packaged engine generator to provide access, without removing connections or accessories, for periodic maintenance.
- E. Exhaust System: Install stainless steel piping with welded joints and connect to engine muffler. Install thimble at wall. Piping shall be same diameter as muffler outlet.
  - 1. Install isolating thimbles where exhaust piping penetrates combustible surfaces with a minimum of 9 inches of clearance from combustibles.
- F. Drain Piping: Install condensate drain piping to muffler drain outlet with a shutoff valve, stainless-steel flexible connector, and stainless steel pipe with welded joints.
- G. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not specified to be factory mounted.

### 3.4 CONNECTIONS

- A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping and specialties.
- B. Connect fuel, cooling-system, and exhaust-system piping adjacent to packaged engine generator to allow space for service and maintenance.
- C. Connect cooling-system water piping to engine generator and with flexible connectors.

- D. Connect engine exhaust pipe to engine with flexible connector.
- E. Connect fuel piping to engines with a gate valve and union and flexible connector.
- F. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- G. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables." Provide a minimum of one 90-degree bend in flexible conduit routed to the engine generator from a stationary element.
- H. Balance single-phase loads to obtain a maximum of 10 percent unbalance between any two phases.

### 3.5 IDENTIFICATION

- A. Identify system components according to Section 230553 "Identification for HVAC Piping and Equipment" and Section 260553 "Identification for Electrical Systems."
- B. Install a sign indicating the generator neutral is bonded to the main service neutral at the main service location.

### 3.6 FIELD QUALITY CONTROL

- A. Testing Agency: Contractor will engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform tests and inspections with the assistance of a factory-authorized service representative.
- D. Tests and Inspections:
  - 1. Perform tests recommended by manufacturer and in "Visual and Mechanical Inspection" and "Electrical and Mechanical Tests" subparagraphs below, as specified in the NETA ATS. Certify compliance with test parameters.
    - a. Visual and Mechanical Inspection:
      - 1) Compare equipment nameplate data with Drawings and the Specifications.
      - 2) Inspect physical and mechanical condition.
      - 3) Inspect anchorage, alignment, and grounding.
      - 4) Verify that the unit is clean.
    - b. Electrical and Mechanical Tests:
      - 1) Perform insulation-resistance tests according to IEEE 43. Test duration shall be 10 minutes. Calculate polarization index.
      - 2) Test protective relay devices.



- 3) Verify phase rotation, phasing, and synchronized operation as required by the application.
    - 4) Functionally test engine shutdown for low oil pressure, overtemperature, overspeed, and other protection features as applicable.
    - 5) Perform vibration test for each main bearing cap.
    - 6) Conduct performance test according to NFPA 110.
    - 7) Verify correct functioning of the governor and regulator.
  2. NFPA 110 Acceptance Tests: Perform tests required by NFPA 110 that are additional to those specified here, including, but not limited to, single-step full-load pickup test.
  3. Battery Tests: Equalize charging of battery cells according to manufacturer's written instructions. Record individual cell voltages.
    - a. Measure charging voltage and voltages between available battery terminals for full-charging and float-charging conditions. Check electrolyte level and specific gravity under both conditions.
    - b. Test for contact integrity of all connectors. Perform an integrity load test and a capacity load test for the battery.
    - c. Verify acceptance of charge for each element of the battery after discharge.
    - d. Verify that measurements are within manufacturer's specifications.
  4. Battery-Charger Tests: Verify specified rates of charge for both equalizing and float-charging conditions.
  5. System Integrity Tests: Methodically verify proper installation, connection, and integrity of each element of engine generator system before and during system operation. Check for air, exhaust, and fluid leaks.
  6. Exhaust-System Back-Pressure Test: Use a manometer with a scale exceeding 40-inch wg. Connect to exhaust line close to engine exhaust manifold. Verify that back pressure at full-rated load is within manufacturer's written allowable limits for the engine.
  7. Voltage and Frequency Transient Stability Tests: Use recording oscilloscope to measure voltage and frequency transients for 50 and 100 percent step-load increases and decreases and verify that performance is as specified.
  8. Harmonic-Content Tests: Measure harmonic content of output voltage at 25 percent and 100 percent of rated linear load. Verify that harmonic content is within specified limits.
  9. Noise-Level Tests: Measure A-weighted level of noise emanating from engine generator installation, including engine exhaust and cooling-air intake and discharge, at four locations 25 feet from edge of the generator enclosure, and compare measured levels with required values.
- E. Coordinate tests with tests for transfer switches and run them concurrently.
- F. Test instruments shall have been calibrated within the past 12 months, traceable to NIST Calibration Services, and adequate for making positive observation of test results. Make calibration records available for examination on request.
- G. Leak Test: After installation, charge exhaust, coolant, and fuel systems and test for leaks. Repair leaks and retest until no leaks exist.
- H. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation for generator and associated equipment.

- I. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- J. Load Bank Testing
  - 1. Perform load bank test, with load bank furnished by the generator supplier.
  - 2. Duration: 4 hours.
  - 3. Load: 100% full rated capacity resistive load, power factor equal to one (1).
  - 4. Witness: Owner's representative.
  - 5. During the test, record the sound level to verify requirements specified herein.
- K. Remove and replace malfunctioning units and retest as specified above.
- L. Retest: Correct deficiencies identified by tests and observations, and retest until specified requirements are met.
- M. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation resistances, time delays, and other values and observations. Attach a label or tag to each tested component, indicating satisfactory completion of tests. Include one hardcopy copy of the report onsite in the maintenance manual folder and furnish another electronic copy to the Owner's representative.
- N. Infrared Scanning: After Substantial Completion, but not more than 60 days after final acceptance, perform an infrared scan of each power wiring termination and each bus connection while running with maximum load. Remove all access panels, so terminations and connections are accessible to portable scanner.
  - 1. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan 11 months after date of Substantial Completion.
  - 2. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
  - 3. Record of Infrared Scanning: Prepare a certified report that identifies terminations and connections checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

### 3.7 MAINTENANCE SERVICE

- A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by skilled employees of manufacturer's authorized service representative. Include quarterly preventive maintenance and exercising to check for proper starting, load transfer, and running under load. Include routine preventive maintenance as recommended by manufacturer and adjusting as required for proper operation. Parts shall be manufacturer's authorized replacement parts and supplies.

### 3.8 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain packaged engine generators.

END OF SECTION 263213.13

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## SECTION 263613 - ENCLOSED TRANSFER SWITCHES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Refer to JEA Facilities Standards 26 36 23 Revised February 15, 2020 – Automatic Transfer Switches, as the primary specification and requirements for the automatic transfer switch. This document is intended to supplement, and not to supersede those requirements.
- B. 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 transfer switches in individual enclosures.
- B. Related Sections:
  - 1. Section 033000 - Cast-In-Place Concrete for concrete pads.
  - 2. Section 260526 - Grounding and Bonding for Electrical Systems.
  - 3. Section 260529 - Hangers and Supports for Electrical Systems.
  - 4. Section 263213 - Engine Generators for testing requirements.

#### 1.3 SUBMITTALS

- A. Section 013300 - Submittal Procedures: Submittal procedures.
- B. Product Data: Submit catalog sheets showing voltage, switch size, ratings and size of switching and overcurrent protective devices, operating logic, short circuit ratings, dimensions, and enclosure details.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Section 017700 - Closeout Procedures: Closeout procedures.
- B. Project Record Documents: Record actual locations of enclosed transfer switches.
- C. Operation and Maintenance Data: Submit routine preventative maintenance and lubrication schedule. List special tools, maintenance materials, and replacement parts.

## 1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience, and with service facilities within 50 miles of Project, available 24/7.
- B. Supplier: Authorized distributor of specified manufacturer with minimum three years documented experience.

## 1.6 MAINTENANCE SERVICE

- A. Section 017300 - Execution: Maintenance service.
- B. Warranty: Furnish service and maintenance of transfer switches for five (5) years from Date of Substantial Completion, including coverage for parts, labor and travel cost for a factory authorized service technician.

## PART 2 - PRODUCTS

### 2.1 AUTOMATIC TRANSFER SWITCH

- A. Furnish automatic transfer switches with bypass / isolation switches from the following manufacturer:
  - 1. ASCO Series 7000.
- B. Product Description: NEMA ICS 10, automatic transfer switch with no-load break manual bypass switch.
- C. Configuration: Electrically operated, mechanically held transfer switch with manually-operated CONNECTED, TEST, AND DISCONNECTED draw-out positions, and with mechanically-operated, mechanically-held transfer switch connected to bypass automatic switch in both NORMAL and EMERGENCY positions.
- D. Front accessible.
- E. Include ASCO 5410 Power Quality Meter with 150BT1 Technology Package.
- F. UL 1008 Rated.
- G. Rating: State voltage and current rating and number of poles or "as indicated on drawings".
- H. Interrupting Capacity: 65,000 AIC.
- I. Withstand Current Rating: 65,000 rms symmetrical amperes, when used with molded case circuit breaker.
- J. Service Conditions: NEMA ICS 10.

1. Temperature: 40 degrees C.
2. Altitude: 3,300 above sea level.

K. Product Features:

1. Indicating Lights: Mount in cover of enclosure to indicate NORMAL SOURCE AVAILABLE, ALTERNATE SOURCE AVAILABLE, switch position.
2. Test Switch: Mount in cover of enclosure to simulate failure of normal source.
3. Return to Normal Switch: Mount in cover of enclosure to initiate manual transfer from alternate source to normal source.
4. Transfer Switch Auxiliary Contacts 3 normally open; 3 normally closed.
5. Normal Source Monitor: Monitor normal source voltage and frequency; initiate transfer when voltage drops below 85 percent or frequency varies more than 3 percent Hertz from rated nominal value.
6. Alternate Source Monitor: Monitor alternate source voltage and frequency; inhibit transfer when voltage is below 85 percent or frequency varies more than 3 percent Hertz from rated nominal value.
7. When in the "open" mode, automatic transfer switch can be completely withdrawn for inspection or maintenance, without removal of power conductors.

L. Surge Protection

1. Include 130 kA per phase or greater surge protective device.

M. Automatic Sequence of Operation:

1. Initiate Time Delay to Start Alternate Source Engine Generator: Upon initiation by normal source monitor.
2. Time Delay to Start Alternate Source Engine Generator: 0 to 60 seconds, adjustable.
3. Initiate Transfer Load to Alternate Source: Upon initiation by normal source monitor and permission by alternate source monitor.
4. Time Delay Before Transfer to Alternate Power Source: 0 to 180 seconds, adjustable.
5. Initiate Retransfer Load to Normal Source: Upon permission by normal source monitor, when normal source has been restored to 90% or more of line voltage.
6. Time Delay Before Transfer to Normal Power: 0 to 180 seconds, adjustable; bypass time delay in event of alternate source failure.
7. Time Delay Before Engine Shut Down: 0 to 5 minutes, adjustable, of unloaded operation.
8. Engine Exerciser: Start engine every 30 days; run for 30 minutes before shutting down. Bypass exerciser control when normal source fails during exercising period.
9. Alternate System Exerciser: Transfer load to alternate source during engine exercising period.

N. Enclosure:

1. Enclosure: ICS 10, Type 12.
2. Finish: Manufacturer's standard gray enamel.

## 2.2 SOURCE QUALITY CONTROL

A. Furnish shop inspection and testing of each transfer switch.

- B. Make completed transfer switch available for inspection at manufacturer's factory prior to packaging for shipment. Notify Owner at least seven days before inspection is allowed.
- C. Allow witnessing of factory inspections and tests at manufacturer's test facility. Notify Owner at least seven days before inspections and tests are scheduled.

### PART 3 - EXECUTION

#### 3.1 EXISTING WORK

- A. Disconnect and remove abandoned transfer switches.
- B. Clean and repair existing transfer switches to remain or to be reinstalled.

#### 3.2 INSTALLATION

- A. Install housekeeping pads in accordance with Section 033000.

#### 3.3 FIELD QUALITY CONTROL

- A. Section 014000 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Perform inspections and tests listed in NETA ATS, Section 7.22.3.

#### 3.4 MANUFACTURER'S FIELD SERVICES

- A. Section 014000 - Quality Requirements: Manufacturers' field services.
- B. Check out transfer switch connections and operations and place in service.

#### 3.5 ADJUSTING

- A. Section 017300 - Execution: Testing, adjusting, and balancing.
- B. Adjust control and sensing devices to achieve specified sequence of operation.

#### 3.6 DEMONSTRATION AND TRAINING

- A. Demonstrate operation of transfer switch in [bypass,] normal, and emergency modes.

END OF SECTION 263613



## SECTION 264113 - LIGHTNING PROTECTION FOR STRUCTURES

### 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. Provide a complete lightning protection system (LPS) for the following structures at the JEA Rivertown Water Treatment Plant:
  - 1. High Service Pump Station.
  - 2. Chemical Building.
  - 3. Ground Storage Tank.
  - 4. Standby Generator Enclosure.
- B. LPS for buildings consists of conductors, air terminals and accessories bonded together and grounded to the system ground grid at regular intervals. Submittal of alternate methods of lightning protection must provide equal or greater lightning protection than specified.
- C. Employ a licensed LPS engineering company to design and install the LPS in compliance with NFPA 780 and UL 96A. Design to include detailed installation drawings and material specifications.
- D. Provide for UL field inspection upon completed installation and UL Master label. Make all corrections and additions required by UL inspector. Pay all costs for UL inspection and any subsequent re-inspections.
- E. Visit and inspect all areas of existing buildings and structures on the site relevant to the work.
- F. Related Requirements:
  - 1. Section 260526 "Grounding and Bonding for Electrical Systems" for grounding and bonding materials and installation.
  - 2. Section 260533 "Raceways and Boxes for Electrical Systems" for PVC conduit.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings:
  - 1. Include layouts of the lightning protection system, with details of the components to be used in the installation.

2. Include raceway locations needed for the installation of conductors.
3. Details of air terminals, ground rods, ground rings, conductor supports, splices, and terminations, including concealment requirements.
4. Include roof attachment details, coordinated with roof installation.
5. Calculations required by NFPA 780 for bonding of metal bodies.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Certificates: For each type of roof adhesive for attaching the roof-mounted air terminal assemblies, approved by the roofing-material manufacturer.
- C. Field quality-control reports.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For lightning protection system to include in maintenance manuals.
  1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
    - a. Dimensioned site plan showing dimensioned route of the ground loop conductor and the ground rod locations. Comply with requirements of Section 017839 "Project Record Documents."
    - b. A system testing and inspection record, listing the results of inspections and ground resistance tests, as recommended by NFPA 780, Annex D.
- B. Completion Certificate:
  1. UL Master Label Certificate.

#### 1.6 QUALITY ASSURANCE

- A. Installer Qualifications: UL-listed installer, category OWAY or LPI Master Installer.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. NFPA Lightning Protection Standard: Comply with NFPA 780 requirements for Class I buildings.
- B. UL Lightning Protection Standard: Comply with UL 96A requirements for Class I buildings.
- C. Lightning Protection Components, Devices, and Accessories: Listed and labeled by a qualified testing agency as complying with UL 96, and marked for intended location and application.

## 2.2 MATERIALS

### A. General:

1. Use new materials.
2. Comply with minimum weight, size, and composition requirements of UL and NFPA unless higher standard is included herein.
3. Comply with Section 260526 "Grounding and Bonding for Electrical Systems" for grounding materials and methods.
4. Comply with Section 260533 "Raceways and Boxes for Electrical Systems" for PVC conduit. Use PVC schedule 80.

### B. Air Terminals:

1. Aluminum: Solid, 1/2-inch diameter by 18 inches long, rounded tip.
2. Copper: Solid, nickel-plated, 3/8-inch diameter by 18-inches long, rounded tip.
3. Cast bronze base with stainless steel bolt pressure connectors. Provide base specific to the attachment surface. Adhesive type for flat roof areas.

### C. Class 1 Main Conductors:

1. Aluminum: 14 AWG, 28 strand (weighing 105 lbs per 1,000 ft).
2. Copper: Tinned, 17 AWG, 32 strand (weighing 220 lbs per 1,000 ft).

### D. Conductor Fasteners: Non-corrosive metal, rated to support conductors.

### E. Conductor Splices and Connectors:

1. Cast bronze with screw pressure type stainless steel bolts and nuts.
2. Exothermic type at buried and non-accessible locations.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Coordinate work with electrical contractor and other trade contractors.
- B. Install materials by a UL listed lightning protection contractor and in accordance with the approved shop drawings, and UL 96A and NFPA 780 recommended practices.
- C. LPS engineering company to provide assistance and supervision of the installation as required and be present during the UL inspection.
- D. Install in a neat and inconspicuous manner.
- E. Coordinate mounting and penetration of roof surface with roofing contractor to assure maximum roofing guarantee. Through-roof penetration flashings shall be furnished, sealed, and guaranteed by a licensed roofing contractor.
- F. Excavate and backfill as required. Finish grade and restore to original condition.

- G. Bond metal bodies within 6 feet of the LPS conductor to the LPS with approved fittings and conductors. Use approved bimetallic connectors for connections between dissimilar metals.
- H. Legibly record field changes on a set of project contract drawings as work progresses. Furnish a complete set of reproducible "As-built" drawings for the Project Record Documents when work is complete.
- I. Air Terminals:
  - 1. Space air terminals so as not to exceed 20 feet apart around the outside perimeter of the roof or ridge and not over 50 feet apart through the center of flat roof areas.
  - 2. Do not project air terminals more than 24 inches nor less than 10 inches above the protected object.
- J. Conductor Routing:
  - 1. Maintain a downward or horizontal course on main conductors, free from "U" or "V" pockets.
  - 2. Do not form conductors with an angle of less than 90 degrees nor less than an 8-inch radius bend.
  - 3. Do not use metal roofing and siding, eave downspouts or other metal parts subject to displacement as part of the lightning conductor system.
  - 4. Space fasteners not more than 3 feet horizontally or vertically.
  - 5. Use fasteners of the same material as the conductor.
  - 6. Use bimetallic fittings for connections between dissimilar metals.
- K. Down Conductors:
  - 1. Follow the most direct patch possible between roof conductors and ground terminals.
  - 2. Provide a minimum of two down conductors installed at the diagonally opposed corners of the building for buildings with a ground perimeter less than 250 feet.
  - 3. Provide down conductors as required so the distance between the conductors does not exceed 100 feet for all buildings with a ground perimeter in excess of 250 feet.
  - 4. Conceal down conductors to greatest extent possible.
  - 5. Use Schedule 80 PVC conduit for any required physical protection of down conductors.
  - 6. Install down conductors within a building within the wall and provide physical protection within the wall.
  - 7. Where down conductors are installed on the exterior of structures, provide physical protection of the conductor from grade level to a height of at least 6 feet.
  - 8. Make connections through the roof with through-roof connectors.
  - 9. Splices are not permitted on conductors embedded in concrete.
- L. Roof Conductors:
  - 1. Interconnect and provide a two-way path from air terminals.
  - 2. Bond together air terminals and install exposed except that where connections are made to equipment located under roof.
  - 3. Form closed loops on perimeters of flat roofs.
  - 4. Dead end air terminals are not permitted.
  - 5. Interconnecting cables from air terminals to roof conductors or metal roof decks shall be similar to roof conductor.

M. Roof Penetrations and Pitch Pockets: By a qualified roofing contractor.

N. Grounding System:

1. Provide ground rods at each down conductor, a minimum of 3 feet away from the foundation walls.
2. Provide LPS ground rods in addition to the ground rods provided for the system grounding grid as required.
3. Interconnect ground terminals with the electric system grounding grid and all grounding mediums. This includes electric and telephone service grounds and underground metallic piping systems.
4. Use an exothermic weld process to bond down conductors to ground rods and any bonds or splices in concealed locations.
5. Notify design Engineer prior to concealment for Engineer's inspection.

O. Identification:

1. Attach corrosion resistant stamped metal tags to, or adjacent to, each down conductor indicating in feet the exact vertical depth in the ground of each ground terminal.
2. Indicate location of down leads connected to water pipes.
3. Place tags at a height of 5 feet above finished grade.

### 3.2 CONNECTIONS

- A. Aboveground concealed connections, and connections in earth or concrete, shall be done by exothermic welds or by high-compression fittings listed for the purpose.
- 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.

### 3.3 CORROSION PROTECTION

- A. Do not install copper lightning protection materials on aluminum roofing, siding or other aluminum surfaces.
- B. Do not embed aluminum lightning protection materials in concrete, masonry, or on or below copper surfaces.
- C. Do not combine materials that can form an electrolytic couple that will accelerate corrosion in the presence of moisture unless moisture is permanently excluded from junction of such materials.
- D. Use conductors with protective coatings where conditions would cause deterioration or corrosion of conductors.

3.4 FIELD QUALITY CONTROL

- A. Special Inspections: Engage a qualified special inspector to perform the following special inspections:
  - 1. Perform inspections as required to obtain a UL Master Label for system.
  - 2. Test the LPS for continuity of all conductors and air terminals.
  - 3. Do not exceed system resistance of five ohms, unless otherwise specified or scheduled.
- B. Prepare test and inspection reports and certificates.

END OF SECTION 264113

## SECTION 264313 - SURGE PROTECTION FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS

### 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. Type 2 surge protective devices.
- B. Related Requirements:
  - 1. Section 262505.00 "480V Control Panels" for SPDs installed by control panel manufacturer.

#### 1.3 DEFINITIONS

- A. Inominal: Nominal discharge current.
- B. MCOV: Maximum continuous operating voltage.
- C. Mode(s), also Modes of Protection: Air of electrical connections where the VPR applies.
- D. MOV: Metal-oxide varistor; an electronic component with a significant non-ohmic current-voltage characteristic.
- E. NRTL: Nationally recognized testing laboratory.
- F. OCPD: Overcurrent protective device.
- G. SCCR: Short-circuit current rating.
- H. SPD: Surge protective device. Previously referred to as a Transient Voltage Surge Suppressor (TVSS).
- I. Type 2 SPDs: Permanently connected SPDs intended for installation on the load side of the service disconnect overcurrent device, including SPDs located at the branch panel.
- J. VPR: Voltage protection rating.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include electrical characteristics, specialties, and accessories for SPDs.
  - 2. NRTL certification of compliance with UL 1449.
    - a. Tested values for VPRs.
    - b. Inominal ratings.
    - c. MCOV type designations.
    - d. OCPD requirements.
    - e. Manufacturer's model number.
    - f. System voltage.
    - g. Modes of protection.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.
- B. Sample Warranty: For manufacturer's special warranty.

#### 1.6 CLOSEOUT SUBMITTALS

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

#### 1.7 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace SPDs that fail in materials or workmanship within 10 years from date of Substantial Completion.

### PART 2 - PRODUCTS

#### 2.1 TYPE 2 SURGE PROTECTIVE DEVICES (SPDs)

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - 1. Advanced Protection Technologies Inc. (APT).
  - 2. Eaton.
  - 3. Schneider Electric USA, Inc.
  - 4. SSI, an ILSCO Company.
  - 5. LEA International.
- B. Source Limitations: Obtain devices from single source from single manufacturer.
- C. Standards:



1. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 1449, Type 2.

D. Product Options:

1. Include LED indicator lights for power and protection status.

E. Performance Criteria:

1. Match the voltage, phasing, and frequency of the power system.
2. SCCR equal to or exceed the equipment being protected by the SPD.
3. Protect again surges produced by a 1.2 / 50  $\mu$ s and 8 / 20  $\mu$ s combination waveform generator.
4. Include EMI/RFI noise filtration and comply with UL 1283.
5. Response time of one nanosecond or less for any individual component, self-restoring, and fully automatic.
6. Provide all modes of protection based on the system voltage.
7. Voltage protection ratings (VPRs) not exceeding the following:

<u>System Voltage</u>	<u>Line-Neutral</u>	<u>Line-Ground</u>	<u>N-Ground</u>	<u>Line-Line</u>
120 (2W+G)	700	700	700	n/a
240 (2W+G)	1200	1200	1200	n/a
120/240 (3W+G)	700	700	700	1200
120/208Y (4W+G)	700	700	700	1200
277/480Y (4W+G)	1200	1200	1200	2000
240 $\Delta$ (3W+G)	n/a	1200	n/a	1200

8. Peak Surge Current Rating: Minimum single-pulse surge current withstand rating per phase must not be less than the following. Peak surge current rating must be arithmetic sum of the ratings of individual MOVs in a given mode.
  - a. Service entrance equipment, switchgear, switchboards (480V): 300 kA
  - b. Distribution panelboards and motor control centers (480V): 200 kA
  - c. Panelboards and control panels (480V): 200 kA
  - d. Panelboards and load centers (240/208/120V): 100 kA
9. Inominal Rating as follows:
  - a. Switchgear, switchboards, motor control centers: 20 kA.
  - b. All other equipment: 10 kA.

F. Enclosures:

1. Dry Indoor Enclosures: NEMA 250, Type 12.
2. Outdoor, Wet, Damp, Corrosive, Process Area Enclosures: NEMA 250, Type 4X.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Comply with NECA 1.
- B. Provide OCPD and disconnect for installation of SPD in accordance with UL 1449 and manufacturer's written instructions.
- C. Install leads between disconnects and SPDs and in accordance with manufacturer's written instructions. Comply with wiring methods in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
  - 1. Install leads as short as possible, not to exceed 24-inches.
  - 2. Route leads to avoid sharp bends or kinks.
  - 3. Where practicable with conductor wire size, gently twist leads.

### 3.2 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections with the assistance of a factory-authorized service representative.
  - 1. Compare equipment nameplate data for compliance with Drawings and Specifications.
  - 2. Inspect anchorage, alignment, grounding, and clearances.
  - 3. Verify that electrical wiring installation complies with manufacturer's written installation requirements.
- B. SPDs that do not pass tests and inspections will be considered defective.
- C. Prepare test and inspection reports.

### 3.3 STARTUP SERVICE

- A. Complete startup checks in accordance with manufacturer's written instructions.
- B. Do not perform insulation-resistance tests of the distribution wiring equipment with SPDs installed. Disconnect SPDs before conducting insulation-resistance tests; reconnect them immediately after the testing is over.
- C. Energize SPDs after power system has been energized, stabilized, and tested.

### 3.4 DEMONSTRATION

- A. Train Owner's maintenance personnel to operate and maintain SPDs.

END OF SECTION 264313

## SECTION 265119 - LED INTERIOR LIGHTING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes interior solid-state luminaires that are designed for and exclusively use LED lamp technology.
- B. Related Requirements:
  - 1. Section 260923 "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.

#### 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 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Arrange in order of luminaire designation.
  - 2. Include data on features, accessories, and finishes.
  - 3. Include physical description and dimensions of luminaires.
  - 4. Include emergency lighting units, including batteries and chargers.
  - 5. Include life, output (lumens, CCT, and CRI), and energy-efficiency data.

6. Photometric data and adjustment factors based on laboratory tests, complying with IES "Lighting Measurements Testing and Calculation Guides" for each luminaire type. The adjustment factors shall be for lamps and accessories identical to those indicated for the luminaire as applied in this Project.
  - a. 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. Testing Agency Certified Data: For indicated luminaires, photometric data certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.

- B. Product Schedule: For luminaires and lamps. Use same designations indicated on Drawings.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing laboratory providing photometric data for luminaires.
- B. Product Test Reports: For each type of luminaire, for tests performed by manufacturer and witnessed by a qualified testing agency.
- C. Sample warranty.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For luminaires and lighting systems to include in operation and maintenance manuals.
  1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

#### 1.7 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. Lamps: Ten for every 100 of each type and rating installed. Furnish at least one of each type.
  2. Diffusers and Lenses: One for every 100 of each type and rating installed. Furnish at least one of each type.
  3. Globes and Guards: One for every 20 of each type and rating installed. Furnish at least one of each type.

#### 1.8 QUALITY ASSURANCE

- A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturer's laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.

- B. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7, accredited under the NVLAP for Energy Efficient Lighting Products, and complying with the applicable IES testing standards.
- C. Provide luminaires from a single manufacturer for each luminaire type.
- D. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

#### 1.9 DELIVERY, STORAGE, AND HANDLING

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

#### 1.10 WARRANTY

- A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires 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 PERFORMANCE REQUIREMENTS

- A. Ambient Temperature: 41 to 104 deg F.
  - 1. Relative Humidity: Zero to 100 percent.
- B. Altitude: Sea level to 1000 feet.

#### 2.2 LUMINAIRE REQUIREMENTS

- 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. Factory-Applied Labels: Comply with UL 1598. Locate labels where they will be readily visible to service personnel, but not seen from normal viewing angles.
  - 1. Label shall include the following lamp characteristics:
- C. Recessed luminaires shall comply with NEMA LE 4.
- D. NRTL Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by an NRTL.

- E. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.
- F. Refer to luminaire schedule on Drawings for detailed requirements for each luminaire type.

## 2.3 MATERIALS

### A. Metal Parts:

1. Free of burrs and sharp corners and edges.
2. Sheet metal components shall be steel unless otherwise indicated.
3. Form and support to prevent warping and sagging.

### B. Steel:

1. ASTM A 36/A 36M for carbon structural steel.
2. ASTM A 568/A 568M for sheet steel.

### C. Stainless Steel:

1. Manufacturer's standard grade.
2. Manufacturer's standard type, ASTM A 240/240 M.

### D. Galvanized Steel: ASTM A 653/A 653M.

### E. Aluminum: ASTM B 209.

## 2.4 METAL FINISHES

- A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

## 2.5 LUMINAIRE SUPPORT

- A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.
- B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.
- C. Wires: ASTM A 641/A 641 M, Class 3, soft temper, zinc-coated steel, 12 gage minimum size.
- D. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.
- E. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

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

### 3.2 TEMPORARY LIGHTING

- A. If approved by the Engineer, use selected permanent luminaires for temporary lighting. When construction is sufficiently complete, clean luminaires used for temporary lighting.

### 3.3 INSTALLATION

- A. Comply with NECA 1.
- B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated. Install lamps in each luminaire.
- C. Fasten luminaire to structural support. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems".
- D. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" and Section 260533 "Raceways and Boxes for Electrical Systems" for wiring connections and wiring methods.
- E. Coordinate layout and installation of luminaires with other construction.

### 3.4 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

### 3.5 FIELD QUALITY CONTROL

- A. Inspect each installed luminaire for damage and cleanliness. Replace damaged luminaires and components. Remove debris and clean luminaire prior to tests, inspections, and acceptance by Engineer.
- B. Perform the following tests and inspections:

1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
  2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.
- C. Luminaire will be considered defective if it does not pass operation tests and inspections.
- D. Prepare test and inspection reports.

END OF SECTION 265119



## SECTION 265213 - EMERGENCY AND EXIT LIGHTING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:

- 1. Emergency lighting units.
  - 2. Exit signs.

- B. Related Requirements:

- 1. Section 265119 "LED Interior Lighting" for luminaire supports.

#### 1.3 DEFINITIONS

- A. CCT: Correlated color temperature.
- B. CRI: Color Rendering Index.
- C. Emergency Lighting Unit: A lighting unit with internal or external emergency battery powered supply and the means for controlling and charging the battery and unit operation.
- D. Fixture: See "Luminaire" Paragraph.
- E. Lumen: Measured output of lamp and luminaire, or both.
- F. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of emergency lighting unit, exit sign, and emergency lighting support.
  - 1. Include data on features, accessories, and finishes.
  - 2. Include physical description of the unit and dimensions.
  - 3. Battery and charger for light units.
  - 4. Include life, output of luminaire (lumens, CCT, and CRI), and energy-efficiency data.

5. Include photometric data and adjustment factors based on laboratory tests, complying with IES LM-45, for each luminaire type.

- 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: For nonstandard or custom luminaires.

1. Include plans, elevations, sections, and mounting and attachment details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

C. Product Schedule:

1. For emergency lighting units. Use same designations indicated on Drawings.
2. For exit signs. Use same designations indicated on Drawings.

## 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing laboratory providing photometric data for luminaires.
- B. Product Test Reports: For each luminaire for tests performed by manufacturer and witnessed by a qualified testing agency.
- C. Sample Warranty: For manufacturer's warranty.

## 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For luminaires and lighting systems to include in emergency, operation, and maintenance manuals.
  1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

## 1.7 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. Lamps: 10 for every 100 of each type and rating installed. Furnish at least one of each type.
  2. Luminaire-mounted, emergency battery pack: One for every 20 emergency lighting units. Furnish at least one of each type.
  3. Diffusers and Lenses: One for every 100 of each type and rating installed. Furnish at least one of each type.
  4. Globes and Guards: One for every 20 of each type and rating installed. Furnish at least one of each type.

## 1.8 QUALITY ASSURANCE

- A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturer's laboratory that is accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.
- B. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7, accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products, and complying with the applicable IES testing standards.
- C. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.

## 1.9 DELIVERY, STORAGE, AND HANDLING

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

## 1.10 WARRANTY

- A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Five year(s) from date of Substantial Completion.
- B. Special Warranty for Emergency Lighting Batteries: Manufacturer's standard form in which manufacturer of battery-powered emergency lighting unit agrees to repair or replace components of rechargeable batteries that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period for Emergency Power Unit Batteries: Five years from date of Substantial Completion. Full warranty shall apply for the entire warranty period.
  - 2. Warranty Period for Self-Powered Exit Sign Batteries: Five years from date of Substantial Completion. Full warranty shall apply for the entire warranty period.

## PART 2 - PRODUCTS

### 2.1 GENERAL REQUIREMENTS FOR EMERGENCY LIGHTING

- 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. NRTL Compliance: Fabricate and label emergency lighting units, exit signs, and batteries to comply with UL 924.
- C. Comply with NFPA 70 and NFPA 101.

- D. Comply with NEMA LE 4 for recessed luminaires.
- E. Comply with UL 1598 for fluorescent luminaires.
- F. Lamp Base: Comply with ANSI C81.61.
- G. Bulb Shape: Complying with ANSI C79.1.
- H. Internal Type Emergency Power Unit: Self-contained, modular, battery-inverter unit, factory mounted within luminaire body.
  - 1. Emergency Connection: Operate lamp(s) continuously at an output of 1100 lumens per luminaire, or as noted in the luminaire schedule, each upon loss of normal power. Connect unswitched circuit to battery-inverter unit and switched circuit to luminaire ballast.
  - 2. Operation: Relay automatically turns lamp on when power-supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
  - 3. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
    - a. Ambient Temperature: Less than 0 deg F or exceeding 104 deg F, with an average value exceeding 95 deg F over a 24-hour period.
    - b. Ambient Storage Temperature: Not less than minus 4 deg F and not exceeding 140 deg F.
    - c. Humidity: More than 95 percent (condensing).
    - d. Altitude: Exceeding 3300 feet.
  - 4. Test Push-Button and Indicator Light: Visible and accessible without opening luminaire or entering ceiling space.
    - a. Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
    - b. Indicator Light: LED indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
  - 5. Battery: Sealed, maintenance-free, type as noted in the luminaire schedule on the Drawings.
  - 6. Charger: Fully automatic, solid-state, constant-current type with sealed power transfer relay.
  - 7. Integral Self-Test: 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.

## 2.2 EMERGENCY LIGHTING

- A. General Requirements for Emergency Lighting Units: Self-contained units.

- B. Emergency Luminaires and Lighting Units: As indicated on luminaire schedule on Drawings.

## 2.3 EXIT SIGNS

- A. General Requirements for Exit Signs: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.
- B. Internally Lighted Signs: As indicated on luminaire schedule on Drawings.

## 2.4 MATERIALS

- A. Metal Parts:
  - 1. Free of burrs and sharp corners and edges.
  - 2. Sheet metal components shall be steel unless otherwise indicated.
  - 3. Form and support to prevent warping and sagging.
- B. Doors, Frames, and Other Internal Access:
  - 1. Smooth operating, free of light leakage under operating conditions.
  - 2. Designed to permit relamping without use of tools.
  - 3. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.
- C. Diffusers and Globes: As indicated on luminaire schedule on Drawings
- D. Housings: As indicated on luminaire schedule on Drawings.

## 2.5 METAL FINISHES

- A. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

## 2.6 LUMINAIRE SUPPORT COMPONENTS

- A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for conditions affecting performance of luminaires.

- B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before luminaire installation.
- C. Examine walls, floors, roofs, and ceilings for suitable conditions where emergency lighting luminaires will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Comply with NECA 1.
- B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.
- C. Install lamps in each luminaire.
- D. Support luminaires in accordance with Section 265119 "LED Interior Lighting".

### 3.3 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

### 3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
  - 1. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.
- B. Luminaire will be considered defective if it does not pass operation tests and inspections.
- C. Prepare test and inspection reports.

### 3.5 STARTUP SERVICE

- A. Perform startup service:
  - 1. Charge emergency power units minimum of one hour and depress switch to conduct short-duration test.
  - 2. Charge emergency power units minimum of 24 hours and conduct one-hour discharge test.

### 3.6 ADJUSTING

- A. Adjustments: Within 12 months of date of Substantial Completion, provide on-site visit to do the following:

1. Inspect all luminaires. Replace lamps, emergency power units, batteries, signs, or luminaires that are defective.
  - a. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
2. Conduct short-duration tests on all emergency lighting.

END OF SECTION 265213

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## SECTION 265613 - LIGHTING POLES AND STANDARDS

### 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. Poles and accessories for support of luminaires.

#### 1.3 DEFINITIONS

- A. EPA: Equivalent projected area.
- B. Luminaire: Complete luminaire.
- C. Pole: Luminaire-supporting structure, including tower used for large-area illumination.
- D. Standard: See "Pole."

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each pole, accessory, and luminaire-supporting and -lowering device, arranged as indicated.
  - 1. Include data on construction details, profiles, EPA, cable entrances, materials, dimensions, weight, rated design load, and ultimate strength of individual components.
  - 2. Include finishes for lighting poles and luminaire-supporting devices.
  - 3. Anchor bolts.
  - 4. Manufactured pole foundations.
- B. Shop Drawings:
  - 1. Include plans, elevations, sections, and mounting and attachment details.
  - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 3. Detail fabrication and assembly of poles and pole accessories.
  - 4. Foundation construction details, including material descriptions, dimensions, anchor bolts, support devices, and calculations, signed and sealed by a professional engineer licensed in the state of installation.

5. Anchor bolt templates keyed to specific poles and certified by manufacturer.
6. Method and procedure of pole installation. Include manufacturer's written installations.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Pole and Support Component Certificates: Signed by manufacturers of poles, certifying that products are designed for indicated load requirements according to AASHTO LTS-6-M and that load imposed by luminaire and attachments has been included in design. The certification shall be based on design calculations signed and sealed by a professional engineer.
- B. Source quality-control reports.
- C. Field quality-control reports.
- D. Sample Warranty: Manufacturer's standard warranty.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For poles to include in emergency, operation, and maintenance manuals.
  1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include pole inspection and repair procedures.

#### 1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Pole repair materials.

#### 1.8 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to ASTM C1093 for foundation testing.

#### 1.9 DELIVERY, STORAGE, AND HANDLING

- A. Package aluminum poles for shipping according to ASTM B660.
- B. Store poles on decay-resistant skids at least 12 inches above grade and vegetation. Support poles to prevent distortion and arrange to provide free air circulation.
- C. Retain factory-applied pole wrappings on metal poles until right before pole installation. Handle poles with web fabric straps.

#### 1.10 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of pole(s) that fail in materials or workmanship; that corrode; or that fade, stain, perforate, erode, or chalk due to

effects of weather or solar radiation within a specified warranty period. Manufacturer may exclude lightning damage, hail damage, vandalism, abuse, or unauthorized repairs from special warranty period.

1. Warranty Period: Five years from date of Substantial Completion.
2. Warranty Period for Corrosion Resistance: Five years from date of Substantial Completion.
3. Warranty Period for Color Retention: Five years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design pole foundation and pole power system for substitution of foundation design shown on Drawings.
- B. Structural Characteristics: Comply with AASHTO LTS-6-M for requirements for dead loads, live loads, and wind loads. Refer to structural general notes on Drawings for project requirements.
- C. Strength Analysis: For each pole, multiply the actual EPA of luminaires and brackets by a factor of 1.1 to obtain the EPA to be used in pole selection strength analysis.
- D. Luminaire Attachment Provisions: Comply with luminaire manufacturers' mounting requirements. Use stainless-steel fasteners and mounting bolts unless otherwise indicated.

### 2.2 ALUMINUM POLES

- A. Refer to Drawings for manufacturer and detailed requirements.
- B. Poles: Seamless, extruded structural tube complying with ASTM B221, Alloy 6063-T6, with access handhole in pole wall.
- C. Pole-Top Tenons: Fabricated to support luminaire or luminaires and brackets indicated, and securely fastened to pole top.
- D. Grounding and Bonding Lugs: Bolted 1/2-inch threaded lug, complying with requirements in 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.
- E. Fasteners: Stainless steel, size and type as determined by manufacturer. Corrosion-resistant items compatible with support components.
  1. Materials: Compatible with poles and standards as well as to substrates to which poles and standards are fastened and shall not cause galvanic action at contact points.
  2. Anchor Bolts, Leveling Nuts, Bolt Caps, and Washers: Hot-dip galvanized after fabrication unless otherwise indicated.

- F. Handhole: Oval shaped, with minimum clear opening of 2-1/2 by 5 inches, with cover secured by stainless-steel captive screws.
- G. Prime-Coat Finish: Manufacturer's standard prime-coat finish ready for field painting.
- H. Aluminum Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" recommendations for applying and designating finishes.
  - 1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
  - 2. Natural Satin Finish: Provide fine, directional, medium satin polish (AA-M32); buff complying with AA-M20 requirements; and seal aluminum surfaces with clear, hard-coat wax.
- I. Factory-Painted Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" recommendations for applying and designating finishes.
  - 1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1 to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, according to SSPC-SP 5/NACE No. 1 or SSPC-SP 8.
  - 2. Interior Surfaces of Pole: One coat of bituminous paint, or otherwise treat for equal corrosion protection.
  - 3. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.
    - a. Color: As indicated by manufacturer's designations.
- J. Powder-Coat Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" recommendations for applying and designating finishes.
  - 1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1 to remove dirt, oil, grease, and other contaminants that could impair powder coat bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, according to SSPC-SP 5/NACE No. 1 or SSPC-SP 8.
  - 2. Powder coat shall comply with AAMA 2604.
    - a. Electrostatic applied powder coating; single application with a minimum 2.5- to 3.5-mils (64- to 89-um) dry film thickness; cured according to manufacturer's instructions. Coat interior and exterior of pole for equal corrosion protection.
    - b. Color: As indicated by manufacturer's designations.

## 2.3 POLE ACCESSORIES

- A. Duplex Receptacle: Ground-fault circuit interrupter type, 120 V ac, 20 A in a weatherproof assembly. Mounting height as shown on Drawings. Comply with requirements in Section 262726 "Wiring Devices."

## 2.4 MOUNTING HARDWARE

- A. Anchor Bolts: Manufactured to ASTM F1554, Grade 55, with a minimum yield strength of 55,000 psi.
  - 1. Galvanizing: Hot dip galvanized according to ASTM A153, Class C.
  - 2. Headed rods with diameter and length per manufacturer.
  - 3. Threading: Uniform National Coarse, Class 2A.
- B. Nuts: ASTM A563, Grade A, Heavy-Hex
  - 1. Galvanizing: Hot dip galvanized according to ASTM A153, Class C.
  - 2. Two nuts provided per anchor bolt, shipped with nuts pre-assembled to the anchor bolts.
- C. Washers: ASTM F436, Type 1.
  - 1. Galvanizing: Hot dip galvanized according to ASTM A153, Class C.
  - 2. Two washer(s) provided per anchor bolt.

## 2.5 GENERAL FINISH REQUIREMENTS

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine poles, luminaire-mounting devices, lowering devices, and pole accessories before installation. Components that are scratched, dented, marred, wet, moisture damaged, or visibly damaged are considered defective.
- C. Examine roughing-in for foundation and conduit to verify actual locations of installation.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 POLE FOUNDATION

- A. Concrete Pole Foundations: Cast in place, with anchor bolts to match pole-base flange. Structural steel complying with ASTM A36/A36M and hot-dip galvanized according to ASTM A123/A123M; and with top-plate and mounting bolts to match pole-base flange and

strength required to support pole, luminaire, and accessories. Concrete, reinforcement, and formwork are specified in Section 033000 "Cast-in-Place Concrete."

- B. Pre-Cast Foundations: Factory fabricated, with structural steel complying with ASTM A36/A36M and hot-dip galvanized according to ASTM A123/A123M; and with top-plate and mounting bolts to match pole-base flange and strength required to support pole, luminaire, and accessories. Concrete, reinforcement, and formwork are specified in Section 033000 "Cast-in-Place Concrete."
- C. Anchor Bolts: Install plumb using manufacturer-supplied template, uniformly spaced.

### 3.3 POLE INSTALLATION

- A. Alignment: Align poles as indicated on Drawings.
- B. Concrete Pole Foundations: Set anchor bolts according to anchor-bolt templates furnished by pole manufacturer. Concrete materials, installation, and finishing requirements are specified in Section 033000 "Cast-in-Place Concrete."
- C. Foundation-Mounted Poles: Mount pole with leveling nuts and tighten top nuts to torque level according to pole manufacturer's written instructions.
  - 1. Grout void between pole base and foundation. Use nonshrink or expanding concrete grout firmly packed to fill space.
  - 2. Install base covers unless otherwise indicated.
  - 3. Use a short piece of 1/2 -inch diameter pipe to make a drain hole through grout. Arrange to drain condensation from interior of pole.
- D. Poles and Pole Foundations Set in Concrete-Paved Areas: Install poles with a minimum 6-inch-wide, unpaved gap between the pole or pole foundation and the edge of the adjacent concrete slab. Fill unpaved ring with pea gravel. Insert material to a level 1 inch below top of concrete slab.
- E. Raise and set pole using web fabric slings (not chain or cable) at locations indicated by manufacturer.

### 3.4 CORROSION PREVENTION

- A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum using insulating fittings or treatment.

### 3.5 GROUNDING

- A. Ground Metal Poles and Support Structures: Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems" and per details shown on Drawings.

3.6 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.7 FIELD QUALITY CONTROL

- A. Inspect poles for nicks, mars, dents, scratches, and other damage and repair finishes.

END OF SECTION 265613

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## SECTION 265619 – LED EXTERIOR LIGHTING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:

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

- B. Related Requirements:

- 1. Section 265613 "Lighting Poles and Standards" for poles and standards used to support exterior lighting equipment.

#### 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. Lumen: Measured output of lamp and luminaire, or both.
- F. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of luminaire.
  - 1. Arrange in order of luminaire designation.
  - 2. Include data on features, accessories, and finishes.
  - 3. Include physical description and dimensions of luminaire.
  - 4. Lamps, include life, output (lumens, CCT, and CRI), and energy-efficiency data.

5. Photometric data and adjustment factors based on laboratory tests, complying with IES Lighting Measurements Testing and Calculation Guides, of each luminaire type. The adjustment factors shall be for lamps and accessories identical to those indicated for the luminaire as applied in this Project.
    - a. Manufacturer's Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the NVLAP for Energy Efficient Lighting Products.
    - b. Testing Agency Certified Data: For indicated luminaires, photometric data certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.
  6. Wiring diagrams for power, control, and signal wiring.
  7. Photoelectric relays.
  8. Means of attaching luminaires to supports and indication that the attachment is suitable for components involved.
- B. Product Schedule: For luminaires and lamps. Use same designations indicated on Drawings.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing laboratory providing photometric data for luminaires.
- B. Product Test Reports: For each luminaire, for tests performed by manufacturer and witnessed by a qualified testing agency.
- C. Source quality-control reports.
- D. Sample warranty.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For luminaires and photoelectric relays to include in operation and maintenance manuals.
  1. Provide a list of all lamp types used on Project. Use ANSI and manufacturers' codes.
  2. Provide a list of all photoelectric relay types used on Project; use manufacturers' codes.

#### 1.7 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. Lamps: Ten for every 100 of each type and rating installed. Furnish at least one of each type.
  2. Glass, Acrylic, and Plastic Lenses, Covers, and Other Optical Parts: One for every 100 of each type and rating installed. Furnish at least one of each type.
  3. Diffusers and Lenses: One for every 100 of each type and rating installed. Furnish at least one of each type.

4. Globes and Guards: One for every 20 of each type and rating installed. Furnish at least one of each type.

#### 1.8 QUALITY ASSURANCE

- A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturers' laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.
- B. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7, accredited under the NVLAP for Energy Efficient Lighting Products and complying with applicable IES testing standards.
- C. Provide luminaires from a single manufacturer for each luminaire type.
- D. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

#### 1.9 DELIVERY, STORAGE, AND HANDLING

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

#### 1.10 FIELD CONDITIONS

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

#### 1.11 WARRANTY

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

## PART 2 - PRODUCTS

### 2.1 LUMINAIRE REQUIREMENTS

- 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. NRTL Compliance: Luminaires shall be listed and labeled for indicated class and division of hazard by an NRTL.
- C. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.
- D. UL Compliance: Comply with UL 1598 and listed for wet location.
- E. Lamp base complying with ANSI C81.61.
- F. Bulb shape complying with ANSI C79.1.
- G. CRI of minimum 80. CCT of 4100 K.
- H. L70 lamp life of 50,000 hours.
- I. Lamps dimmable from 100 percent to 0 percent of maximum light output.
- J. Internal driver.
- K. Nominal Operating Voltage: As shown on Drawings.
- L. In-line Fusing: Separate in-line fuse for each luminaire.
- M. Lamp Rating: Lamp marked for outdoor use.
- N. Source Limitations: Obtain luminaires from single source from a single manufacturer.

### 2.2 LUMINAIRE-MOUNTED PHOTOELECTRIC RELAYS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - 1. Intermatic, Inc.
  - 2. Lithonia Lighting; Acuity Brands Lighting, Inc.
  - 3. Manufacturer of the luminaire.
- B. Comply with UL 773 or UL 773A.
- C. Contact Relays: Factory mounted, single throw, designed to fail in the on position, and factory set to turn light unit on at 1.5 to 3 fc and off at 4.5 to 10 fc with 15-second minimum time delay. [Relay shall have directional lens in front of photocell to prevent artificial light sources from causing false turnoff.]

1. Relay with locking-type receptacle shall comply with ANSI C136.10.
2. Adjustable window slide for adjusting on-off set points.

## 2.3 LUMINAIRE TYPES

- A. As detailed in the luminaire schedule on the Drawings.

## 2.4 MATERIALS

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

- c. CCT and CRI for all luminaires.

## 2.5 FINISHES

- A. Variations in Finishes: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- B. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finish process and color of pole or support materials.
- C. Factory-Applied Finish for Aluminum Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
  - 1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
  - 2. Natural Satin Finish: Provide fine, directional, medium satin polish (AA-M32); buff complying with AA-M20 requirements; and seal aluminum surfaces with clear, hard-coat wax.
  - 3. Class I, Clear-Anodic Finish: AA-M32C22A41 (Mechanical Finish: Medium satin; Chemical Finish: Etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.
  - 4. Class I, Color-Anodic Finish: AA-M32C22A42/A44 (Mechanical Finish: Medium satin; Chemical Finish: Etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker), complying with AAMA 611.
    - a. Color: As noted in the luminaire schedule on Drawings.
- D. Factory-Applied Finish for Steel Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
  - 1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1 or SSPC-SP 8.
  - 2. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.
    - a. Color: As selected by Engineer from manufacturer's full range.

## 2.6 LUMINAIRE SUPPORT COMPONENTS

- A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

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

### 3.2 TEMPORARY LIGHTING

- A. If approved by the Engineer, use selected permanent luminaires for temporary lighting. When construction is substantially complete, clean luminaires used for temporary lighting and install new lamps.

### 3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Comply with NECA 1.
- B. Install lamps in each luminaire.
- C. Fasten luminaire to structural support.
- D. Wiring Method: Install cables in raceways. Conceal raceways and cables.
- E. Install luminaires level, plumb, and square with finished grade unless otherwise indicated.] Install luminaires at height and aiming angle as indicated on Drawings.
- F. Coordinate layout and installation of luminaires with other construction.
- G. Adjust luminaires that require field adjustment or aiming. Include adjustment of photoelectric device to prevent false operation of relay by artificial light sources, favoring a north orientation.
- H. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" and Section 260533 "Raceways and Boxes for Electrical Systems" for wiring connections and wiring methods.

### 3.4 CORROSION PREVENTION

- A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.

### 3.5 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

### 3.6 FIELD QUALITY CONTROL

- A. Inspect each installed luminaire for damage. Replace damaged luminaires and components. Remove debris and clean luminaire prior to tests, inspections, and acceptance by Engineer.
- B. Perform the following tests and inspections:
  - 1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
  - 2. Verify operation of photoelectric controls.
- C. Illumination Tests:
  - 1. Measure light intensities at night. Use photometers with calibration referenced to NIST standards.
  - 2. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
- D. Luminaire will be considered defective if it does not pass tests and inspections.
- E. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

### 3.7 DEMONSTRATION

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

END OF SECTION 265619



## SECTION 271523 - COMMUNICATIONS OPTICAL FIBER HORIZONTAL CABLING

### 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. 50/125 micrometer, multimode, optical fiber cable (OM2).
2. Optical fiber cable connecting hardware, patch panels, and cross-connects.
3. Grounding.
4. Cabling identification products.

#### B. Related Requirements:

1. Section 078413 "Penetration Firestopping."

### 1.3 DEFINITIONS

- A. BICSI: Building Industry Consulting Service International.
- B. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.
- C. RCDD: Registered Communications Distribution Designer.

### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Fiber optic cable testing plan.

### 1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For optical fiber cable, splices, and connectors to include in maintenance manuals.

### 1.6 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. Patch cables: One of each type.
2. Connectors: Ten of each type.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Test cables upon receipt at project site, in accordance with PART 3 specification herein.

#### 1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

#### 1.9 COORDINATION

- A. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications equipment and service suppliers.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. General Performance: Horizontal cabling system shall comply with transmission standards in TIA-568-C.1, when tested according to test procedures of this standard.

#### 2.2 50/125 MICROMETER, MULTIMODE, OPTICAL FIBER CABLE (OM2)

- A. Description: Multimode, 50/125-micrometer, 12-fiber, nonconductive, loose tube, optical fiber cable.
- B. Manufacturers: Subject to compliance with requirements, provide products by the following:
  1. Corning Cable Systems.
- C. Standards:
  1. Comply with ICEA S-83-596 for mechanical properties.
  2. Comply with TIA-568-C.3 for performance specifications.
  3. Comply with TIA-492AAAB for detailed specifications.
- D. Maximum Attenuation: 3.50 dB/km at 850 nm; 1.5 dB/km at 1300 nm.
- E. Minimum Overfilled Modal Bandwidth-length Product: 500 MHz-km at 850 nm; 500 MHz-km at 1300 nm.

F. Jacket:

1. Jacket Color: Orange.
2. Cable cordage jacket, fiber, unit, and group color shall be according to TIA-598-D.
3. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches.

2.3 OPTICAL FIBER CABLE HARDWARE

A. Standards:

1. Comply with Fiber Optic Connector Intermateability Standard (FOCIS) specifications of the TIA-604 series.
2. Comply with TIA-568-C.3.

B. Fiber Optic Termination Patch Panels.

1. Rack Mount Fiber Distribution Center (FDC):
  - a. Where required in Drawings or Specifications, provide rack-mountable Fiber Distribution Centers (FDCs) capable of 24 ST fiber termination points. The connector center shall be 19" rack-mountable and provide for internal fan-out, splicing, and connection of the fiber optic cable to front panel LC connection patch panel.
  - b. The FDC shall provide backbone and intermediate connects and cable strain relief for a maximum of five fiber cable systems. The front shall be swing open construction with keyed latch mechanism.
  - c. The Fiber Connection Center shall be Corning Cable Systems LANscape CCH series or approved equal.
2. Panel Mount Fiber Distribution Center (PDC):
  - a. Where required in Drawings and Specifications, in remote panels, provide surface-mounted patch panels for fiber terminations. Furnish DINSpace SNAP-12ST-SM or approved equal.

C. Patch Cords: Factory-made, single-fiber cables in 36-inch lengths.

D. Connector Type: Type ST complying with TIA-604-2-B, connectors.

2.4 IDENTIFICATION PRODUCTS

- A. Comply with TIA-606-B and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

2.5 SOURCE QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to evaluate cables.

- B. Factory test multimode optical fiber cables according to TIA-526-14-B and TIA-568-C.3.
- C. Factory test preterminated optical fiber cable assemblies according to TIA-526-14-B and TIA-568-C.3.
- D. Cable will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

## PART 3 - EXECUTION

### 3.1 WIRING METHODS

- A. Wiring Method: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters. Conceal raceway and cables except in unfinished spaces.
- B. Wiring Method: Conceal cables in accessible ceilings, walls, and floors where possible.
- C. Wiring within Enclosures: Bundle, lace, and train cables within enclosures. Connect to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

### 3.2 INSTALLATION OF OPTICAL FIBER BACKBONE CABLES

- A. Comply with NECA 1, NECA 301 and NECA/BICSI 568.
- B. General Requirements for Optical Fiber Cabling Installation:
  - 1. Terminate all cables; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
  - 2. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
  - 3. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
  - 4. Bundle, lace, and train cable to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified by the manufacturer. Use lacing bars and distribution spools.
  - 5. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
  - 6. Pulling Cable: Comply with manufacturer recommendations. Monitor cable pull tensions.
  - 7. Cable may be terminated on connecting hardware that is rack or cabinet mounted.
- C. Group connecting hardware for cables into separate logical fields.

### 3.3 FIRESTOPPING

- A. Comply with requirements in Section 078413 "Penetration Firestopping."

### 3.4 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA-606-B.
- B. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA 606-B, for the following:
  - 1. Flexible vinyl or polyester that flexes as cables are bent.

### 3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. Inspections:
  - 1. Visually inspect optical fiber jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments and inspect cabling connections for compliance with TIA-568-C.1.
  - 2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
- D. Tests:
  - 1. Test equipment: The Contractor shall use the following to perform pre-installation and post-installation FOC tests:
    - a. Optical time domain reflectometer (OTDR). The OTDR shall be laser precision, and be able to test single mode or multimode systems with a visual fault locator. The OTDR shall be as manufactured by Corning, Agilent Technologies, Fluke Networks, or equal.
  - 2. Pre-installation Tests
    - a. The purpose of these tests is to perform acceptance tests on the cable prior to installation to verify that the cable conforms to the manufacturer's specifications; is free of defects, breaks, and damages by transportation and manufacturing processes; and to provide baseline readings in dB.
    - b. Prior to removal of each cable from the delivery reel, all optical fibers within the cables shall be tested by the Contractor using an OTDR. The OTDR tests shall consist of end-to-end length and fiber attenuation (dB/km) measurements to ensure proper performance of the fiber optic cable. The tests shall be performed from

- both ends of each fiber to ensure complete fiber continuity within the cable structure.
- c. Pre-installation, "on-reel" test results shall be compared with the manufacturer's test report delivered with the cable. Gross dissimilarities shall be noted and remedied between the Contractor and manufacturer. In all cases, all fibers must meet the optical attenuation specifications prior to cable installation.
  - d. The Contractor shall perform tests on all reels of cable. The Construction Manager shall be notified a minimum of 15 days prior to any test.
  - e. The Contractor shall document each test and submit the report to the Construction Manager for review. Documentation shall consist of both hard copy and 3.5-inch electronic disk complete with all application software.
  - f. Cable shall not be installed until the Construction Manager has reviewed the test report.
  - g. Maximum allowable attenuation is 0.5 dB/km at 1310 and 1550 nm. The Contractor shall replace any cable in which any fiber does not meet this requirement.
3. Post-installation tests: After FOC has been installed and connectorized, the following tests shall be performed:
- a. Visually inspect terminal connectors for out-of-round condition and surface defects such as micro-chips and cracks using a 200X (minimum) inspection microscope.
  - b. A recording OTDR shall be used to test for end-to-end continuity and attenuation of each optical fiber. The OTDR shall have an X-Y plotter to provide a hard copy record of each trace of each fiber. The OTDR shall be equipped with sufficient internal masking to allow the entire cable section to be tested. This may be achieved by using an optical fiber pigtail of 30 feet or more to display the required cable section.
  - c. The maximum permissible end-to-end loss shall be 0.5 dB/km. The Contractor shall replace any cable in which any fiber does not meet this requirement.
  - d. The OTDR shall be calibrated for the correct index of refraction to provide proper length measurement for the known length of reference fiber.
  - e. A transmission test shall be performed with the use of a 1310 and 1550 nm stabilized light sources and 1310 nm/1550 nm power meters for SMF. This test shall be conducted in both directions on each fiber of each cable.
  - f. Hard and electronic copies of test documentation shall be submitted to the Construction Manager. The documentation shall include:
    - 1) The trace plot.
    - 2) Index.
    - 3) dB/km loss.
    - 4) Cable length.
    - 5) Date and time of test.
    - 6) Wavelength.
    - 7) Pulse width.
    - 8) The test site.
    - 9) Cable ID.
    - 10) Fiber number and type.
    - 11) Operator's initials.

- g. The Contractor shall compare the pre-installation test results to the post-installation results. If a deviation of greater than one dB occurs, the Construction Manager shall be notified in writing by the Contractor, and the cable shall be removed and replaced at no additional cost to the Owner.
- 4. Upon completion of the previous tests, all FOC coils shall be secured with ends capped to prevent intrusion of dirt and water.
- 5. Certification of completion of pre- and post-fiber installation testing including test results shall be provided to the Engineer, Contractor, and Ozone Control System Supplier. Test results shall be submitted on paper in a binder, including results indicated in tables or a spreadsheet. Test results that exceed specification limits shall be noted. The electronic copy shall be included in the binder.
- 6. Required OTDR Trace Information
  - a. All traces shall display the entire length of cable under test, highlighting any localized loss discontinuities (installation-induced losses and/or connector losses). The trace shall display fiber length (in kilofeet), fiber loss (dB), and average fiber attenuation (in dB/km), as measured between two markers placed as near to the opposite ends of the fiber under test as is possible while still allowing an accurate reading. Care shall be taken to ensure that the markers are placed in the linear region of the trace, away from the front-end response and far-end Fresnel reflection spike. Time averaging shall be used to improve the display signal to noise ratio. The pulse width of the OTDR shall be set to a sufficient width to provide adequate injected power to measure the entire length the fiber under test.
  - b. If connectors exist in the cable under test, then two traces shall be recorded. One trace shall record the fiber loss (dB) and average attenuation (dB/km) of the entire cable segment under test, including connectors. The second trace shall display a magnified view of the connector regions, revealing the connector losses (dB). All connector losses shall be measured using the five-point splice loss measurement technique.
  - c. The OTDR trace shall also include the following information:
    - 1) The date and time of the test.
    - 2) The cable ID number.
    - 3) The cable segment ID number.
    - 4) The fiber color or sub-cable number.
    - 5) Launch point connector number.
    - 6) The optical wavelength used for the test.
    - 7) The refractive index setting of the OTDR.
    - 8) The pulse width setting of the OTDR.
    - 9) The averaging interval of the test.
    - a) Data for each measurement shall be documented.
  - 10) Remove and replace cabling where test results indicate that it does not comply with specified requirements.
    - a) End-to-end cabling will be considered defective if it does not pass tests and inspections.
  - 11) Prepare test and inspection reports.

END OF SECTION 271523



## SECTION 284621.15 - FIRE ALARM SYSTEM

### PART 1 GENERAL

#### 1.01 SCOPE OF WORK

- A. The Construction Contractor shall employ the services of a licensed fire alarm protection systems engineering company to design and install the fire alarm protection system and prepare detailed installation drawings and material specifications for the High Service Pump Station and Chemical Building at the JEA Rivertown Water Treatment Plant, to be signed and sealed by a professional engineer registered in the state where the project is located. These Contract Documents shall be submitted for review in accordance with Section 013300. Fire alarm systems are to be provided for each building.
- B. The fire alarm protection system shall be checked by the local fire authority having jurisdiction during design and upon completion of the installation. The Construction Contractor shall assume full responsibility for the correctness of the installation and make any and all corrections and additions deemed necessary by the fire authority. The Construction Contractor shall pay for all costs of the inspection and any subsequent re-inspections as required.
- C. Design, furnish, install, test and place in operating condition an electronically-operated, double-supervised, closed-circuit fire alarm system. All units of equipment shall be listed by UL for fire alarm signaling use and shall consist of a control unit, manual fire boxes, alarm indicating appliances, automatic smoke and heat detectors, door release appliances, standby battery and charger and supervisory switches, all located as required by the system designer and applicable codes and wired in accordance with the manufacturer's instructions to make a complete and workable system.
- D. System designer shall coordinate with the local Fire Department to assure that all local, state, and federal requirements are met.
- E. The fire alarm system design shall provide total coverage for all the facilities and shall be in accordance with the applicable local building codes and the Americans with Disabilities Act (ADA). Where the local codes are silent on an issue, the design shall be in accordance with NFPA 101. The application, installation, performance and maintenance of the fire alarm system and its components shall be in accordance with the NFPA 72.
- F. The design and installation of all wiring, cable and equipment shall be in accordance with NFPA 70, and specifically with Article 760, Article 770 and Article 800.
- G. Provide all the documentation indicated in NFPA 72, Sections 1-7 and 7-5.2. The documentation and permanent records shall include but not be limited to written statement by the Construction Contractor indicating the system has been installed and tested in accordance with applicable documents; certificate of completion; installation instructions and after successful completion of acceptable test satisfactory to the Authority having jurisdiction; a set of reproducible as-built installation drawings; operation and maintenance manuals and a written sequence of operation.

- H. The fire alarm system shall be designed and installed in accordance with FM Global standards and the FM Global Property Loss Prevention Data Sheet 5-40, *Fire Alarm Systems*.

#### 1.02 RELATED WORK

- A. Conduit, boxes, fittings, and supports shall be furnished for all wiring to meet the requirements of the system design and be provided and installed under this Section as specified in Section 260533.
- B. Wire shall be furnished to meet the requirements of the system design and be provided and installed under this Sections as specified in Section 260519 and 260523.
- C. Fire suppression systems, sprinkler system alarm valves, flow and supervisory switches shall be furnished under Division 21.

#### 1.03 SUBMITTALS

- A. Submit, in accordance with Section 013300, the following:
  - 1. Shop drawings for each Fire Alarm Control Panel and its associated detectors, alarms, inputs and outputs. Each set of Fire Alarm Control Panel shop drawings shall include:
    - a. Manufacturer's equipment data sheets including sufficient data to indicate compliance with the specifications and component identification tag number, when applicable. Show physical dimensions, mounting and installation details and wiring connections. Indicate all options, special features and deviations from this Section.
    - b. Bill of material for each fire alarm panel listing all modules by quantity and part number.
    - c. Listing of every input/output point address for each panel.
    - d. Standby battery calculations.
    - e. Internal point-to-point wiring diagram for each panel showing interconnections between modules.
    - f. External loop interconnection wiring diagram for each initiating and notification circuit, including interlock wiring to HVAC systems. Loop diagrams shall indicate the origin of the loop at the control panel and include all external devices connected to the loop. Identify external devices by room number or location and type. Show all terminal numbers and color coding for wiring.
    - g. Qualifications of installation contractor.

#### 1.04 SEQUENCE OF OPERATION

- A. Upon activation of any manual pull station, automatic detector, the system shall:
  - 1. Automatically notify local Fire Department (and JEA's UL and FM Global approved listed central monitoring station and JEA central security system or other agency as directed by the fire authority) via a dedicated telephone line and transmitting/receiving equipment provided, installed and coordinated by the Construction Contractor. All costs for this work shall be borne by this Construction Contractor.
  - 2. Automatically start the audible and visual alarm indicating appliances throughout the building under alarm (if more than one) as specified herein.

3. The audible alarm appliances shall sound the standard evacuation tone temporal pattern 3 and visual alarms flash until alarm initiating devices have been restored to normal and the reset switch located at the control panel actuated.
- B. When any of the building's alarm initiating devices are activated, its building exterior mounted beacons shall operate.
- C. Provide smoke detectors in electrical transformer and switchgear rooms in accordance with FM Global standards and the FM Global Property Loss Prevention Data Sheet 5-40, *Fire Alarm Systems*. The detectors shall be arranged to alarm to a constantly attended location.
- D. The local Fire Department shall be hereinafter referred to as the Fire Department.

#### 1.05 REFERENCE STANDARDS

- A. National Fire Protection Association (NFPA)
  1. NFPA 70 - National Electrical Code (latest edition).
  2. NFPA 72 - National Fire Alarm Code (latest edition).
  3. NFPA 101 - Code for Safety to Life from Fire in Buildings and Structures (latest edition).
- B. Underwriters Laboratories (UL)
- C. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

#### 1.06 JEA ACCEPTABLE MANUFACTURERS

- A. Fire alarm control panels and associated components shall be manufactured by one of the following below. References to other manufacturers within this specification are made for reference standards of quality.
  1. Silent Knight
  2. Edwards Systems Technology (EST)
  3. Notifier
  4. Siemens
  5. Potter

#### 1.07 JEA INSTALLATION CONTRACTOR QUALIFICATIONS

- A. Installation Contractor shall have an office, which has been in existence for at least three (3) years within a 30 mile radius of the city limits of Jacksonville, Florida.
- B. Installation Contractor shall have a minimum of five (5) years of experience in the installation of fire alarm systems.

### PART 2 PRODUCTS

#### 2.01 MATERIALS

- A. The control panel shall be surface mounted, modular, of dead-front construction using solid-state components to operate the system. Alarm initiating circuits shall meet National Electrical Code

(NEC) requirements for limited energy applications and function with up to 100 ohms resistance in the alarm initiating device and its associating wiring. The control unit shall contain an internal audible signal with audible acknowledge switch, system reset switch, lamp test switch, audible silence switch and auxiliary master box disconnect switch. Control unit shall be double-supervised so that a trouble signal shall sound in the event of loss of either operating or supervising power. Two light-emitting diodes (LEDS) shall be installed and shall remain illuminated to indicate both operating and supervisory power are energized. Trouble audible acknowledge switches shall be furnished with its associated LED so that indication of trouble on alarm initiating circuits, alarm indicating circuits and supervisory circuits shall initiate a control panel audible and be silenced independent of each other. The silencing of a trouble condition in any zone shall not prevent the resounding of the control panel audible in the event of a subsequent trouble conditions in other circuits. When trouble conditions are restored to normal, the audible acknowledge switch shall not require restoration to normal.

1. Each circuit shall be supervised to provide a trouble condition in the event of an open or short in either circuit. A means shall be provided so that alarm indicating appliances may be discontinued before the actuated initiating device has been restored to normal; but shall not prevent the resounding of subsequent alarms received from another zone. A visual indicator shall be provided so that operating personnel can readily determine that the signals have been discontinued.
2. The initiating device circuits and the notification appliance circuits shall be Class "A". They shall allow the receipt of and notification of alarms even in the event of a single open or a single ground in the circuits.
3. Each of the zones shall have a separate zone trouble and alarm indicator. All field wires connected to alarm initiating devices necessary to activate an alarm shall be electrically supervised and a single open or ground on such wires shall not cause an alarm condition. An open in any alarm initiating circuit shall cause the associated visual trouble indicator to flash and the control panel audible to sound steady, until the audible acknowledge switch is actuated at which time the trouble indicator shall go steady and the control panel silenced. On alarm condition in any alarm initiating circuit, its associated visual alarm indicator shall flash and the control panel audible shall pulsate and the alarm indicating appliances shall sound. When a zone audible acknowledge switch is activated, the indicator shall be lit steady and the control panel audible silenced. The silencing of a trouble or alarm condition in any zone shall not prevent the resounding of the control panel audible in the event of a subsequent alarm or trouble condition in other circuits, or loss of either operating or supervising power. Each alarm initiating circuit shall have associated dry, fused, Form "C" alarm contacts for its associated zone. This contact shall transfer upon alarm condition in its associated zone. Each initiating circuit containing four wire smoke detectors shall incorporate an end of line relay to supervise the smoke detector power circuit.
4. The horn/strobe light units shall be wired on dual circuits to permit silencing of the horns and allow the strobe lights to flash during alarm conditions.
5. Means shall be provided to sound the control panel audible upon a ground fault between any supervised circuit and ground. This ground fault shall also light a visual indicator on the control unit for rapid identification of the trouble cause.
6. All visual indicators on the control panel shall be supervised so that an open or short in any visual indicator shall provide a trouble indication.
7. The batteries used with the fire alarm control panel shall be capable of operating the panel for 60 hours with a 5-minute ring-down at the end of a 60-hour period. The calculation used to determine battery capacity shall be submitted to the Engineer and presented to the Fire Department at the time of inspection. Control unit shall be Autocall, Type MDK or equal.

- B. Manual fire boxes shall be non-coded and shall be semi-flush mounted in finished areas and surface-mounted in unfinished and existing areas. Stations shall be double-action with "LIFT TO BREAK" plastic shield. When operated, fire boxes shall remain mechanically locked until manually reset. Construction shall be of rigid metal with raised lettering and clear plastic shield with lettering "LIFT TO BREAK - PULL LEVER DOWN". Manual fire boxes shall be Autocall, double-action 4051 or equal. Double-action stations requiring external hammer to break glass to gain access to actuating lever shall not be acceptable.
- C. Manual fire boxes for "WP" weatherproof applications shall be non-coded, surface mounted type. Stations shall be slide action type with internal glass rod. Construction shall be die-cast aluminum finished in red with raised natural aluminum lettering, gasketed with back box. Stations shall be Autocall, Catalog No. 5 DW or equal. Double-action stations requiring external hammer to break glass to gain access to actuating lever will not be acceptable.
- D. Manual fire boxes for Class 1, Division 1, Group D hazardous area applications shall be non-coded surface mounting type. Stations shall be double-action type with a hinged cover which holds a sliding actuator plate in place. Activation of the stations is made by lifting the hinged cover and pulling down on the ring. Stations may be reset after activation without need for replacement parts. Stations shall be Killark, XAD Series or equal. Double-action stations requiring a hammer to break glass to gain access to actuating lever will be acceptable.
- E. Automatic ionization type smoke detectors shall be of the dual-chamber, locking type. The dual-chamber shall be highly sensitive to products of combustion and shall allow for compensation for pressure and humidity changes. The detectors shall be equipped with a solid-state regulator to maintain detection sensitivity over a wide range of input voltages. A visual indication of an alarm shall be given by a LED on the detector grille. Automatic ionization type detectors shall be four-wire Autocall, Type 1451-B402B or equal.
- F. Automatic photo-electronic type smoke detectors shall operate on the forward light scattering principle using a pulsed infra-red light emitting diode light source and a photo diode sensor. The detectors shall be of the locking type and have an alarm verification circuit requiring several successive signals exceeding the alarm threshold value prior to transmitting an alarm. A visible LED indicator shall blink to indicate power on and normal operation. On alarm the indicator shall turn on and remain on until the detector is reset. Automatic photo-electronic detector shall be four wire type, Autocall, Model 2451-B402B or equal.
- G. Heat Detectors
  - 1. Heat detectors shall be combination fixed temperature and rate of rise of fixed temperature only. Rate of rise element shall comprise of calibrated, moisture proof, trouble free vented chamber with flexible metal diaphragm to close contact when temperature rise exceeds 15 degrees F per minute. Contact shall be rated 3 Amps, 28 VDC. Fixed temperature element shall comprise nonrestorable fusible alloy element with external heat collector that drops for view when alloy fuses for visual indication of operation. Units shall be enclosed in white low profile dome shell with matching base.
  - 2. Units shall be color-coded to indicate one of the following types:
    - a. 135 degrees F fixed temperature and rate of rise (Autocall 601)
    - b. 200 degrees F fixed temperature and rate of rise (Autocall 602)
    - c. 135 degrees F fixed temperature only (Autocall 603)
    - d. 200 degrees F fixed temperature only (Autocall 604)

3. Heat detectors for Class 1, Division 1, Group D hazardous areas shall have, in addition to their rated enclosures, electrical features similar to those above.
  - a. 136 degrees F fixed temperature and rate of rise (Autocall EPB-501)
  - b. 190 degrees F fixed temperature and rate of rise (Autocall EPB-502)
  - c. 136 degrees F fixed temperature only (Autocall EPB-503)
  - d. 190 degrees F fixed temperature only (Autocall EPB-504)
- H. Combination audio-visual horn/strobe light units meeting current ADA requirements and shall be installed on supervised circuits. Visual portion shall flash on alarm condition. Audio-visual units shall be Autocall, Types SM-24D/H or equal.
- I. Horn for Class 1, Division 1, Group D hazardous area applications shall have a sound rating of 100 dB at 10-ft and be Federal Signal, 41x.
- J. Strobe light for Class 1, Division 1, Group D hazardous area applications shall be for wall mounting, provide 72 high intensity flashes per minute, be furnished with a red polycarbonate lens and be Crouse-Hinds, EVBS101R/024.
- K. Remote trouble station shall consist of buzzer and silencing with switch. Autocall, Type SC-3 or equal.
- L. Remote zone annunciator shall be of the non-graphic type with red bulls-eye lamps mounted on a stainless steel plate.
- M. Door hold and release units for the closing of doors when the threat of fire exists to prevent the spread of fire and smoke shall each consist of two elements: an electromagnetic portion to be wall or floor mounted and an armature section to be mounted on the door. The electromagnetic portion is continuously energized by 120 VAC input power. Wall-to-door mounted assembly shall be Autocall, Model 7392-3 or equal. Floor-to-door mounting assembly shall be Autocall, Model 7392-1 or equal.
- N. Beacon alarm lights for building exterior mounting shall be weatherproof construction and have a 750,000 candle power xenon strobe tube and red polycarbonate lens. Beacon alarm lights shall be similar and equal to Federal Signal, Model 371 DST.
- O. Master box shall be of the local energy, weatherproof enclosure type for surface mounting. Gamewell, Model M3456.
- P. Grounding assembly consisting of ground rod, clamps and all other required hardware shall be provided for master box protection. Gamewell, Model 30118.
- Q. All components shall be products of one manufacturer where such is obtainable.

### PART 3 EXECUTION

#### 3.01 INSTALLATION

- A. The system shall be wired with No. 14 THHN throughout in accordance with the manufacturer's diagrams and requirements. All wires shall be numbered at both ends with typewritten heat shrinkable markers.

- B. All fire alarm system junction boxes shall be painted red.
- C. Upon completion of the installation, the fire alarm system designer and the electrical contractor shall test each and every device including manual station, smoke detector, alarm signals, visual signals, waterflow switches, valves, for proper operation. A certified report shall be submitted to the Engineer indicating date of testing and signatures of the designer's and electrical contractor's personnel that performed the test.
- D. Final connections in the system shall be made under the direct supervision of an authorized representative of the manufacturer. Upon completion of the installation and testing indicated above, the manufacturer shall check and test the entire system with a representative of the Fire Department present.
- E. Provide the OWNER with wiring diagrams including terminal to terminal designations, complete equipment specifications and complete sequence of operation.
- F. Fire Alarm System manufacturer shall warranty all equipment for a period of one (1) year upon acceptance of the system by the OWNER.

END OF SECTION 284621.15

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## SECTION 310515 - SOILS AND AGGREGATES FOR EARTHWORK

### 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 work shall comply and be installed per the latest JEA Water and Wastewater Standards Manual (January 2019 or latest) and the JEA Facilities Standards Manual.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Soils: Soil and topsoil materials.
  - 2. Aggregates: Coarse and fine aggregate materials.
- B. Related Sections:
  - 1. Section 312000 "Earthwork" For excavating, backfilling and compaction in open areas.
  - 2. Section 312333 "Trenching and Backfilling" for trenching, backfilling, and compaction in trench excavations.

#### 1.3 ACTION SUBMITTALS

- A. Section 013300 "Submittal Procedures" for requirements of submittals.
- B. Quality Control Testing: Submit conformance testing performed by a certified independent laboratory engaged by Contractor for all fill materials. Verify maximum density, gradation, Atterberg limits, sand equivalent, and other applicable criteria at least 72 hours prior to importing or placing any fill. Perform additional conformance testing at a minimum frequency of 1 per every 2,000 cubic yards or change in material.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Materials Source: Submit name and location of imported materials suppliers.
- B. Source's Certificate: Certify materials meet or exceed specified requirements.
- C. Material Test Reports: For each on-site soil and aggregate material proposed for fill and backfill as follows:
  - 1. Test Reports: Submit any test reports required by this Section to the Engineer.

## 1.5 QUALITY ASSURANCE

- A. Furnish each soil and topsoil material from single source throughout the Work unless an alternate source is approved by the Engineer.
- B. Furnish each coarse and fine aggregate material from single source throughout the Work unless an alternate source is approved by the Engineer.
- C. Perform Work according to JEA standards and as noted herein.
- D. Quality Control and Quality Assurance consists of laboratory conformance testing of samples supplied from each coarse and fine aggregate source and quality control during installation.
  - 1. Geotechnical Testing Agency Qualifications: Qualified according to ASTM E 329 and ASTM D 3740 for testing indicated.

## 1.6 FIELD CONDITIONS

- A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earth-moving operations.
  - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
  - 2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.

## PART 2 - PRODUCTS

### 2.1 SOIL MATERIALS

- A. Common Fill:
  - 1. Composed of approved on site excavated material or imported fill material that is composed of durable soil free of debris, organic matter, or other deleterious materials.
  - 2. Do not contain stones larger than 6 inches in largest diameter,
  - 3. Have a maximum of 50 percent passing the No. 200 sieve,
  - 4. Have a maximum dry density of at least 90 pounds per cubic foot (pcf) as determined by ASTM D1557.
  - 5. Do not contain granite blocks, broken concrete, masonry rubble, or other similar materials and shall have physical properties such that it can be readily spread and compacted during filling.
- B. Select Fill:
  - 1. Consist of mineral soil free of organic material loam, debris, frozen soil or other deleterious material which may be compressible, or which cannot be properly compacted.
  - 2. Consist of non-plastic, granular soils with a Unified Soil Classification System (USCS) designations of SP, SP-SM, or SM in accordance with ASTM D2487.

C. Structural Fill:

1. Consist of mineral soil free of organic material loam, debris, frozen soil or other deleterious material which may be compressible, or which cannot be properly compacted.
2. Consist of an inorganic, non-plastic, granular soils containing less than 12 percent material passing the No. 200 sieve (relatively clean sand with a Unified Soil Classification System (USCS) designation of SP or SP-SM in accordance with ASTM D2487).

2.2 TOPSOIL MATERIALS

- A. Topsoil: Conforming to State of Florida Department of Transportation (FDOT) and JEA Water and Wastewater Standards Manual.

2.3 COARSE AGGREGATE MATERIALS

- A. Coarse Aggregate - Crushed Stone: Natural stone; washed, free of clay, shale, organic matter; conforming to State of Florida Department of Transportation (FDOT) and JEA Water and Wastewater Standards Manual

1. Coarse Aggregate Designation: No. 57

- B. Coarse Aggregate - Screened Gravel: Natural stone; washed, hard, durable, rounded, or sub-angular particles of proper size and gradation, and shall be free from sand, loam, clay, excess fines, and other deleterious materials; to the following limits:

1. Percent Passing per Sieve Size:

- a. 5/8- inch: 100 percent.
- b. 1/2-inch: 40 to 100 percent.
- c. 3/8-inch: 15 to 45 percent.
- d. No. 10: 0 to 5 percent.

- C. Coarse Aggregate – Limerock base for pavement: the limerock base course shall have a minimum Limerock Bearing Ratio (LBR) of 100.

2.4 FINE AGGREGATE MATERIALS

- A. Fine Aggregate - Sand: Natural river or bank sand; washed; free of silt, clay, loam, friable or soluble materials, and organic matter; graded according to ASTM C 33.

2.5 SOURCE QUALITY CONTROL

- A. Section 014000 - Quality Requirements: Testing and inspection services. Submit test result reports to the Engineer.
- B. Soil Materials - Testing and Analysis: Perform in accordance with ASTM D 1557.
- C. Aggregate Materials - Testing and Analysis: Perform according to ASTM D 1557.

- D. When tests indicate materials do not meet specified requirements, change material and retest.
- E. Furnish materials of each type from same source throughout the Work.

### PART 3 - EXECUTION

#### 3.1 EXCAVATION - SOILS

- A. Excavate soil and topsoil from areas designated. Strip topsoil to full depth of topsoil in designated areas.
- B. Stockpile excavated material meeting requirements for soil and topsoil materials.
- C. Remove excess excavated materials not intended for reuse, from site.
- D. Remove excavated materials not meeting requirements for soil and topsoil materials from site.

#### 3.2 STOCKPILING

- A. Stockpile materials on site at locations indicated on Drawings.
- B. Stockpile in sufficient quantities to meet Project schedule and requirements.
- C. Separate different soil and aggregate materials with dividers or stockpile individually to prevent mixing. Prevent intermixing of soil types or contamination.
- D. Stockpile topsoil 8-foot-high maximum.
- E. Direct surface water away from stockpile site to prevent erosion or deterioration of materials.

#### 3.3 STOCKPILE CLEANUP

- A. Remove stockpile, leave area in clean and neat condition. Grade site surface to prevent free standing surface water.
- B. When borrow area is indicated, leave area in clean and neat condition. Grade site surface to prevent free standing surface water.

END OF SECTION 310515

## SECTION 310900 - GEOTECHNICAL INSTRUMENTATION AND MONITORING

### 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 work shall comply and be installed per the latest JEA Water and Wastewater Standards Manual (January 2019 or latest) and the JEA Facilities Standards Manual.

#### 1.2 SUMMARY

- A. Section includes installing and monitoring geotechnical instrumentation and survey markers to measure.
  - 1. Groundwater levels inside and outside excavation limits.
- B. Related Requirements:
  - 1. Section 312000 "Earthwork" for excavating, backfilling and compaction in open areas..
  - 2. Section 312319 "Dewatering" for controlling surface and groundwater and disposing of water during construction.
  - 3. Section 312333 "Trenching and Backfilling" for trenching, backfilling, and compaction in trench excavations..
  - 4. Section 315000 "Excavation Support and Protection" for temporary support of excavations.

#### 1.3 DEFINITIONS

- A. Groundwater Observation Wells: Screened or slotted pipe with solid riser pipe installed in a drilled hole with the annulus around the pipe backfilled with sand. Near surface groundwater levels are measured in the well.

#### 1.4 ACTION SUBMITTALS

- A. Submit in accordance with Section 013300.
- B. Submit for the Engineer's review four weeks prior to instrument installation:
  - 1. Installation Plan and Schedule: Full details and plan/layout of proposed instruments/points, schedule for installing and monitoring instruments/points, equipment types, installation methods, reference points, and monitoring and data reporting schedule for instruments/points, and instrumentation protection.

2. Description of methods for installing and protecting all instrumentation including but not limited to observation wells and reference points.
  3. Groundwater observation well construction details including casing type, filter gradation, screen interval, grout mix, drilling methods, and well depths.
  4. For instrumentation installed in borings, submit a detailed procedure for installation, including post-installation acceptance test, together with a sample installation record sheet that include:
    - a. Method to be used for cleaning inside of casing or augers.
    - b. Drill casing or auger type and size.
    - c. Depth increments for backfilling boreholes with sand and bentonite.
- C. Installations Records: Within five working days of installing each instrument, submit to the Engineer, specified as-built instrument location and its corresponding installation record sheet.
1. Include in installation record sheet, location with instrument identification numbers, established elevations, initial elevations and coordinates (baseline readings), boring log, installation, and monitoring date and time.
  2. Furnish details of installed instruments showing dimensions, materials used, and as-built drawings of each instrument.
  3. Submit field calibrations.
- D. Reports and Records: Provide reports of monitoring data to the Engineer. include following minimum information:
1. As-installed location plan, installation records, and baseline values for instrumentation.
  2. Monitoring data for instruments with plots against threshold values.
  3. Discussion and associated action related to results exceeding threshold values.
- E. Submit proposed remedial measures to the Engineer of action to be taken in event that instrument Threshold Values are reached.

## 1.5 QUALITY ASSURANCE

- A. Surveyor Qualifications: Professional Land Surveyor registered licensed in the State of Florida with at least 3 years' experience in surveying of similar instruments
- B. Instrument Installation Technicians: Experienced in installation and reading of specified geotechnical instrumentation and equipment.
- C. Perform instrument installations in presence of the Engineer.
- D. Be responsible for installation, maintenance, and monitoring of geotechnical instrumentation.

## PART 2 - PRODUCTS

### 2.1 DESIGN AND PERFORMANCE REQUIREMENTS

#### A. Project Requirements:

1. Install geotechnical instrumentation to monitor groundwater conditions, ground response, and facilities to achieve specified project requirements and prevent damage to facilities potentially affected.
2. Install instrumentation in accordance with approved Instrumentation Schedule.
3. Engineer's monitoring of installed instruments does not relieve Contractor of its obligation to complete project within the requirements specified herein taking necessary additional measurements.

#### B. Secure required permits prior to the installation or removal of observation wells.

#### C. Provide and facilitate safe access to the instruments at all times. Engineer may perform additional monitoring in a manner that will minimize unnecessary work delays. Allow and facilitate instrument monitoring as required by the Engineer. No claim for lost production time due to this activity will be allowed.

#### D. Maintain instrumentation. Report damaged or non-functional instrumentation to the Engineer within 24 hours. Replace damaged instruments within 24 hours.

#### E. Availability of Data:

1. Instrumentation readings shall be collected by the Contractor's Geotechnical Instrumentation Monitoring Firm. Contractor may take their own supplementary readings in addition to those specified.
2. Monitoring data is the property of Owner and is not to be disclosed or published to third parties without Owner's written permission.
3. Contractor is expected to make their own interpretations for their own purposes without additional compensation.
4. Coordinate with the Engineer to verify consistency of collected data.

### 2.2 INSTRUMENTATION - GENERAL

#### A. Instruments and materials, including readout units, installation tools, materials, and miscellaneous instrumentation components.

#### B. Provide surface protection for instruments flush with surface in paved or other ground surface areas at the time that work is completed.

#### C. Minimum Quantity of Instruments: While quantities in following Paragraph are considered minimums, obtain data from instrumentation in quantity to monitor construction, performance, and safety aspects of the Work.

#### D. Following subparagraphs identify instrument type, minimum number to be provided, and approximate installed depth from below bottom of excavation:

<u>Instrument Type:</u>	<u>Number:</u>	<u>Depth:</u>
1. Observation Wells:	1	10 feet
E. Locate instruments and obtain approval from the Engineer.		

## 2.3 GROUNDWATER OBSERVATION WELLS

- A. Pipe: ASTM D 1785, Schedule 40 PVC pipe, 1-inch minimum inside diameter.
- B. Maximum Screen Size: 0.020 inch, unless otherwise approved by the Engineer.
- C. Use observation wells to monitor groundwater levels outside excavations.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

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

### 3.2 PREPARATION

- A. Existing Conditions: Locate vaults, structures, conduits and underground utilities in areas where wells are to be drilled and installed. Conduct utility clearance and contact utility companies prior to any drilling.
  - 1. Modify instrument locations, as approved by the Engineer, to avoid interference with existing vaults, structures, conduits and utilities.
  - 2. Repair damage to existing facilities resulting from instrument installations without additional compensation.
- B. Prior to commencing installation of, excavation support, excavation,, and dewatering work, furnish instrumentation and related components that are to be installed during construction.
- C. Protect from damage and maintain instruments. Repair or replace damaged instruments.
- D. Drilling from Ground Surface: Obtain necessary permits for each instrument and conform to permit requirements during drilling and installation.
- E. Implement remedial measures based on interpretations of monitoring data program.



### 3.3 GENERAL REQUIREMENTS

- A. Install instruments at the Engineer approved locations in accordance with approved installation procedures. Engineer may modify instrument locations depending on field conditions and monitoring objectives. Install instrumentation in accordance with approved installation schedule. Install instruments and obtain baseline data before construction starts.
- B. Allow the Engineer access to instrument locations and assistance required in obtaining monitoring data.
- C. Clearly mark and label instruments and protected to avoid being obstructed or otherwise damaged by construction operations or general public. Immediately following installation, survey location and top of instruments to provide horizontal and vertical coordinates.
  - 1. Resurvey if the Engineer questions instrument locations.
- D. Assign a unique identification number to each instrument and each point that is clearly marked in a non-destructible manner.
- E. Initial Reading: Immediately following instrument installation take two sets of initial readings in the Engineer's presence to provide baseline readings and to demonstrate adequacy of completed installation.

### 3.4 GROUNDWATER OBSERVATION WELLS

- A. Install at least one monitoring well at the ground storage tank location.
- B. Set screened interval of each well to monitor groundwater levels.
- C. Drill 4 inch minimum diameter holes for observation wells of required size and depth and case with temporary casing. Do not use bentonite drilling mud in drilling holes for observation wells.
- D. Flush cased holes with clean water through an approved bit. Flush until discharge water is free of soil particles.
- E. Construct observation well with 10 feet of slotted PVC well screen, filter sand, bentonite seal, couplings, a pipe cap, and a locking cover.
  - 1. Place two feet of filter sand in bottom of drilled hole. Then place well screen and surround it with filter sand, as temporary casing is carefully withdrawn.
  - 2. Insert solid PVC casing and cap and fill annular space with bentonite pellets then non-shrink cement grout.
  - 3. Protect observation wells at ground surface by providing a roadway box or outer protective casing with lockable top and padlock. Design surface protection to prevent damage by vandalism or construction operations and to prevent surface water from infiltrating.
    - a. Provide two keys for each padlock to the Engineer for access to each well.

- b. Develop observation wells to provide a reliable indication of groundwater levels. Re-developed wells if well clogging is observed, in event of apparent erroneous readings, or as directed by the Engineer.
- c. Submit observation well installation logs, top of casing elevation, and well locations to the Engineer within 24 hours of completion of well installation.

F. Observation Well Maintenance:

- 1. Maintain each observation well until adjacent structures and pipelines are completed and backfilled. Clean out or replace any observation well which ceases to be operable before adjacent work is completed.
- 2. Maintain observation wells and repair or replace them without additional compensation, whether or not observation wells are damaged by Contractor's operations or by third parties.

G. Monitoring and Reporting of Observation Well Data:

- 1. Begin daily monitoring of groundwater levels in work areas prior to initial operation of drainage and dewatering system. Continue daily monitoring in areas where groundwater control is in operation until time that adjacent structures and pipelines are completed and backfilled and until time that groundwater control systems are turned off.
- 2. Be responsible for processing and reporting observation well data to the Engineer daily. Submit data to the Engineer on a form that includes following information.
  - a. Observation well number.
  - b. Depth to groundwater.
  - c. Top of casing elevation.
  - d. Groundwater level elevation.
  - e. Date and time of reading.

H. Following construction, abandon new observation wells as directed by the Engineer.

- 1. Abandon observation wells by removing materials within original borehole, including casing, filter, and grout seal in accordance with applicable permits.
- 2. Using approved tremie methods, completely fill hole and voids with non-shrink cement grout prior to removal of drill casing, such that formation materials do not move into hole prior to grouting.
- 3. Restore ground surface to its original condition.
- 4. Abandon wells within paved areas by removing vaults and well caps to pavement subgrade.
- 5. Remove wells with as discussed above and repair or patch pavement with same surface type.

### 3.5 INSTRUMENT PROTECTION, MAINTENANCE AND REPAIR

- A. Protect instruments from damage. Replace damaged or destroyed instruments within 72 hours of damage, without additional compensation. If necessary, suspend work in areas being monitored by damaged instrument and take remedial action.

- B. Maintain instruments by draining water and flushing debris from under protective covers and keeping covers locked and sealed at all times.

### 3.6 MONITORING

- A. Collect, tabulate, plot, and interpret survey monitoring data and provide the Engineer with tabulated and plotted data. Report status of, excavation, bracing, groundwater levels, and backfilling at time of data collection with each report.
- B. Monitoring frequency may be modified as directed and approved by the Engineer.
- C. Submit data from readings of monitoring points to the Engineer within 24 hours of reading. Communicate verbally with the Engineer immediately after visual observations or data collection if excessive movements or other anomalies are indicated.
- D. Make visual observations of ground conditions in site vicinity and communicate immediately with the Engineer if signs of ground movements are observed.
- E. Engineer may take independent instrumentation measurements. Cooperate with the Engineer during instrumentation monitoring by providing access to instrumentation locations in a timely manner and by providing and maintaining safe means of access to instrumentation locations for data collection. Data acquired by the Engineer will be made available to Contractor in a timely manner.
- F. Contractor may make their own interpretations of monitoring data for their own purposes. Do not publish or disclose data or interpretations shall to other parties without advance written permission of Owner.
- G. For data collected from an instrument that has been installed to replace a damaged instrument, use formal initial reading as an initial reading for replacement instrument so that data are continuously plotted, without an offset at time of damage. Note time of damage and replacement on plot.

### 3.7 INTERPRETATION AND RESPONSE VALUES

- A. Make interpretations of data resulting from monitoring programs.
- B. Threshold and Limiting Values for Instruments:

<u>Instrument</u>	<u>Threshold Value</u>	<u>Limiting Value</u>
1. Observation Wells	2 feet *	0 feet **

NOTES: \* below bottom of excavation.  
\*\* at bottom of excavation.

- C. Values are subject to adjustment by the Engineer as indicated by prevailing conditions or project circumstances.

- D. If a Threshold Value is reached:
1. Engineer and Contractor will meet to discuss remedial measures.
  2. Increase instrument monitoring frequency as directed by the Engineer.
  3. Install and monitor additional instruments as directed by the Engineer.
  4. Implement remedial measures in event Threshold Value is reached, so Limiting Value is not reached.
- E. Take necessary steps so Limiting Value is not exceeded. Engineer may direct Contractor to suspend activities in affected area with exception of those actions necessary to avoid exceeding Limiting Value.

### 3.8 TOLERANCES

- A. Survey Measurements: Initial location of each instrumentation elements consisting of determining elevation and horizontal positions with respect to the Engineer approved benchmarks.
- B. If actual field conditions prohibit installation at location and specified elevations, obtain prior acceptance from the Engineer for new instrument location and elevations.

### 3.9 DISPOSITION OF INSTRUMENTS

- A. Observation Wells: When required by the Engineer, abandon and remove protective housings and caps in accordance with required permits. Restore surfaces affected by installation of instruments to their original condition prior to completion of work.
1. Leave in place any casings located within plan limits of new or existing structures or pipelines or within zone below 1H:1V planes extending downward and out from edges of foundation elements, from downward vertical footprint of pipe, or where removal would otherwise result in ground movements causing adverse settlement to adjacent ground surface, utilities or structures.
  2. Where casings are pulled, fill holes with cement grout. Where left in place, fill casings with non-shrink cement grout and cut off a minimum of 3 feet below finished ground level or 1 foot below foundation level so as not to interfere with finished structures or pipelines.
  3. Following backfilling, remove precast boxes or vaults and reconstruct pavement in paved areas. Restore surface to conditions existing prior to instrument installation.

END OF SECTION 310900

## SECTION 311000 - SITE CLEARING

### 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. Protecting existing vegetation to remain.
2. Removing existing vegetation.
3. Clearing and grubbing.
4. Stripping and stockpiling topsoil.
5. Stripping and stockpiling rock.
6. Removing above- and below-grade site improvements.
7. Disconnecting, capping or sealing, and removing site utilities.
8. Temporary erosion and sedimentation control.

- B. Related Requirements:

1. Section 015000 "Temporary Facilities and Controls" for temporary erosion- and sedimentation-control measures.
2. Section 015639 "Temporary Tree and Plant Protection" for temporary protection of existing vegetation.
3. Section 312316 "Rock Removal" for rock and boulder excavation.
4. Section 312500 "Erosion and Sedimentation Controls" for temporary protection of erosion and sedimentation.

#### 1.3 DEFINITIONS

- A. Subsoil: Soil beneath the level of subgrade; soil beneath the topsoil layers of a naturally occurring soil profile, typified by less than 1 percent organic matter and few soil organisms.
- B. Surface Soil: Soil that is present at the top layer of the existing soil profile. In undisturbed areas, surface soil is typically called "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; the zone where plant roots grow.
- D. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil; the zone where plant roots grow. Its appearance is generally friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of

subsoil, clay lumps, gravel, and other objects larger than 2 inches in diameter; and free of weeds, roots, toxic materials, or other nonsoil materials.

- E. Plant-Protection Zone: Area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction and indicated on Drawings.
- F. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction and indicated on Drawings.
- G. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

#### 1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

#### 1.5 MATERIAL OWNERSHIP

- A. Except for materials indicated to be stockpiled or otherwise remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

#### 1.6 INFORMATIONAL SUBMITTALS

- A. 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 recordings.
  - 2. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plant designated to remain.
- B. Topsoil stripping and stockpiling program.
- C. Rock stockpiling program.
- D. Record Drawings: Identifying and accurately showing locations of capped utilities and other subsurface structural, electrical, and mechanical conditions.
- E. Burning: Documentation of compliance with burning requirements and permitting of authorities having jurisdiction. Identify locations and conditions under which burning will be performed.

#### 1.7 QUALITY ASSURANCE

- A. Topsoil Stripping and Stockpiling Program: Prepare a written program to systematically demonstrate the ability of personnel to properly follow procedures and handle materials and equipment during the Work. Include dimensioned diagrams for placement and protection of stockpiles.

- B. Rock Stockpiling Program: Prepare a written program to systematically demonstrate the ability of personnel to properly follow procedures and handle materials and equipment during the Work. Include dimensioned diagrams for placement and protection of stockpiles.
- C. Conform to applicable JEA and St. Johns County codes for environmental requirements, disposal of debris, use of herbicides, and related site clearing.

## 1.8 FIELD CONDITIONS

- A. Traffic: 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.
  - 2. Provide alternate routes around closed or obstructed roadways if required by Owner or authorities having jurisdiction.
- B. Improvements on Adjoining Property: Authority for performing site clearing indicated on property adjoining Owner's property will be obtained by Owner before award of Contract.
  - 1. Do not proceed with work on adjoining property until directed by Engineer.
- C. Salvageable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises where indicated.
- D. Utility Locator Service: Notify utility locator service for area where Project is located before site clearing.
- E. Do not commence site clearing operations until temporary erosion- and sedimentation-control and plant-protection measures are in place.
- F. Tree- and Plant-Protection Zones: Protect according to requirements in Section 015639 "Temporary Tree and Plant Protection."
- G. Soil Stripping, Handling, and Stockpiling: Perform only when the soil is dry or slightly moist.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Satisfactory Soil Material: Requirements for satisfactory soil material are specified in Section 312000 "Earthwork."
  - 1. Obtain approved borrow soil material off-site when satisfactory soil material is not available on-site.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Protect and maintain benchmarks and survey control points from disturbance during construction.
- B. Verify that trees, shrubs, and other vegetation to remain or to be relocated have been flagged and that protection zones have been identified and enclosed according to requirements in Section 015639 "Temporary Tree and Plant Protection."
- C. Protect existing site improvements to remain from damage during construction.
  - 1. Restore damaged improvements to their original condition, as acceptable to Owner.
- D. Call Local Utility Line Information service not less than three working days before performing Work.
  - 1. Request underground utilities to be located and marked within and surrounding construction areas.

### 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. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.
- C. Inspect, maintain, and repair erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
- D. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

### 3.3 TREE AND PLANT PROTECTION

- A. Protect trees and plants remaining on-site according to requirements in Section 015639 "Temporary Tree and Plant Protection."
- B. Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations according to requirements in Section 015639 "Temporary Tree and Plant Protection."



### 3.4 EXISTING UTILITIES

- A. Owner will arrange for disconnecting and sealing indicated utilities that serve existing structures before site clearing, when requested by Contractor.
  - 1. Verify that utilities have been disconnected and capped before proceeding with site clearing.
- B. Locate, identify, disconnect, and seal or cap utilities indicated to be removed or abandoned in place.
  - 1. Owner will arrange to shut off indicated utilities when requested by Contractor.
- C. Locate, identify, and disconnect utilities indicated to be abandoned in place.
- D. 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 not less than two days in advance of proposed utility interruptions.
  - 2. Do not proceed with utility interruptions without Owner's written permission.
- E. Excavate for and remove underground utilities indicated to be removed.
- F. Removal of underground utilities is included in earthwork sections; in applicable fire suppression, plumbing, HVAC, electrical, communications, electronic safety and security, and utilities sections..

### 3.5 CLEARING AND GRUBBING

- A. Remove obstructions, trees, shrubs, and other vegetation to permit installation of new construction.
  - 1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.
  - 2. Grind down stumps and remove roots larger than 2 inches in diameter, obstructions, and debris to a depth of 18 inches below exposed subgrade.
  - 3. Use only hand methods or air spade for grubbing within protection zones.
  - 4. Chip removed tree branches and dispose of off-site.
- B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.
  - 1. Place fill material in horizontal layers not exceeding a loose depth of 8 inches and compact each layer to a density equal to adjacent original ground.

### 3.6 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 nonsoil materials from topsoil, including clay lumps, gravel, and other objects larger 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 or other materials. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust and erosion by water.
  - 1. Limit height of topsoil stockpiles to 72 inches.
  - 2. Do not stockpile topsoil within protection zones.
  - 3. Dispose of surplus topsoil. Surplus topsoil is that which exceeds quantity indicated to be stockpiled or reused.

### 3.7 STOCKPILING ROCK

- A. Remove from construction area naturally formed rocks that measure more than 1 foot across in least dimension. Do not include excavated or crushed rock.
  - 1. Separate or wash off non-rock materials from rocks, including soil, clay lumps, gravel, and other objects larger than 2 inches in diameter; trash, debris, weeds, roots, and other waste materials.
- B. Stockpile rock away from edge of excavations without intermixing with other materials. Cover to prevent windblown debris from accumulating among rocks.
  - 1. Limit height of rock stockpiles to 36 inches.
  - 2. Do not stockpile rock within protection zones.
  - 3. Dispose of surplus rock. Surplus rock is that which exceeds quantity indicated to be stockpiled or reused.
  - 4. Stockpile surplus rock to allow later use by Owner.

### 3.8 SITE IMPROVEMENTS

- A. Remove existing above- and below-grade improvements as indicated and necessary to facilitate new construction.
- B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.
  - 1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut along line of existing pavement to remain before removing adjacent existing pavement. Saw-cut faces vertically.
  - 2. Paint cut ends of steel reinforcement in concrete to remain with two coats of antirust coating, following coating manufacturer's written instructions. Keep paint off surfaces that will remain exposed.

### 3.9 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.
- B. Burning tree, shrub, and other vegetation waste is permitted according to burning requirements and permitting of authorities having jurisdiction. Control such burning to produce the least smoke or air pollutants and minimum annoyance to surrounding properties. Burning of other waste and debris is prohibited.
- C. Separate recyclable materials produced during site clearing from other nonrecyclable materials. Store or stockpile without intermixing with other materials and transport them to recycling facilities. Do not interfere with other project work.

END OF SECTION 311000

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## SECTION 312000 – EARTHWORK

### 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 work shall comply and be installed per the latest JEA Water and Wastewater Standards Manual (January 2019 or latest) and the JEA Facilities Standards Manual.

#### 1.2 SUMMARY

- A. General: Earthwork includes clearing and stripping, procurement of on-site and imported fill material, excavating, placing, and compacting fill and backfill, structural excavating and backfilling, transportation and storage of excess earthwork materials; disposal of unsuitable, waste, and surplus materials; restoration of excavation and trench surfaces; and subsidiary work necessary to complete the grading of developed areas to conform with required lines, grades, and slopes.
- B. Work includes but is not necessarily limited to; excavation for structures, tanks, foundations, manholes, vaults, electrical manholes, conduits, cables, raceways and ducts, pipes, paving; embankments; grading; and related work such as sheeting, bracing and dewatering.
- C. Provide services of a licensed Professional Engineer to prepare temporary excavation support system and dewatering system designs and submittals.
- D. Provide temporary excavation support systems, including shoring and bracing, to ensure the safety of personnel and protect adjacent structures, piping, and other materials in accordance with Federal, State and local laws, regulations, and requirements. Temporary excavation support systems are specified in Section 315000.
- E. Provide temporary dewatering, surface water control systems, and operate to dewater and maintain excavations in a dry condition. Control drainage into excavations and remove groundwater and rainwater. Dewatering and surface water control are specified in Section 312319.
- F. Examine site and review available geotechnical data prior to submitting a proposal, taking into consideration project conditions that may affect the work. Owner and Design Engineer do not assume responsibility for variations of subsurface conditions at locations other than places shown and at the time investigations were made.
- G. Do not initiate extra work without written notification to Owner and Engineer and receiving Owner's written approval in response.
- H. Protect existing structures and utilities that remain.

I. Related Requirements:

1. Section 013200 "Construction Progress Documentation" for recording pre-excavation and earthwork progress.
2. Section 310515 "Soils and Aggregates for Earthwork" for soil and aggregate materials.
3. Section 310900 "Geotechnical Instrumentation and Monitoring" for monitoring of ground and groundwater.
4. Section 311000 "Site Clearing" for site preparation work, including stripping, grubbing, stripping and stockpiling topsoil, and removal of above- and below-grade improvements and utilities.
5. Section 312333 "Trenching and Backfilling" for trenching, backfilling, and compaction in trench excavations.
6. Section 312319 "Dewatering" for controlling surface and groundwater and disposing of water during construction.
7. Section 312500 "Erosion and Sedimentation Controls" for temporary stated work.
8. Section 315000 "Excavation Support and Protection" for shoring, bracing, and sheet piling of excavations.

1.3 DEFINITIONS

- A. Backfill: Soil 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. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.
- C. Coverage: Pass of compaction equipment over the complete surface area of exposed lift or subgrade to receive compaction.
- D. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.
1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Engineer. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
  2. Unauthorized Additional Excavation: Excavation as directed by Engineer to correct Contractor's work not in compliance with Contract Documents, which will be performed without additional compensation.
  3. Bulk Excavation: Excavation more than 10 feet width and more than 30 feet in length.
  4. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Engineer. Unauthorized excavation, as well as remedial work directed by Engineer, shall be provided without additional compensation.
- E. Finished Grade: Required final grade elevation indicated on Drawings. Spot elevations take precedent over proposed contours.

- F. In-the-Dry: An excavation subgrade where groundwater level has been lowered to at least 2 feet below lowest level of excavation; is stable with no ponded water, mud, or muck; is able to support construction equipment without rutting or disturbance; and is suitable for placement and compaction of fill material, pipe, or concrete foundations.
- G. Objectionable Material: Includes topsoil, organic matter, contaminated soil, construction debris, perishable materials, and rocks or lumps of cemented soils over 6 inches in maximum dimension.
- H. Optimum Moisture Content: Moisture content (percent by dry weight) corresponding to maximum dry density of the same material as determined by ASTM Test Method D 1557.
- I. Overexcavation: Removal of unsuitable soil or objectionable material at or below the normal grade of excavation or subgrade as indicated on Drawings.
- J. Percent Compaction: Required in-place dry density of the material, expressed as a percentage of the maximum dry density of the same material, as determined in the laboratory by ASTM Test Method D 1557.
- K. Structures: Buildings, wet wells, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, manholes and vaults, or other man-made stationary features constructed above or below the ground surface.
- L. Subgrade: Required surface of subsoil, borrow fill, or compacted fill that is immediately beneath site improvements, especially dimensioned fill, paving, or other surfacing material.
- M. Unsuitable Soil: Includes existing fill materials, organic soils (i.e., organic content greater than 3 percent per ASTM D2974), weak native soils, or clays with a plasticity index of greater than 30, and any materials that cannot be properly placed and compacted as specified.
- N. Utilities: On-site underground pipes, conduits, ducts, and cables as well as underground services within buildings.
- O. Zone of Influence: A line extending at least 2 feet beyond foundation or pipeline edge, then outward and downward at a slope of 1 horizontal to 1 vertical. Do no excavation below foundation of existing structures or pipeline.
- P. Professional Engineer: Licensed Professional Engineer meeting project qualifications and who is hired by Contractor.
- Q. The Engineer: The Engineer or designated representative hired by Owner.
  - 1. Approval given by the Engineer shall not relieve Contractor of its responsibilities for performing the work in accordance with Contract Document requirements.

#### 1.4 ACTION SUBMITTALS

- A. Coordinate various submittal types required by this Section with requirements of dewatering, support of excavation, and geotechnical instrumentation submittals specified in other Sections.

- B. Samples: Submit a representative sample weighing approximately 50 pounds of each fill material, filter sand, and crushed stone contained in sealed 5 gallon containers, at least 30 calendar days prior to date of anticipated use of each material.
- C. Submit laboratory test results for fill materials that include maximum density, gradation, Atterberg limits, sand equivalent, and other applicable criteria, at least 72 hours prior to importing or placing fill.
- D. Prepare excavation support system designs by a Professional Engineer, licensed in State of Florida and having a minimum of 5 years of professional experience in design and construction of excavation support systems.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Construction and Operations Plan: Submit proposed methods of construction, including earthwork operations, excavation limits, slopes, fill material moisture conditioning and handling, compaction equipment, excavation support systems designs, backfilling and filling and compaction, and material sources.
  - 1. Submit excavation support system plan as prepared by a licensed Professional Engineer complying with requirements stated in previous Article.
- B. Upon completion of earthwork and grading operations, submit an as-graded map showing density test numbers and locations, a table of density test results and depths, and a certification of compliance by geotechnical engineer in charge.
- C. Qualification Data: For qualified testing agency to conduct geotechnical observation, testing and documentation, include qualifications of firm, resumes of soil technicians assigned to the project, and licensed geotechnical engineer in charge.
  - 1. Firm Qualifications: Meet ASTM D 3740.
  - 2. Soil Technicians: Have minimum three years demonstrated experience in earthwork and grading operations and satisfy certification requirements of agency having local jurisdiction.
    - a. The Engineer reserves right to request substitution of soil technicians assigned to field work. Do not substitute assigned soil technicians without prior approval of the Engineer.
- D. Pre-Excavation Photographs: 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.

#### 1.6 QUALITY ASSURANCE

- A. Excavation, trenching, sheeting, bracing, and similar work shall comply with requirements of the Florida "Trench Safety Act", CS/SB 2626, which incorporates by reference, OSHA excavation safety standards, 29 CFR 1926 Subpart P.



- B. At least three working days prior to starting any excavation, notify the appropriate regional notification center for underground utilities and underground utility owners who are not members of notification center. To obtain area specific information for project site, refer to [www.call 811.com](http://www.call811.com).

## 1.7 FIELD CONDITIONS

- A. Be responsible for construction layout and reference staking necessary for proper control and satisfactory completion of structures, cutting, filling, grading, drainage, fencing, embankment improvements, curbing, and other appurtenances.
- B. Perform construction layout and staking by a Professional Surveyor or Professional Engineer licensed in State of Florida, experienced and skilled in construction layout and staking requirements.
- C. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earthwork operations.
  - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
  - 2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.
- D. Utility Locator Service: Notify Sunshine 811 before beginning earthwork operations.
- E. Do not commence earthwork operations until temporary site fencing and erosion- and sedimentation-control measures specified in Section 311000 "Site Clearing" are in place.
- F. Do not commence earthwork operations until plant-protection measures specified on the drawings are in place.
- G. The following practices are prohibited within protection zones:
  - 1. Storage of construction materials, debris, or excavated material.
  - 2. Parking vehicles or equipment.
  - 3. Foot traffic.
  - 4. Erection of sheds or structures.
  - 5. Impoundment of water.
  - 6. Excavation or other digging unless otherwise indicated.
  - 7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.
- H. Do not direct vehicle or equipment exhaust towards protection zones.
- I. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones.

## PART 2 - PRODUCTS

### 2.1 SOIL MATERIALS

- A. Fill materials designated for use in this Section are specified in Section 310515.
- B. On-Site Fill Material: Earth and rock material obtained at project site during excavation, following clearing and stripping, from which any Unsuitable Soil or Objectionable Material has been removed.
- C. General: Provide imported fill materials when sufficient satisfactory soil materials are not available from excavations.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Protect structures, tanks, utilities, sidewalks, pavements, fencing, landscaping, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.
  - 1. If necessary, remove and restore or replace curbing, driveway aprons, and fencing after performing backfilling work.
  - 2. Replace existing facilities damaged by construction with new material fully equal to existing without additional compensation.
- B. Prior to and During Earthwork Operations:
  - 1. Protect and maintain erosion and sedimentation controls; coordinate with Section 312500 "Erosion and Sedimentation Controls."
  - 2. Provide, monitor, and maintain excavation support; coordinate with Section 315000 "Excavation Support and Protection."
    - a. Use excavation support system for excavations within the zone of influence for existing structures or utilities.
    - b. Do not permit excavations below base level of adjacent foundations or retaining walls, unless excavation design and bracing includes an analysis of structure's stability supported by the foundation. When necessary due to project conditions, incorporate required bracing and foundation underpinning.
  - 3. Provide, monitor, and maintain dewatering and drainage systems; coordinate with Section 312319 "Dewatering."
- C. Test Pits:
  - 1. Perform exploratory excavation work, test pits, for purpose of verifying the location of underground utilities and structures and to check for unknown utilities and structures, prior to commencing excavation work.

2. Backfill and compact test pits as soon as desired information has been obtained. Stabilize backfilled surfaces in accordance with approved erosion and sedimentation control plans.
- D. Clearing and Stripping. Initially clear and strip ground surfaces beneath planned structures and in areas requiring excavation or filling of organic material and debris. Do not use those materials as On-Site Fill Material; remove from the site and properly disposed.
- E. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.
- F. Saw cut existing pavement with a saw, wheel, or pneumatic chisel along straight lines before excavating.

### 3.2 DEWATERING AND DRAINAGE

- A. Provide dewatering and drainage in accordance with Section 312319 “Dewatering”. This Article supplements those requirements.
- B. Prevent surface water and groundwater from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.
- C. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.
  1. Reroute surface water runoff and groundwater seepage away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.
- D. Prior to excavation, verify groundwater will be at required level indicated on approved dewatering and drainage submittal.
- E. Accomplish dewatering by methods that preserve undisturbed state of subgrade soils. Dewater in a manner to prevent boiling, detrimental under-seepage, or disturbance at excavation base.

### 3.3 SUPPORT OF EXCAVATION

- A. Provide excavation support in accordance with Section 315000 “Excavation Support and Protection”. This Article supplements those requirements.
- B. Install excavation support in accordance with reviewed Shop Drawings prior to beginning excavation work. Maintain excavation supports that are required to remain in place, if applicable, as indicated on Drawings or as required by approved Shop Drawings.
- C. Owner or Engineer may direct that certain excavation supports remain in place or be cut off at any specific elevation. Supports directed by Owner or Engineer to be left in place and not so designated on Contract Documents will be paid for according to Contract provisions for changes in the Work.
- D. The right of Owner or Engineer to direct that certain excavation supports remain in place shall not be construed as creating any obligation on Owner or Engineer to give such direction, nor

shall failure to give such direction relieve the Contractor from liability for damages to persons or property occurring from or upon the work occasioned by negligence or otherwise, growing out of a failure on the part of the Contractor to leave in place sufficient excavation supports to prevent any movement of the ground or damage to adjacent structures.

- E. Construct temporary excavation slopes in accordance with the requirements of OSHA excavation safety standards and approved Shop Drawings.
- F. Where allowed, carefully remove excavation supports in a manner without endangering the Work or other adjacent structures, utilities, or property. Immediately fill voids left or caused by withdrawal of supports with sand and compact.

### 3.4 EXCAVATION

- A. Include material of every description and of whatever substance encountered as an unclassified excavation.
- B. General: Excavate on-site soils using standard earthmoving equipment. Excavation in dense soil or rock may require special equipment. Do not plough, scrape, or dig earth with machinery so near to finished subgrade to result in excavation of or disturbance of below grade material.
- C. Make excavations to grades indicated on Drawings and in widths sufficient for laying of pipe, construction of the structure, installing bracing, excavation supports, dewatering and drainage facilities, and working clearances.
- D. Perform excavation in-the-dry and accomplished by methods which preserve the natural undisturbed condition of subgrade soils.
- E. Moisture Sensitive Soils: Use a smooth-edge bucket to excavate last one foot of depth when excavation is to end in such soils.
- F. If excavation bottom is removed below the limits shown on Drawings, specified, or directed by the Engineer, refill with structural fill, crushed stone, or other material satisfactory to the Engineer without additional compensation.
- G. When excavation has reached prescribed depths, notify the Engineer who will observe the conditions. If materials and conditions are not satisfactory, the Engineer will issue instructions for corrective procedures. The Engineer will be the sole judge as to whether the work has been accomplished satisfactorily.
- H. Subgrade soils that have become soft, loose, quick, or otherwise unsatisfactory due to inadequate excavation, dewatering, or other construction methods in the opinion of the Engineer, remove existing soil and replaced with structural fill, crushed stone, or other material as acceptable to the Engineer at Contractor's expense.
- I. Exposed subgrades in large open areas (bulk excavations) and for foundations and pavement footprint shall be proofrolled with at least two overlapping coverages of a vibratory drum roller with a minimum static drum weight of 10 tons. Conduct proofrolling in presence of the Engineer. The Engineer will waive this requirement, if in its opinion the subgrade will be rendered unsuitable by such proofrolling.

1. Confined Areas: Proofroll with hand operated vibratory equipment that is approved by the Engineer.
- J. Perform overexcavation at the Engineer's request to remove unsuitable soil, objectionable material, or other materials as determined by the Engineer and to such depth and width as directed. Replace with suitable material as directed by the Engineer.
  1. Authorized additional excavation and replacement material will be paid for according to Contract provisions for unit prices.
- K. Perform excavation for pipelines beneath structures and excavation for footings with excavating equipment operating from the subgrade for the structure, while in-the-dry and in a manner preserving the undisturbed state of subgrade soils.
- L. When excavations have reached the required subgrade, including any allowances for working mats or base materials and prior to their placement, notify the Soils Testing Laboratory to verify suitability of existing subgrade soils for anticipated foundation and structural loadings.
  1. If existing subgrade soils are determined to be unsuitable, follow direction provided by the Engineer regarding removal and replacement with suitable materials.
  2. Notify the Engineer if the revised work scope would modify Contractor's cost and thereby entitle a change to the Contract Sum. Authorized additional excavation and replacement material will be paid for according to Contract provisions for unit prices.
- M. Replace overexcavation beyond the limits and depths required by Contract Documents using structural fill, crushed stone, or other material satisfactory to the Engineer without additional compensation.

### 3.5 SUBGRADE PREPARATION

- A. Notify Engineer when excavations have reached required subgrade.
- B. Maintain excavated subgrade in-the-dry condition.
- C. Prior to fill placement, remove objectionable material which includes, but not be limited to, pavement, topsoil, organic matter, contaminated soil, construction debris, perishable materials, and rocks or lumps of cemented soils over 6 inches in maximum dimension.
- D. For subgrades consisting of granular soils, proofroll the final subgrade using at least four coverages of a vibrator plate compactor.
  1. Exposed subgrade beneath structures shall be compacted to 95% maximum dry density for ASTM D1557 within the upper 24 inches of compacted natural soils.
  2. Exposed subgrade beneath pavement areas shall have a minimum Limerock Bearing Ratio (LBR) of 40, and be compacted to 98% maximum dry density for ASTM D1557.
  3. Organic silty sands (SM/PT), clayey sand (SC) or sandy clay (CL) materials (as classified per ASTM D2487) within 24 inches of the proposed footing, slab, or pavement base shall be removed and replaced with compacted structural fill material.

- E. Where existing subgrade contains a significant amount of clay or cohesive soils, over-excavate sufficiently below the bottom of structure for placement of a lean concrete working mat. Remove loose or soft material from the subgrade immediately prior to placing lean concrete working mat.
- F. Remove and replace soft subgrades or unusable material with structural fill or other material satisfactory to the Engineer.
- G. During wet or freezing weather, or in areas where exposed subgrade consists of moisture-sensitive soils, take measures to protect foundation excavations once they have been approved by the Engineer. Protective measures include, but are not limited to, placing insulation blankets, placing a layer of fill, crushed stone, or lean concrete on the exposed subgrade, or covering the exposed subgrade with a plastic tent.
  - 1. If additional overexcavation is required due to the subgrade not being protected against wet or freezing weather, perform additional work without additional compensation.
- H. Notify the Engineer to observe conditions following subgrade preparation and prior to fill placement. If existing subgrade soils are determined to be unsuitable, follow direction provided by the Engineer regarding removal and replacement with suitable materials.
  - 1. Authorized additional excavation and replacement material will be paid for according to Contract provisions for unit prices.

### 3.6 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. Protect from precipitation.
  - 1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

### 3.7 FILL PLACEMENT AND COMPACTION PROCEDURES

- A. Fill and Backfill: Place materials in lifts to suit specified compaction requirements to required lines and grades, making allowances for settlement and placement of cover materials, such as topsoil or sod. Correct soft spots or uncompacted areas.
- B. Do not place or compact fill and backfill when materials are too wet to properly compact.
  - 1. In-place Soil Moisture Content: Maximum of two percentage points above optimum moisture content of soil, as determined by laboratory test of moisture-density relation appropriate to specified level of compaction.
- C. Structural Fill and Embankment Fill: Construct to required lines and grades, making allowances for settlement and placement of cover materials, such as topsoil and sod. Correct soft spots or uncompacted areas.

- D. Fill material shall be free of snow, ice, frost, and frozen earth. Do not place fill materials on frozen surfaces or surfaces covered by snow, ice, or frost.
- E. If subgrade slopes more than 10 percent, step subgrade to produce a stable, horizontal surface for placement of fill materials. Scarify existing subgrade slope to a depth of at least 6 inches.
- F. Compact filled slopes by slope rolling and trimming, or overfill and trim back to plan grade to expose a firm, smooth surface free of loose material.
- G. Do not allow fill lifts to contain stones with a dimension larger than 1/2 the specified loose measure lift thickness.
- H. Confined Compaction: Perform compaction in confined areas, including areas within a 45-degree angle extending upward and outward from the base of a wall, and in areas where the use of large equipment is impractical, using hand-operated vibratory equipment or mechanical tampers.
  - 1. Do not exceed lift thickness of 6 inches or ½ the specified lift thickness (whichever is less), measured before compaction, when using hand operated equipment.
- I. Moisture condition on-site fill material prior to placement, unless Contractor demonstrates to the Engineer in-place moisture conditioning methods can achieve the required moisture content.
- J. Conduct compaction of each specified lift of fill materials by a minimum of four complete coverages with acceptable compaction equipment to a specified density as a percentage of maximum dry density as determined by ASTM D 1557, unless otherwise specified.
- K. Use structural fill required beneath foundations, slabs on grade, or pavement areas. Place and compact structural fill in even lifts having a maximum thickness of 12 inches, measured before compaction.
- L. Use select fill material within 10 feet of all structures. Uniformly place and compact select fill around the structure in even lifts having a maximum thickness of 12 inches, measured before compaction.
- M. Use common fill in areas beyond those designated for structural fill or select fill, unless shown or otherwise specified. Place in even lifts having a maximum thickness of 12 inches, measured before compaction.

### 3.8 COMPACTION REQUIREMENTS

- A. Perform in-place testing of compacted fill lifts to measure in-place density and water content according to ASTM D 6938 and ASTM D 1557.
- B. Beneath Foundations and Slabs-on-Grade, except sidewalks: Compact top 24 inches of existing subgrade and each layer of fill, if applicable to:
  - 1. Maximum Dry Density: Minimum of 95 percent for ASTM D 1557.
  - 2. Moisture Content: At or near its optimum moisture content of minus 3 percent to plus 3 percent.

- C. Area Around Structures: Within 10 feet, compact each fill or backfill layer to:
  - 1. Maximum Dry Density: Minimum of 92 percent for ASTM D 1557.
  - 2. Moisture Content: At or near its optimum moisture content of minus 3 percent to plus 3 percent.
- D. Embankments, Lawn, or Unimproved Areas: Does not include embankments under roadways and earth dam structures. Compact each fill or backfill layer to:
  - 1. Maximum Dry Density: Minimum of 90 percent for ASTM D 1557.
  - 2. Moisture Content: At or near its optimum moisture content of minus 3 percent to plus 3 percent.
- E. Sidewalks: Compact each fill layer to:
  - 1. Maximum Dry Density: Minimum of 95 percent for ASTM D 1557.
  - 2. Moisture Content: At or near its optimum moisture content of minus 3 percent to plus 3 percent.
- F. Roads, Paved Areas, and Roadway Embankments: Compact each layer of fill or backfill to:
  - 1. Stabilized subgrade (12" of fill beneath the base course): Minimum of 98 percent for ASTM D 1557 with a minimum Limerock Bearing Ratio (LBR) of 40.
  - 2. Limerock base course: shall have a minimum Limerock Bearing Ratio (LBR) of 100, and be compacted to 98 percent of maximum dry density for ASTM D1557.
  - 3. Moisture Content: At or near its optimum moisture content of minus 2 percent to plus 2 percent.

### 3.9 DISPOSAL OF UNSUITABLE, WASTE, AND SURPLUS EXCAVATED MATERIALS

- A. Unsuitable soil, objectionable material, waste, and surplus excavated material shall be removed and disposed of off-site. Materials may be temporarily stockpiled in an area within the limits of construction that does not disrupt construction activities, create any nuisances or safety hazards, or otherwise restricts access to work site.
- B. Topsoil or loam excavated under this Section may be salvaged for use as specified under Section 329200 "Turf and Grasses", as approved by the Engineer.

### 3.10 GRADING

- A. Perform grading to lines and grades shown on Drawings. Remove objectionable materials encountered within the limits indicated and disposed of off-site. Completely and continuously drained and dewatered subgrades throughout the grading process. Install temporary drains and drainage ditches to intercept or divert surface water that may affect the execution or condition of grading work.
- B. If it is not possible at the time of grading to place material in its proper section of the Work, stockpile it in approved areas for later use. No additional compensation will be made for stockpiling or double handling of excavated materials.



- C. In cut areas, remove loose or protruding rocks in slopes to line or finished grade of the slope. Uniformly dress, cut, and fill slopes to slope cross-section and alignment shown on Drawings, unless otherwise directed by the Engineer.

### 3.11 FIELD QUALITY CONTROL

- A. Test and observe materials as described in this Article. Cooperate by allowing free access to work for selection of test materials and observations.
- B. General Testing Requirements:
  - 1. At Structures: Prior to placement of bedding material, concrete work mats, structural fill or structural concrete, coordinate with Soils Testing Laboratory to verify suitability of existing subgrade soil.
  - 2. Backfill and Fill: Prior to and during the placement of backfill and fill coordinate with Soils Testing Laboratory to perform in-place soil density tests to verify that backfill and fill material has been placed and compacted in accordance with specified compaction requirements.
    - a. Provide minimum 72 hours' notice prior to placement of backfill and fill.
  - 3. Subgrade: Do not cover with fill without observation, testing, and approval by Soils Testing Laboratory.
    - a. Earthwork activities performed without properly scheduled inspection are subject to removal and replacement or additional testing as directed by the Engineer without additional compensation.
- C. Test materials by a certified independent laboratory, engaged by Contractor and acceptable to the Engineer, demonstrating conformance with project requirements. Deliver test reports and material certifications to the Engineer before using any material in the work.
  - 1. If field test results are not in conformance with project requirements, costs involved in correcting deficiencies in compacted materials to satisfaction of the Engineer without additional compensation.
- D. Earthwork activities performed without properly scheduled inspection are subject to removal and replacement or additional testing as directed by the Engineer without additional compensation.
- E. Testing methods shall comply with latest ASTM or equivalent AASHTO Standards applicable during bidding.
- F. During placement of bedding, backfill, and fill, perform in-place soil density testing to confirm that fill material has been compacted in accordance with project requirements. The Engineer may designate areas to be tested. Notify the Engineer at least 72 hours in advance of scheduled compaction testing. In-place soil density tests on backfill and fill material shall be as required by authorities having jurisdiction, project geotechnical report, but in no instance, shall less than those listed:

1. Structures: At least one density and moisture content test for each 1,000 square feet of surface area for each lift of fill at structure locations.
  2. Bulk Excavation and Embankments: At least one density and moisture content test for each 2,500 square feet of surface area for each lift of fill at bulk excavations and embankment locations.
  3. Column Footing: At least one density and moisture content test for 25% of the column footing locations.
  4. Wall/ring Footing: At least one density and moisture content test for 25 linear feet of the wall or ring footings.
  5. Pavement Areas: At least one density and moisture content test for each 5,000 square feet of surface area for each lift of fill at pavement area.
  6. Trench Excavations: At least one nuclear density and one moisture content test at a maximum of 300 foot intervals for each lift of fill placed or as directed by the Engineer.
  7. The Engineer may designate supplemental areas to be tested at additional compensation.
- G. Materials which have been previously tested may be subjected to further testing from time to time and may be rejected, if it is determined that results do not conform to project requirements. Immediately remove rejected materials when directed by the Engineer, notwithstanding results of previous testing.
- H. The Engineer or Owner may conduct additional soil testing. Cooperate fully in allowing additional test to be made, including free access to the work.
- I. Geotechnical Testing Agency Qualifications: Qualified according to ASTM E 329 and ASTM D 3740 for testing indicated.

### 3.12 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 the Engineer; reshape and recompact.
- 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.

END OF SECTION 312000

## SECTION 312319 - DEWATERING

### 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 work shall comply and be installed per the latest JEA Water and Wastewater Standards Manual (January 2019 or latest) and the JEA Facilities Standards Manual.

#### 1.2 SUMMARY

- A. Section includes construction dewatering and surface water control and incorporates the design, equipment, materials, installation, operation, protection, monitoring and removal of dewatering and drainage system. Provide dewatering system sufficient to lower groundwater and collect surface water, regardless of groundwater level or rainfall at any time during the work.
- B. Obtain and pay for permits required for dewatering and drainage systems. Implement measurements to comply with dewatering and discharge permits requirements.
- C. Related Requirements:
  - 1. Section 013233 "Photographic Documentation" for recording preexisting conditions and dewatering system progress.
  - 2. Section 310515 "Soils and Aggregates for Earthwork" for soil and aggregate materials.
  - 3. Section 310900 "Geotechnical Instrumentation and Monitoring" for monitoring of ground and groundwater.
  - 4. Section 312000 "Earthwork" for excavating, backfilling, and compaction in open areas.
  - 5. Section 312333 "Trenching and Backfilling" for trenching, backfilling, and compaction in trench excavations.
  - 6. Section 312500 "Erosion and Sedimentation Controls" for controlling surface-water runoff and ponding.
  - 7. Section 315000 "Excavation Support and Protection" for temporary support of excavations.
  - 8. Division 32 "Exterior Improvements" for various Sections relating to civil and landscape related work.

#### 1.3 DEFINITIONS

- A. In-the-Dry: An excavation subgrade where all of the following are met:
  - 1. Groundwater level has been lowered to at least 2 feet below lowest excavation level.
  - 2. Subgrade is stable with no ponded water, mud, or muck.
  - 3. Subgrade is able to support construction equipment without rutting or disturbance.

4. Subgrade is suitable for placement and compaction of fill material, pipe, or concrete foundations.
- B. Professional Engineer: Licensed Professional Engineer meeting project qualifications and who is hired by Contractor.
- C. The Engineer: Engineer hired by Owner.
  1. Approvals given by the Engineer shall not relieve Contractor of its responsibilities for performing the work in accordance with Contract Document requirements.

#### 1.4 ACTION SUBMITTALS

- A. Design Plan: Submit written dewatering and drainage system design plan, prepared by a qualified Professional Engineer licensed in the State of Florida, that includes:
  1. Description of proposed dewatering system and installation methods to be used for system elements and observation wells.
  2. Description of equipment, drilling methods, holes sizes, filter sand placement techniques, sealing materials, development techniques, number and location of dewatering points and observations wells.
  3. Dewatering system design calculations demonstrating that the proposed system meets all requirements herein and elsewhere.
  4. Sequence of well and well-point placement coordinated with support of excavation system installation and control procedures to be adopted, if dewatering problems arise.
  5. Identification of anticipated area influenced by dewatering system and address impacts to adjacent existing and proposed structures.
    - a. Include detailed plans for pre-construction surveys of existing structures in vicinity of dewatering system, settlement monitoring of existing structures during construction, and provisions to address settlement of existing structures resulting from dewatering activities.
  6. Coordinate dewatering and drainage submittals with excavation and support of excavation submittals.
- B. Shop Drawings: For dewatering system, prepared by a qualified Professional Engineer licensed in the State of Florida.
  1. Include plans, elevations, sections, and details.
  2. Show arrangement, locations, and details of wells and well-points; locations of risers, headers, filters, pumps, power units, and discharge lines; and means of discharge, control of sediment, and disposal of water.
  3. Include pump capacity and anticipated discharge rate.
  4. Include layouts of piezometers and flow-measuring devices for monitoring performance of dewatering system.
  5. Show areas and depths of excavation to be dewatered and adjacent structures or facilities within the anticipated area influence.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and Professional Engineer.
- B. Field quality-control reports.
- C. Existing Conditions: Using photographs, show existing conditions of adjacent construction and site improvements that might be misconstrued as damage caused by dewatering operations. Submit before Work begins.
- D. Record Drawings: Identify locations and depths of capped wells and well points and other abandoned-in-place dewatering equipment.

#### 1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer that has specialized in installation of dewatering systems and dewatering work and having a minimum of 5 years' experience.
- B. Professional Engineer Qualifications: Professional Engineer licensed in the State of Florida; having a minimum of 5 years' experience in design and construction of dewatering and drainage systems; and having completed not less than 5 successful dewatering and drainage projects of equal type, size, and complexity to that required for the work.
- C. Comply with authorities having jurisdiction for the following:
  - 1. Drilling and abandoning of wells used for dewatering systems.
  - 2. Water discharge and disposal from dewatering operations.
- D. Obtain all permits for storm water discharge from construction sites.

#### 1.7 FIELD CONDITIONS

- A. Project-Site Information: Geotechnical Data has been prepared for this Project and is available for information only. Owner is not responsible for interpretations or conclusions drawn from this data.
  - 1. Make additional test borings and conduct other exploratory operations necessary for dewatering according to the performance requirements.
  - 2. Groundwater levels may vary during the work and should not be assumed to be accurately represented by groundwater level readings reported in the geotechnical data.
- B. Survey Work: Engage a qualified land surveyor or Professional Engineer to survey adjacent existing buildings, structures, and site improvements; establish exact elevations at fixed points to act as benchmarks. Clearly identify benchmarks and record existing elevations.

## PART 2 - PRODUCTS

### 2.1 DESIGN REQUIREMENTS

- A. Dewatering Performance: Design, furnish, install, test, operate, monitor, and maintain dewatering system of sufficient scope, size, and capacity to control hydrostatic pressures and to lower, control, remove, and dispose of surface and groundwater and permit excavation and construction to proceed in-the-dry in accordance with the requirements herein and elsewhere.
  - 1. Design dewatering system, including comprehensive engineering analysis by the Contractor's Design Engineer.
  - 2. Continuously monitor and maintain dewatering operations to ensure required groundwater lowering, erosion control, stability of excavations, excavation support, and constructed slopes, prevention of flooding in excavation, and prevention of damage to subgrades and permanent structures.
  - 3. Prevent surface water from entering excavations by grading, dikes, or other means.
  - 4. Accomplish dewatering without damaging existing buildings, structures, and site improvements adjacent to excavation.
  - 5. Remove dewatering system when no longer required for construction.
- B. Primary Purpose of Work: Preserve natural undisturbed condition of subgrade soils in areas of proposed excavations.
  - 1. Prior to excavation, lower groundwater to at least 2 feet below lowest excavation subgrade elevation.
  - 2. Additional groundwater lowering may be necessary beyond the 2 foot requirement, depending on construction methods, equipment used, and prevailing groundwater and soil conditions. Lower groundwater as necessary to complete construction in accordance with Contract Documents without additional compensation
- C. Design deep wells, well-points and sumps, and other groundwater control system components to prevent loss of fines from surrounding soils. Use sand filters with dewatering installations, unless screens are properly sized by Contractor's Design Engineer to prevent passage of fines from surrounding soils.
- D. Maintain standby pumping systems and sources of standby power at various sites.
- E. Design dewatering system to prevent damage to adjacent properties, buildings, structures, utilities, and facilities from dewatering operations. Be responsible for damage to properties, buildings or structures, sewers and other utility installations, pavements, and work that may result from dewatering or surface water control operations.
- F. Regulatory Requirements: Comply with governing regulations before beginning dewatering. Comply with water- and debris-disposal regulations of authorities having jurisdiction.

### 2.2 MATERIALS

- A. Refer to Section 310900 "Geotechnical Instrumentation and Monitoring" for observation well materials.

- B. Equipment: Piping, pumping, and other equipment and materials to provide control of surface water and groundwater in excavations.
- C. Grout: Mixture of Portland cement and bentonite clay or sand suitable for sealing abandoned wells and piping.

## PART 3 - EXECUTION

### 3.1 GENERAL

- A. Control surface water and groundwater such that:
  - 1. Excavation to final grade is made in-the-dry.
  - 2. Natural undisturbed conditions of subgrade soils are maintained.
  - 3. Softening, instability, or disturbance due to presence or seepage of water does not occur.
  - 4. Construction and backfilling proceeds in-the-dry.
  - 5. Floation of completed portions of work shall be prohibited.
- B. Methods of groundwater control may include but are not limited to trenches and sump pumping, perimeter groundwater cutoff, well-points, ejectors, deep wells, or any combination.
- C. Where groundwater levels are above proposed bottom of excavation level, provide a pumped dewatering system for pre-drainage of soils prior to excavation and for maintaining lowered groundwater level until construction has been completed such that structure, pipeline, or fill will not be floated or otherwise damaged.
- D. Vary type of system, spacing of dewatering units, and other details of the work depending on soil and water conditions at each location.
- E. Do work in a manner to protect adjacent structures and utilities without causing loss of ground or disturbance to pipe bearing soils or soils supporting overlying or adjacent structures.
- F. Install, monitor, and report data from observation wells. Evaluate collected data relative to groundwater control system performance and modify systems necessary to dewater site.
- G. Locate groundwater control system components where they will not interfere with construction activities adjacent to the work area or interfere with installation and monitoring of geotechnical instrumentation including observation wells. Do not make excavations for sumps or drainage ditches within or below 1H:1V slopes extending downward and out from edges of existing or proposed foundation elements or from downward vertical footprint of pipe without approval by the Engineer.

### 3.2 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by dewatering operations.

1. Prevent surface water and ground-water from entering excavations, from ponding on prepared subgrades, and from flooding site or surrounding area.
  2. Protect subgrades and foundation soils from softening and damage by rain or water accumulation.
- B. Install dewatering system to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.
1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways, if required by authorities having jurisdiction.
- C. Provide temporary grading to facilitate dewatering and control of surface water.
- D. Protect and maintain temporary erosion and sedimentation controls, which are specified in Section 311000 "Site Clearing" during dewatering operations.

### 3.3 INSTALLATION

- A. Install dewatering system utilizing wells, well-points, or similar methods complete with pump equipment, standby power and pumps, filter material gradation, valves, appurtenances, water disposal, and surface-water controls.
1. Space well-points or wells at intervals required to provide sufficient dewatering.
  2. Use filters or other means to prevent pumping of fine sands or silts from the subsurface.
- B. Place dewatering system into operation to lower water to specified levels before excavating below groundwater level.
- C. Provide sumps, sedimentation tanks, and other flow-control devices as required by authorities having jurisdiction.
- D. Provide standby equipment on-site, installed and available for immediate operation, to maintain dewatering on continuous basis if any part of system becomes inadequate or fails.

### 3.4 SURFACE WATER CONTROL

- A. Construct surface water control measures, including dikes, ditches, sumps and other methods to prevent flow of surface water into excavations and to allow construction to proceed without delay.
- B. Grade excavation to divert surface water and ground-water within excavation areas into sumps and dewatering wells.

### 3.5 EXCAVATION DEWATERING

- A. Provide and maintain equipment and facilities to promptly remove and properly dispose of water entering excavations. Maintain excavations in-the-dry.



- B. Excavation dewatering shall maintain the subgrade in a natural undisturbed condition and be in operation until the fill, structure or pipes to be built thereon have been completed to such extent that they will not be floated or otherwise damaged by allowing water levels to return to natural elevations.
- C. Do not place pipe and concrete in water or submerge within 24 hours after being installed. Prevent water from flow over new concrete within four days after placement.
- D. Prevent water from rising to cause unbalanced pressure on structures until concrete or mortar has set at least 24 hours. Prevent pipe flotation by promptly placing backfill.
- E. Conduct dewatering to preserve natural undisturbed condition of subgrade soils at bottom of excavation.
- F. If trench subgrade or excavation bottom becomes disturbed due to inadequate dewatering or drainage, excavate below normal grade as directed by the Engineer and refill with structural fill, crushed stone, or other material as approved by the Engineer without additional compensation.
- G. It is expected that initial dewatering plan may be modified to suit variable soil and water conditions encountered. Dewater and excavate in a manner without causing loss of ground or disturbance to pipe bearing soil or soil that supports overlying or adjacent structures.
- H. If methods do not properly dewater excavation, install additional groundwater observation wells as directed by the Engineer. Do not place pipe or structure until readings obtained from observation wells indicate that groundwater has been lowered to specified minimum of below bottom of final excavation.
- I. Surround dewatering units with suitable filter sand with no fines being removed by pumping. Pump continuously from dewatering system until pipe or structure is adequately backfilled. Provide stand-by pumps.
- J. Collect water entering excavations from precipitation or surface runoff in shallow ditches around excavation perimeter, drained to a sump, and pump from excavation to maintain a bottom free from standing water.
- K. Dispose of drainage to an approved area as specified in an acceptable manner and in accordance with applicable permits. Do not use existing or new sanitary sewers to dispose of drainage unless approved by the Owner.

### 3.6 WELL-POINT SYSTEMS

- A. Where necessary, install a vacuum well-point system around excavation for dewatering purposes. Surround each well-point and riser pipe by a sand filter. Use sand of gradation that after initial development of well-points, quantity and size of soil particles discharged shall be negligible. Provide well-point systems capable of operating continuously under highest possible vacuum. Include sufficient valves and gauges to accurately monitor and control the system. Develop and redevelop well-points to provide reliable performance throughout the duration of the work.
- B. Install well-point systems in the Engineer's presence according with approved submittal.

### 3.7 OBSERVATION WELLS

- A. Section 310900 “Geotechnical Instrumentation and Monitoring” for observation well execution details

### 3.8 REMOVAL OF SYSTEMS

- A. At completion of excavation and backfilling work and when approved by the Engineer, remove from site various pipe, deep wells, well-points, pumps, generators, observation wells, other equipment, and accessories used for groundwater and surface water control systems.
  - 1. Removed materials and equipment become property of Contractor.
- B. Restore areas disturbed by installation and removal of groundwater control systems and observation wells to their original condition.
- C. Leave in place deep wells casings, well-points, and observation wells located:
  - 1. Within plan limits of structures or pipelines.
  - 2. Within zone below 1H:1V planes extending downward and out from edges of foundation elements or from downward vertical footprint of pipe.
  - 3. Where removal would result in ground movements causing adverse settlement to adjacent ground surface, utilities, or existing structures.
- D. Fill pulled casings holes with cement grout. Where left in place, fill casings with cement grout and cut off a minimum of 3 feet below finished ground level or 1 foot below foundation level to prevent interference with finished structures or pipelines.
- E. When directed by the Engineer, leave observation wells in place for continued monitoring. Cut casings flush with final ground level when directed and provide protective lockable boxes with locking devices. Provide protective boxes suitable for traffic and other conditions to which observation wells will be exposed.

END OF SECTION 312319

## SECTION 312333 - TRENCHING AND BACKFILLING

### 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 work shall comply and be installed per the latest JEA Water and Wastewater Standards Manual (January 2019 or latest) and the JEA Facilities Standards Manual.

#### 1.2 SUMMARY

- A. Section includes trench excavation, backfilling, and compaction.
- B. Related Requirements:
  - 1. Section 310515 "Soils and Aggregates for Earthwork" for soil and aggregate materials.
  - 2. Section 312000 "Earthwork" for excavating, backfilling and compaction in open areas.
  - 3. Section 312319 "Dewatering" for lowering and disposing of groundwater during construction and dewatering excavations.
  - 4. Section 312500 "Erosion and Sedimentation Controls" to prevent erosion, sedimentation, and contamination of adjacent properties.

#### 1.3 DEFINITIONS

- A. Percent Compaction: Means at least the stated percentage of maximum density as determined by ASTM D 1557, Method D.

#### 1.4 ACTION SUBMITTALS

- A. Submit proposed method of backfilling and compaction prior to start of Work.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Material Test Reports: For material excavated from trench for re-use as backfill, by a qualified testing agency.

#### 1.6 QUALITY ASSURANCE

- A. Comply with following regulations:
  - 1. Florida "Trench Safety Act" (CS/SB 2626).

2. Occupational Safety and Health Administration (OSHA): 29 CFR Part 1926 Subpart P.

- B. Provide excavation, trenching, related sheeting, bracing, and related materials to comply with requirements of the Florida "Trench Safety Act" (CS/SB 2626) which incorporates, by reference, OSHA's excavation safety standards, 29 CFR 1926 Subpart P.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store excavated materials according to Section 312500 "Erosion and Sedimentation Control" to prevent erosion of soil type materials and contamination of adjacent water sources.

PART 2 - PRODUCTS

2.1 Materials

- A. Refer to Section 310515 "Soils and Aggregates for Earthwork" for soil and aggregate materials.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine that erosion and sedimentation controls are in place and comply with project requirements and authorities having jurisdiction.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Where excavation activities occur across active vehicular or pedestrian circulation paths, use temporary controls specified in Division 01 to maintain circulation during operations required by this Section. Maintain temporary controls for each day circulation paths are restricted.
- B. Coordinate work of this Section with materials specified in other Sections of Division 31.
- C. Identify required lines, levels, contours, and datum locations.
- D. Protect features to remain-in-place including benchmarks, existing structures, fences, sidewalks, paving, curbs, etc. from excavating equipment and vehicular traffic. Maintain and protect above and below grade utilities indicated to remain.

3.3 TRENCH EXCAVATION

- A. Trench excavation includes material of every description and substance encountered, except rock and boulders.

- B. Cut rigid and flexible pavement with a saw, wheel, or pneumatic chisel along straight lines before excavating.
- C. Strip and stockpile topsoil from grassed areas crossed by trenches.
  - 1. At Contractor's option when required, topsoil may be disposed of and replaced with approved topsoil of equal quality.
- D. While excavating and backfilling is in progress, maintain traffic and protect utilities and other property.
- E. Excavate trenches to indicated depths and in widths sufficient and of practical minimum for pipe laying, bracing, and pumping and drainage facilities.
- F. Accomplish excavation and dewatering by methods preserving undisturbed state of subgrade soils. Excavate trench by machinery to or just below designated subgrade, if material remaining in trench bottom is no more than slightly disturbed.
  - 1. Remove subgrade soils that become soft, loose, quick, or otherwise unsatisfactory due to inadequate excavation, dewatering, or other construction methods and replace with crushed stone or other material acceptable to the Engineer.
- G. Use care when working in fine-grained soils, which are particularly susceptible to disturbance due to construction operations. When excavation is to end in such soils, use a smooth-edge bucket to excavate the last 12 inches of depth.
- H. Where pipe is to be laid in pipe bedding, excavate trench by machinery to normal depth of pipe, provided material remaining in trench bottom is no more than slightly disturbed.

### 3.4 DISPOSAL OF MATERIALS

- A. Stack excavated material without excessive surcharge on trench bank or obstructing free access to hydrants and gate valves. Avoid inconvenience to traffic and abutters. Segregated excavated material for use in backfilling as specified below.
- B. Do not remove excavated material from work site, except as directed by the Engineer. When removal of surplus materials is approved by the Engineer, dispose of such surplus material in approved designated areas.
- C. Should conditions make it impracticable or unsafe to stack material adjacent to trench, haul and store material at a location provided. When required, re-handled and use it in backfilling trench.

### 3.5 TEMPORARY EXCAVATION SUPPORT

- A. Provide and maintain excavation support required by Federal, State, or local safety requirements to support sides of excavation and prevent loss of ground which could endanger personnel, damage, adjacent structures, or delay the work.
  - 1. Engineer may order additional supports placed at Contractor's expense if it is determined that at any point sufficient or proper supports have not been provided. Compliance with

such order shall not relieve Contractor from their responsibility for sufficiency of such supports. Take care to prevent voids outside of excavation support; if voids are formed, immediately fill and ram them.

- B. When moveable trench bracing such as trench boxes, moveable sheeting, shoring or plates are used to support trench sides, take care in placing and moving the boxes or supporting bracing to prevent pipe movement, disturbance of pipe bedding, or crushed stone backfill.
  - 1. Rigid Pipe Installation (such as R.C., V.C., A.C.): Raise that portion of box extending below mid-diameter above this point prior to moving box ahead to install next pipe. Perform to prevent separation of installed pipe joints due to box movement.
  - 2. Flexible Pipe Installation (such as PVC): Do not allow trench boxes, moveable sheeting, shoring, or plates to extend below mid-diameter of pipe. As trench boxes, moveable sheeting, shoring, or plates are moved, place screened gravel to fill voids created. Re-compact screened gravel and backfill to provide uniform side support for pipe.
- C. Carefully remove temporary excavation support and bracing in manner to not endanger construction of other structures, utilities, or property, whether public or private. Immediately refill voids left after withdrawal of excavation support using sand by ramming with tools especially adapted to that purpose and watering or otherwise directed by the Engineer.
- D. No extra payment will be given for excavation support during progress of the work. No payment will be given for excavation support left in trench for Contractor's convenience.
- E. Leave excavation support driven below mid-diameter of pipe in place from driven elevation to at least 12 inches above top of pipe.

### 3.6 TEST PITS

- A. Excavation of test pits may be required for purpose of locating underground utilities or structures as an aid in establishing the precise location of new work.
- B. Backfill test pits as soon as desired information has been obtained. Maintain backfilled surface appropriate for travel until resurfaced.

### 3.7 EXCAVATION BELOW GRADE AND REFILL

- A. Drain trench completely and effectively be in-the-dry (i.e., two feet below excavation subgrade), whatever the nature of unstable material encountered or groundwater conditions.
- B. If Contractor excavates below grade through error or for their own convenience, through failure to properly dewater the trench, or disturbs subgrade before dewatering is sufficiently complete, the Engineer may direct Contractor to excavate below grade as set forth in following Paragraph, where work shall be performed at its own expense.
- C. If material at trench bottom consists of fine sand, sand and silt or soft earth which may work into the pipe bedding, even with effective drainage, remove subgrade material to extent directed. Refill excavation with a 6-inch layer of coarse sand or a mixture graded from coarse sand to fine pea stone to form a filter layer preserving voids in pipe bedding. Composition and

gradation of pipe bedding shall be approved by the Engineer prior to placement. Place pipe bedding in 6-inch layers thoroughly compacted up to normal grade of pipe.

### 3.8 BACKFILLING

- A. Begin backfilling as soon as practicable after laying and jointing pipe and continue expeditiously. Place pipe bedding of specified type for pipe installed up to 12 inches over the pipe.
- B. Construct a low permeability dam or bulkhead cutoff of clay or other low permeability material in the trench, as directed by the Engineer, to interrupt unnatural flow of groundwater after construction is completed. Key dam into trench bottom and sidewalls. Provide at least one low permeability material dam in pipe bedding between each manhole where directed or every 500 feet, whichever is less.
- C. Where pipes are laid in non-paved areas, refer to Drawings for pipe bedding and trench backfill requirements.
- D. Where pipes are laid in paved areas, refer to Drawings for pipe bedding and trench backfill requirements.
- E. To prevent longitudinal pipe movement, do not dump backfill material into trench and then spread, until selected material or crushed stone has been placed and compacted to a level at least 12 inches over the pipe.
- F. Bring backfill up evenly on all sides. Thoroughly compact each layer of backfill material by rolling, tamping, or vibrating with mechanical compacting equipment or hand tamping in accordance with compaction requirements on Drawings for trench backfill. If rolling, use a suitable roller or tractor being careful to compact fill throughout full width of trench.
- G. Do not compact by puddling or water jetting.
- H. Use hand or pneumatic ramming with tools weighing at least 20 pounds for compacting in confined areas. Spread and compact material in layers not exceeding 6 inches thick, an uncompacted loose measurement.
- I. Use granular fill material as backfill around structures. Spread and compact specified backfill under and over pipes connected to structures.
- J. Do not place bituminous paving in backfill. Do not use frozen material under any circumstances.
- K. Broom and hose-clean road surfaces immediately after backfilling. Employ dust control measures throughout construction period.

### 3.9 COMPACTION

- A. Refer to Section 312000 "Earthwork", for compaction requirements.

3.10 FIELD QUALITY CONTROL

- A. Refer to Section 312000 “Earthwork”, for field quality control requirements.

3.11 RESTORING TRENCH SURFACE

- A. Where trench occurs adjacent to paved streets, in shoulders, sidewalks, or in cross-country areas, thoroughly consolidate backfill and maintain surface as the work progresses. If settlement takes place, immediately deposit additional fill to restore ground level.
- B. In and adjacent to streets, 12 inches of trench backfill below specified initial pavement shall consist of compacted aggregate base course. If Contractor wants to use material excavated from trench as gravel subbase for pavement replacement, take samples at intervals not to exceed 500 feet of material and test by an independent testing laboratory at Contractor’s expense. Use only materials approved by the Engineer.
- C. Restore surface of driveways or other areas which are disturbed by trench excavation to a condition at least equal to that existing before work began.
- D. In areas where pipeline passes through grassed areas, remove and replace sod or loam and seed surface at Contractor's own expense.

END OF SECTION 312333



## SECTION 312500 - EROSION AND SEDIMENTATION CONTROLS

### 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 work shall comply and be installed per the latest JEA Water and Wastewater Standards Manual (January 2019 or latest) and the JEA Facilities Standards Manual.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Silt Fence
  - 2. Construction Entrances
- B. Related Sections:
  - 1. Section 031000 - Concrete Forming and Accessories
  - 2. Section 032000 - Concrete Reinforcing
  - 3. Section 033000 - Cast-In-Place Concrete
  - 4. Section 055000 - Metal Fabrications
  - 5. Section 310515 "Soils and Aggregates for Earthwork"
  - 6. Section 311000 - Site Clearing
  - 7. Section 312316 - Excavation
  - 8. Section 329119 - Landscape Grading
  - 9. Section 329200 - Turf and Grasses

#### 1.3 REFERENCE STANDARD

- A. EPA document titled: "Stormwater Management for Construction Activities – Developing Pollution Prevention Plans and Best Management Practices" document number EPA 832-R-92-005, dated 1992, or most recent edition.

#### 1.4 ACTION SUBMITTALS

- A. Section 013300 - Submittal Procedures: Requirements for submittals.
  - 1. Submit, within 10 days after award of Contract, technical product literature for all commercial products.
  - 2. The Contractor shall submit to the Engineer an erosion and sedimentation control plan for approval. The silt fence and erosion and sedimentation control plan shown on the Contract Documents is for guidance only.

- B. Manufacturer's Certificate: Certify Products meet or exceed specified requirements

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Stormwater Pollution Prevention Plan (SWPPP) as specified in “Quality Assurance” article.
- B. Copy of EPA NPDES Notice of Intent to Discharge submitted to the EPA as specified in “Quality Assurance” article.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Section 017700 “Closeout Procedures”: Requirements for submittals.

#### 1.7 QUALITY ASSURANCE

- A. Prepare and submit a Stormwater Pollution Prevention Plan (SWPPP) in accordance with the U.S. Environmental Protection Agency (EPA) National Pollution Discharge Elimination System (NPDES) General Permit applicable to this work) document number EPA 832-R-92-005, dated 1992, or most recent edition.
- B. Prepare and submit the EPA NPDES Notice of Intent to Discharge to the applicable EPA office in accordance with EPA regulations.
- C. Perform Work in accordance with requirements of Section 310515, Section 312333, Section 311000, Section 312319, Section 321313, Section 329119, Section 329200, Section 031000, Section 032000, and Section 033000.

#### 1.8 ENVIRONMENTAL REQUIREMENTS

- A. Section 016000 - Product Requirements: Environmental conditions affecting products on site.

### PART 2 - PRODUCTS

#### 2.1 MATERIAL

- A. Crushed stone for sediment filtration devices, access ways and staging areas shall conform to Florida Department of Transportation Specifications.
- B. Rip-rap shall be sound, durable rock which is roughly rectangular shape and of suitable quality to insure permanence in the condition in which it is to be used. Rounded stones, boulders, sandstone or similar soft stone will not be acceptable. Material shall be free from overburden, spoil, shale and organic material, meet the Engineer’s approval, and meet the gradation, thickness, and physical property requirements presented in FDOT Standard Specifications Section 530:

<u>Weight of Stone</u>	<u>Percent Finer by Weight</u>
------------------------	--------------------------------

40 lb	100
12 lb	50
3 lb	0

C. Sediment Fence

1. Sediment fence shall be a prefabricated commercial product made of a woven, polypropylene, ultraviolet resistant material such as ADS Geosynthetic 3302W AASHTO Grade Woven Geotextile”, “Polypropylene Silt Fence by Tenax” or approved equal.

D. 1/4-in woven wire mesh for filter boxes shall be galvanized steel or hardware cloth.

E. Straw mulch shall be utilized on all newly graded areas to protect areas against washouts and erosion. Straw mulch shall be comprised of threshed straw of oats, wheat, barley, or rye that is free from noxious weeds, mold or other objectionable material. The straw mulch shall contain at least 50 percent by weight of material to be 10-in or longer. Straw shall be in an air-dry condition and suitable for placement with blower equipment.

F. Latex acrylic copolymer, or organic tackifier shall be a commercial product specifically manufactured for use as straw mulch tackifier.

G. An asphalt tackifier shall only be used when temperatures are too low to allow the use of a latex acrylic copolymer and only with prior written approval from the Engineer.

H. Erosion control blanket shall be installed in all seeded drainage swales and ditches as shown on the Drawings or as directed by the Engineer. Erosion control blanket shall be 100 percent agricultural straw matrix stitch bonded with degradable thread between two photodegradable polypropylene nettings, such as Model S150 Double Net Short-Term Blanket (10 months) by North American Green, Evansville, IN or approved equal.

### PART 3 - EXECUTION

#### 3.1 SILT FENCE

- A. Position sediment fences as indicated on the Drawings and to prevent off site movement of sediment produced by construction activities as directed by the Engineer. Areas beyond limits of silt fence shall be undisturbed or stabilized.
- B. Dig trench approximately 6-inch-wide and 8-inch-deep along proposed fence lines.
- C. Drive stakes, 6 feet on center (maximum) at back edge of trenches. Drive stakes 2 feet (minimum) into ground.
- D. Hang filter fabric on posts carrying to bottom of trench with about 4 inches of fabric laid across bottom of trench. Stretch fabric fairly taut along fence length and maintain secure both ways.

- E. Backfill trench with excavated material and tamp.
- F. Install pre-fabricated silt fence according to manufacturer's instructions.

### 3.2 CONSTRUCTION ENTRANCE

- A. Construct entrance with minimum of 6 inch of course aggregate at all points of ingress/egress.
- B. Width: Minimum 20 feet, increased as needed for typical construction vehicles.
- C. Minimum Length: 50 feet
- D. Install filter fabric below aggregate.
- E. Maintain entrance throughout construction, adding more aggregate or increasing length as needed.

### 3.3 SITE STABILIZATION

- A. Incorporate erosion control devices indicated on the Drawings into the Project at the earliest practicable time.
- B. Construct, stabilize and activate erosion controls before site disturbance within tributary areas of those controls.
- C. Stockpile and waste pile heights shall not exceed 35 feet. Slope stockpile sides at 2:1 or flatter.
- D. Apply temporary mulch to areas where rough grading has been completed but final grading is not anticipated to begin within 30 days of the completion of rough grading. Straw mulch shall be applied at rate of 100 lbs/1000 sq ft and tackified with latex acrylic copolymer at a rate and diluted in a ratio per manufacturer's instructions.
- E. Install erosion control blankets in all seeded drainage swales and ditches as shown on the Drawings and as directed by the Engineer in accordance with manufacturer's instructions. The area to be covered shall be properly prepared, fertilized and seeded with permanent vegetation before the blanket is applied. When the blanket is unrolled, the netting shall be on top and the fibers in contact with the soil over the entire area. Apply blankets in the direction of water flow and stapled. Place blankets a minimum of three rows (of 4 ft) wide (total approx. 12 ft width) within the drainage swale/ditch and stapled together in accordance with manufacturer's instructions. Overlap sides 4 in minimum. Provide staples made of wire, .091 in in diameter or greater, "U" shaped with legs 10 in in length and a 1 1/2 in crown. Commercial biodegradable stakes may also be used with prior approval by the Engineer. Drive staples vertically into the ground, spaced approximately two linear feet apart, on each side, and one row in the center alternately spaced between each side. Bury upper and lower ends of the matting to a depth of 4 in in a trench. Create erosion stops every 25-ft by making a fold in the fabric and carrying the fold into a silt trench across the full width of the blanket. Fold the bottom 4 in below the ground surface. Staple on both sides of fold. Where the matting must be cut or more than one roll length is required in the swale, turn down upper end of downstream roll into a slit trench to a depth of 4 in. Overlap lower end of upstream roll 4 in past edge of downstream roll and staple.

### 3.4 FIELD QUALITY CONTROL

- A. Section 014000 - Quality Requirements and 017300 - Execution: Field inspecting, testing, adjusting, and balancing.
- B. Inspect erosion control devices on a weekly basis and after each runoff event. Make necessary repairs to ensure erosion and sediment controls are in good working order. If such inspection reveals that additional measures are needed to prevent movement of sediment to offsite areas, promptly install additional devices as needed. Sediment controls in need of maintenance shall be repaired promptly. Stormwater inspections and monitoring shall be performed in accordance with the NPDES General Permit.

### 3.5 CLEANING

- A. Section 017300 "Execution" and 017700 "Closeout Procedures": Requirements for cleaning.
- B. When sediment accumulation in sedimentation structures has reached a point one-third depth of sediment structure or device, remove and dispose of sediment.
- C. Do not damage structure or device during cleaning operations.
- D. Do not permit sediment to erode into construction or site areas or natural waterways.
- E. Clean channels when depth of sediment reaches approximately one half channel depth.

END OF SECTION 312500

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## SECTION 315000 - EXCAVATION SUPPORT AND PROTECTION

### 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 work shall comply and be installed per the latest JEA Water and Wastewater Standards Manual (January 2019 or latest) and the JEA Facilities Standards Manual.

#### 1.2 SUMMARY

- A. Section includes temporary excavation and trench support and protection systems.
- B. List related sections in other portions of the specifications that have application to excavation support such as: earthwork, dewatering, geotechnical instrumentation, management of contaminated materials, slurry wall construction, concrete work, cement grouting, and tieback construction.
- C. Related Requirements:
  - 1. Retain subparagraphs below to cross-reference requirements Contractor might expect to find in this Section but are specified in other Sections.
  - 2. Section 013233 "Photographic Documentation" for recording preexisting conditions and excavation support and protection system progress.
  - 3. Section 310900 "Geotechnical Instrumentation and Monitoring" for monitoring of ground and groundwater.
  - 4. Section 312000 "Earthwork" for excavating, backfilling, and compacting in open areas.
  - 5. Section 311000 "Site Clearing" for site stripping, grubbing, stripping and stockpiling topsoil, and removal of above- and below-grade improvements and utilities.
  - 6. Section 312319 "Dewatering" for lowering and disposing of ground water during construction and dewatering excavations.

#### 1.3 ACTION SUBMITTALS

- A. Shop Drawings: For excavation support and protection system, prepared by or under the supervision of a qualified Professional Engineer licensed in the State of Florida, meeting the minimum performance requirements in Part 2 of this Section.
  - 1. Include overall system plan, indicating clearances, dimensions, material properties, member sizes, locations, spacing and member penetrations depths, and locations of various types of lateral supports.
  - 2. Show details, layout, arrangement, equipment requirements, and method of construction of proposed excavation support system.

3. Indicate existing and proposed utilities, structures or other obstructions.
4. Show wall elevations and locations of bracing.
5. Show overall installation sequence and removal of bracing. Indicate work levels to be performed before bracing is installed or removed.
6. Method of preloading bracing, if required, including preload for each member, and method of locking-off the preload. Submit detailed drawings of connections, jacking supports, and method of shimming.
7. Include procedures for resolving difficulties arising from misalignment of members exposed during excavation and criteria for implementing those procedures. n.

B. Design Calculations: For excavation support and protection system. Include analysis data prepared, signed, and sealed by Professional Engineer responsible for their preparation.

1. Include loads on excavation support system for all stages of excavation, bracing removal, and concrete placement, including material and equipment loads on adjacent ground during construction.
2. Include design of wall and bracing members including details for all construction stages.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Submit quality control measures to ensure that performance of excavation support system complies with project requirements.
- B. Submit welder qualifications and weld procedures in accordance with AWS D1.1.
- C. Qualification Data: For land surveyor.
- D. Maintain at least one copy of design at job site during excavation that includes a plan indicating sizes, types, and configurations of the materials to be used in protective system. Identity registered Contractor's Design Engineer who stamped the design.
- E. Do not proceed with excavation support or protection activities until submittals have been reviewed by the Engineer.

#### 1.5 QUALITY ASSURANCE

- A. Contractor Qualifications: Minimum 5 years' experience compatible to indicated Work, and who employs labor and supervisory personnel similarly experienced in Work of this Section.
- B. Contractor's Design Engineer: Professional Engineer licensed in the State of Florida with at least 5 years' professional experience in design and construction of support of excavation systems and having completed a minimum of 5 successful excavation support projects of equal type, size, and complexity to specified work.
- C. Existing Conditions: Using photographs, show existing conditions of adjacent construction and site improvements that might be misconstrued as damage caused by inadequate performance of excavation support and protection systems. Submit before Work begins.



- D. Regulatory Requirements: Comply with authorities having jurisdiction, including OSHA requirements.
- E. Record Drawings: Identify locations and depths of capped utilities, abandoned-in-place support and protection systems, and other subsurface structural, electrical, or mechanical conditions.

## 1.6 FIELD CONDITIONS

- A. Interruption of Existing Utilities: Do not interrupt any utility serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility according to requirements indicated:
  - 1. Contact utility companies and other responsible authorities to locate and mark underground utilities.
  - 2. Notify the Engineer and Owner no fewer than two days in advance of proposed interruption of utility.
  - 3. Do not proceed with interruption of utility without the Engineer's and Owner's written permission.
- B. Project-Site Information: Geotechnical data has been prepared for this Project and is available for information only. The opinions expressed in this data are those of a geotechnical engineer and represent soil borings and tests, conducted by a geotechnical engineer. Owner is not responsible for interpretations or conclusions drawn from the data.
  - 1. Make additional test borings and conduct other exploratory operations necessary for excavation support and protection according to the performance requirements.
  - 2. The geotechnical data is included elsewhere in Project Manual.
- C. Survey Work: Engage a qualified land surveyor or professional engineer to survey adjacent existing buildings, structures, and site improvements; establish exact elevations at fixed points to act as benchmarks. Clearly identify benchmarks and record existing elevations.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Do not permit excavations below the level of the base of adjacent existing foundations or retaining walls, unless excavation design and bracing includes an analysis of stability of structure supported by foundation and if necessary, incorporates required bracing or underpinning of foundation.
- B. For support systems in which bracing is installed between opposite sides of the excavation, design excavation support of both sides to be nearly the same as feasible.
- C. Where necessary to resist point loads, fill pipe piles used as soldier piles with concrete. Do not consider concrete strength in design of pipe pile for bending stress.

- D. Design, install, operate, and maintain ground water control system to control ground water inflows, prevent piping or loss of ground, and maintain stability of the excavation. Refer to the requirements of Section 312319 "Dewatering."
- E. Design review and field monitoring activities by Owner or the Engineer does not relieve Contractor of its work responsibilities.

## 2.2 MATERIALS

- A. General: Provide materials that are either new or in serviceable condition.
- B. Structural Steel: ASTM A 36/A 36M, ASTM A 690/A 690M, or ASTM A 992/A 992M.
- C. Steel Pipe Used as Soldier Piling: ASTM A 252, Grade or better.
- D. Steel Sheet Piling: ASTM A 328/A 328M, ASTM A 572/A 572M, or ASTM A 690/A 690M; with continuous interlocks.
  - 1. Corners: Roll-formed corner shape with continuous interlock.
- E. Wood Lagging: Lumber, mixed hardwood, nominal rough thickness of 3 inches with minimum allowable flexural strength of 1,100 psi .
- F. Cast-in-Place Concrete: ACI 301, with minimum compressive strength of 3,000 psi unless a higher strength is required for application.
- G. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Obtain permits from local authorities having jurisdiction prior to initiating excavation work.
- B. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards that could develop during excavation support and protection system operations.
  - 1. Shore, support, and protect utilities encountered.
- C. Install excavation support and protection systems to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.
  2. Install fencing, gates, lights, and signs around excavations and staging areas to provide for public safety.
- D. Locate excavation support and protection systems clear of permanent construction so that construction and finishing of other work is not impeded.

### 3.3 GENERAL

- A. Install excavation support systems in accordance with the Shop Drawings and applicable permits.
- B. Fill voids between excavation support system and earth with materials acceptable to the Engineer.
- C. If unstable material is encountered during excavation, take immediately measures to contain it in place and prevent ground displacement.
- D. If settlement or deflections of supports indicate that support system requires modification to prevent excessive movements, redesign and resubmit revised Shop Drawings and calculations to the Engineer without additional compensation.
- E. Maintain sufficient quantity of material on site for protection of Work and for use in case of accident or emergency.

### 3.4 PORTABLE TRENCH BOXES

- A. Use portable trench boxes or sliding trench shields only for worker protection.
- B. Additional excavation, backfilling, and surface restoration required as result of trench box use shall be provided without additional compensation.
- C. Design, construct, and maintain trench boxes or shields to meet acceptable engineering and industry standards.
- D. Install shields in a manner to restrict lateral or other hazardous movement of the shield in the event of sudden lateral loads.
- E. Maintain a written copy of trench box manufacturer's specifications, recommendations, and limitations at job site during excavation work.

### 3.5 STEEL SHEET PILING

- A. Thoroughly cleaned and inspect sheet piles for defects and proper interlock dimensions prior to installation. Provide a tool for checking interlock dimensions.

- B. Before starting excavation, drive one-piece sheet piling lengths in plumb position and tightly interlock vertical edges for its entire length to form a continuous barrier. Form a continuous diaphragm throughout length of each run of wall, bearing tightly against original ground.
  - 1. Exercise care in driving so interlocking members can be extracted without damaging adjacent structures or utilities.
  - 2. Use driving, cutting, and splicing methods conforming to approved Shop Drawings.
  - 3. Use templates or other temporary alignment facilities to maintain piling line.
- C. Accurately place piling, using templates and guide frames unless otherwise recommended in writing by sheet piling manufacturer. Limit vertical offset of adjacent sheet piling to 5 feet. Accurately align exposed faces of sheet piling to vary not more than 2 inches from a horizontal line and not more than 1:120 out of vertical alignment.
- D. Install each sheet pile having sufficient clearance in interlocks to slide under its own weight into interlock of previously placed sheet pile.
- E. Do not excavate in advance of steel sheet piling installation.
- F. Where obstructions are anticipated, pre-excavate or pre-drill along sheet pile wall alignment without additional compensation. Do not extend pre-excavation and pre-drilling below lowest excavation level or into bearing soils for existing or future structures.
- G. Remove obstructions encountered before the specified embedment for piles. Where obstructions cannot be removed, re-evaluate sheet pile system by Contractor's dDesign Engineer show reduced embedment and additional toe stability measures to be implemented for sheet pile wall realignment. Submittal proposed design measures to the Engineer for review.
- H. Withdraw damaged or faulty aligned pilings with provide new piling, driven properly in its place without additional compensation.
- I. Cut tops of sheet piling to uniform elevation at top of excavation.

### 3.6 INTERNAL BRACING

- A. Bracing: Locate bracing to clear columns, floor framing construction, and other permanent work. If necessary to move brace, install new bracing before removing original brace.
  - 1. Do not place bracing where it will be cast into or included in permanent concrete work, unless otherwise approved by the Engineer.
  - 2. Install internal bracing if required to prevent spreading or distortion of braced frames.
  - 3. Maintain bracing until structural elements are supported by other bracing or until permanent construction is able to withstand lateral earth and hydrostatic pressures.
- B. Provide internal bracing to carry maximum design load without distortion or buckling.
- C. Include web stiffeners, plates, or angles required to prevent rotation, crippling, or buckling of connections and points of bearing between structural steel members. Allow for eccentricities caused by field fabrication and assembly.

- D. Install and maintain bracing support members in tight contact with each other and with the surface being supported. Do not use wood shims.
- E. Coordinate excavation work with installation of bracing. Extend excavation no more than 2 feet below any brace level prior to installation of the bracing.
- F. Use procedures that produce uniform loading of bracing member without eccentricities, overstressing, or distortion of system members.

### 3.7 FIELD QUALITY CONTROL

- A. Survey-Work Benchmarks: Resurvey benchmarks regularly during installation of excavation support and protection systems, excavation progress, and for as long as excavation remains open. Maintain an accurate log of surveyed elevations and positions for comparison with original elevations and positions. Promptly notify Engineer if changes in elevations or positions occur or if cracks, sags, or other damage is evident in adjacent construction.
- B. Promptly correct detected bulges, breakage, or other evidence of movement to ensure that excavation support and protection system remains stable.
- C. Promptly repair damages to adjacent facilities caused by installation or faulty performance of excavation support and protection systems.

### 3.8 REMOVAL

- A. Remove excavation support and protection systems when construction has progressed sufficiently to support excavation and earth and hydrostatic pressures. Remove in stages to avoid disturbing underlying soils and rock or damaging structures, pavements, facilities, and utilities.
  - 1. Remove excavation support and protection systems to a minimum depth of 48 inches below overlying construction and abandon remainder.
  - 2. Fill voids immediately with approved backfill compacted to density specified in Section 312000 "Earthwork."
  - 3. Repair or replace, as approved by Engineer, adjacent work damaged or displaced by removing excavation support and protection systems.
- B. Do not remove vertical support members that were installed within zone of influence of new or existing structures. Cut off support members installed within this zone at 5 feet (1525 mm) below finished grade and abandon in place.
- C. Do not remove internal bracing or transfer loads to permanent structure without prior acceptance of the Engineer.
- D. Begin removal at excavation bottom and progress upward. Slowly release members noting indication of possible failure of remaining members or possible cave-in of excavation sides.
- E. Progress backfilling together with removal of support systems from excavations.

- F. Remove all portions of excavation support, unless otherwise indicated by approved Shop Drawings.
  - 1. Zone of Influence Definition: Zone extending down and away from outer edge of the structure at 1 horizontal to 1 vertical.
- G. Do not leave wood as part of abandoned portion of the work.
- H. When removing excavation support system, do not disturb or damage adjacent buildings, structures, waterproofing material, or utilities. Fill voids immediately with lean concrete or well-graded cohesionless sand or as directed by the Engineer.
- I. Immediately remove excavation support system material from site.

END OF SECTION 315000

## SECTION 321216 - ASPHALT PAVING

### 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. Asphalt materials.
  - 2. Aggregate materials.
  - 3. Aggregate subbase.
  - 4. Asphalt paving base course, binder course, and wearing course.
  - 5. Asphalt paving overlay for existing paving.
  - 6. Surface slurry.

- B. Related Requirement:

- 1. Section 310515 – Soils and Aggregates for Earthwork

#### 1.3 SUBMITTALS

- A. Section 013300 - Submittal Procedures: Requirements for submittals.

- B. Product Data:

- 1. Submit product information for asphalt and aggregate materials.
  - 2. Submit mix design with laboratory test results supporting design.

- C. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

#### 1.4 QUALITY ASSURANCE

- A. Mixing Plant: Conform to Florida Department of Transportation (FDOT) requirements.
- B. Obtain materials from same source throughout.
- C. Perform Work in accordance with FDOT requirements.

## 1.5 QUALIFICATIONS

- A. Installer: Company specializing in performing work of this section with minimum 5 years of experience.

## 1.6 AMBIENT CONDITIONS

- A. Section 015000 - Temporary Facilities and Controls: Ambient conditions control facilities for product storage and installation.
- B. Do not place asphalt mixture when ambient air or base surface temperature is less than 40, or surface is wet or frozen.
- C. Place asphalt mixture when temperature is not more than 15 less than initial mixing temperature.

## PART 2 - PRODUCTS

### 2.1 ASPHALT PAVING

- A. Performance / Design Criteria:
  - 1. Paving: Design for parking, chemical delivery trucks.
- B. Asphalt Materials:
  - 1. Asphalt Binder: AASHTO M320; performance grade PG 58-28.
- C. Aggregate Materials:
  - 1. Coarse Aggregate: ASTM D692; crushed stone, gravel, or blast furnace slag.
- D. Aggregate Subbase: Specified in 310515.

### 2.2 MIXES

- A. Use dry material to avoid foaming. Mix uniformly.
- B. Asphalt Paving Mixtures: ASTM D3515; designed in accordance with AI MS2.
  - 1. Base Course: Dense Mixture.
  - 2. Binder Course: Dense Mixture.
  - 3. Wearing Course: Dense Mixture.
- C. Surface Slurry: ASTM D3910, Friction Course FC 12.5 provide 1 ½ inch minimum thickness; emulsified asphalt slurry. Structural Course Type SP 12.5 provide 3-inch minimum thickness.



- D. Paving Surfaces: Minimum solar reflectance index (SRI) of 29, calculated in accordance with ASTM E1980.
  - 1. Reflectance: Measured in accordance with ASTM E903, ASTM E1918, or ASTM C1549.
  - 2. Emittance: Measured in accordance with ASTM E408 or ASTM C1371.

## 2.3 ACCESSORIES

- A. Geotextile Fabric: AASHTO M288; non-woven, polypropylene.
- B. Sealant: ASTM D6690, Type I; hot applied type.

## 2.4 SOURCE QUALITY CONTROL

- A. Section 014000 - Quality Requirements: Testing, inspection and analysis requirements.
- B. Submit proposed mix design of each class of mix for review prior to beginning of Work.
- C. Test samples in accordance with AI MS-2.

# PART 3 - EXECUTION

## 3.1 EXAMINATION

- A. Section 017300 "Execution": Requirements for installation examination.
- B. Verify utilities indicated under paving are installed with excavations and trenches backfilled and compacted.
- C. Verify compacted subgrade subbase is dry and ready to support paving and imposed loads as required by FDOT standards
  - 1. Proof roll subbase with in minimum two perpendicular passes to identify soft spots.
  - 2. Remove soft subbase and replace with compacted fill as specified in Section 310515.
- D. Verify gradients and elevations of base are correct.

## 3.2 PREPARATION

- A. Prepare subbase in accordance FDOT Standards.

## 3.3 DEMOLITION

- A. Saw cut and notch existing paving as indicted on Drawings.

- B. Clean existing paving to remove foreign material, excess joint sealant and crack filler from paving surface.
- C. Repair surface defects in existing paving to provide uniform surface to receive new paving.

### 3.4 INSTALLATION

#### A. Subbase:

- 1. Prepare subbase in accordance with FDOT Standards

#### B. Primer:

- 1. Apply primer in accordance with AI MS-2.

#### C. Tack Coat:

- 1. Apply tack coat in accordance with AI MS-19

#### D. Single Course Asphalt Paving:

- 1. Install Work in accordance with FDOT Standards
- 2. Place asphalt within 24 hours of applying primer or tack coat.
- 3. Place asphalt wearing course to thickness indicated on Drawings.
- 4. Compact paving by rolling to specified density. Do not displace or extrude paving from position. Hand compact in areas inaccessible to rolling equipment.
- 5. Perform rolling with consecutive passes to achieve even and smooth finish without roller marks.

#### E. Double Course Asphalt Paving:

- 1. Place asphalt binder course within 24 hours of applying primer or tack coat.
- 2. Place binder course to thickness indicated on Drawings.
- 3. Place wearing course within 24 hours of placing and compacting binder course. When binder course is placed more than 24 hours before placing wearing course, clean surface and apply tack coat before placing wearing course.
- 4. Place wearing course to thickness indicated on Drawings.
- 5. Compact each course by rolling to specified density. Do not displace or extrude paving from position. Hand compact in areas inaccessible to rolling equipment.
- 6. Perform rolling with consecutive passes to achieve even and smooth finish, without roller marks.

#### F. Surface Slurry

- 1. Install uniform thickness surface slurry over existing paving in accordance with ASTM D3910.
- 2. Allow slurry to cure.
- 3. Roll paving to achieve uniform surface.

### 3.5 TOLERANCES

- A. Section 014000 - Quality Requirements: Tolerances.
- B. Flatness: Maximum variation of 1/4 inch measured with 10-foot straight edge.
- C. Scheduled Compacted Thickness: Within 1/4 inch.
- D. Variation from Indicated Elevation: Within 1/2 inch.

### 3.6 FIELD QUALITY CONTROL

- A. Section 014000 - Quality Requirements: Requirements for inspecting, testing.
- B. Take samples and perform tests in accordance with AI MS-2.
- C. Asphalt Paving Mix Temperature: Measure temperature at time of placement.
- D. Asphalt Paving Thickness: ASTM D3549; test one core sample from every 1000 square yards compacted paving.
- E. Asphalt Paving Density: ASTM D1188 or ASTM D2726; test one core sample from every 1000 square yards compacted paving.

### 3.7 PROTECTION

- A. Section 017300 "Execution": Requirements for protecting finished Work.
- B. Immediately after placement, protect paving from mechanical injury for 24 hours or until surface temperature is less than 140 degrees F.

### 3.8 ATTACHMENTS

- A. Paving at Parking Areas: Two courses; binder course of 2-1/2-inch compacted thickness and wearing course of 1-inch compacted thickness.

END OF SECTION 321216

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## SECTION 323113 - CHAIN LINK 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 01 Specification Sections, apply to this Section.
- B. All work shall comply and be installed per the latest JEA Water and Wastewater Standards Manual (January 2019 or latest) Fencing - Section 492, the JEA Facilities Standards Manual and the latest requirements of the JEA Security Standards.

END OF SECTION 323113

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## SECTION 329119 - LANDSCAPE GRADING

### 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. Final grade topsoil for finish landscaping.
- B. Related Sections:
  - 1. Section 329200 Turf and Grasses

#### 1.3 SUBMITTALS

- A. Section 013300 - Submittal Procedures: Submittal procedures
- B. Samples: Submit, in air-tight containers, 10 lb sample of each type of fill to testing laboratory.
- C. Materials Source: Submit name of imported materials source.
- D. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

#### 1.4 QUALITY ASSURANCE

- A. Furnish each topsoil material from single source throughout the Work.
- B. Perform Work in accordance with St Johns County Landscaping Regulations.

### PART 2 - PRODUCTS

#### 2.1 MATERIAL

- A. Topsoil: Fill Type S2

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Section 017300 – Execution: Verification of existing conditions before starting work.
- B. Verify building and trench backfilling have been inspected.
- C. Verify substrate base has been contoured and compacted.

### 3.2 PREPARATION

- A. Protect landscaping and other features remaining as final Work.
- B. Protect existing structures, fences, sidewalks, utilities, paving, and curbs.

### 3.3 SUBSTRATE PREPARATION

- A. Eliminate uneven areas and low spots.
- B. Remove debris, roots, branches, stones, in excess of 1 inch in size. Remove contaminated subsoil.
- C. Scarify surface to depth of 6 inches where topsoil is scheduled. Scarify in areas where equipment used for hauling and spreading topsoil has compacted subsoil.

### 3.4 PLACING TOPSOIL

- A. Place topsoil in areas where seeding and sodding is required, to thickness as scheduled. Place topsoil during dry weather.
- B. Fine grade topsoil to eliminate rough or low areas. Maintain profiles and contour of subgrade.
- C. Remove roots, weeds, rocks, and foreign material while spreading.
- D. Manually spread topsoil close to structures to prevent damage.
- E. Lightly compact placed topsoil.
- F. Remove surplus subsoil and topsoil from site.
- G. Leave stockpile area and site clean and raked, ready to receive landscaping.



3.5 TOLERANCES

- A. Section 014000 - Quality Requirements: Tolerances.
- B. Top of Topsoil: Plus or minus **1/2** inch.

3.6 PROTECTION OF INSTALLED WORK

- A. Section 017300 "Execution": Requirements for protecting finished Work.
- B. Prohibit construction traffic over topsoil.

3.7 SCHEDULES

- A. Seeded Grass: 6 inches.
- B. Sod: 4 inches.

END OF SECTION 329119

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## SECTION 329200 - TURF AND GRASSES

### 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. Seeding.
  - 2. Sodding.
  - 3. Erosion-control material(s).

#### 1.3 DEFINITIONS

- A. Finish Grade: Elevation of finished surface of planting soil.
- B. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.  
Subgrade: The surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For landscape Installer.
- B. Certification of Grass Seed: From seed vendor for each grass-seed monostand or mixture, stating the botanical and common name, percentage by weight of each species and variety, and percentage of purity, germination, and weed seed. Include the year of production and date of packaging.
  - 1. Certification of each seed mixture for sod Include identification of source and name and telephone number of supplier.
- C. Product Certificates: For fertilizers, from manufacturer.
- D. Pesticides and Herbicides: Product label and manufacturer's application instructions specific to Project.

## 1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: Recommended procedures to be established by Owner for maintenance of turf during a calendar year. Submit before expiration of required maintenance periods.

## 1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful turf establishment.
  - 1. Pesticide Applicator: State licensed, commercial.

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Seed and Other Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of compliance with state and Federal laws, as applicable.
- B. Sod: Harvest, deliver, store, and handle sod according to requirements in the Turfgrass Producers International's (TPI) "Specifications for Turfgrass Sod Materials" and "Specifications for Turfgrass Sod Transplanting and Installation" sections in TPI's "Guideline Specifications to Turfgrass Sodding." Deliver sod within 24 hours of harvesting and in time for planting promptly. Protect sod from breakage and drying.
- C. 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 materials with appropriate certificates.

## 1.8 FIELD CONDITIONS

- A. 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.

## PART 2 - PRODUCTS

### 2.1 SEED

- A. Grass Seed: Fresh, clean, dry, new-crop seed complying with Association of Official Seed Analysts (AOSA's) "Rules for Testing Seeds" for purity and germination tolerances.
- B. Seed Species: Species to be Scarified Argentine Bahia Seed.

### 2.2 SOD

- A. Sod shall be planted within 100-feet of all structures, 5-feet of all paved areas, and on all pond embankments.
- B. Sod shall be Bahia, except for restoration, where type of sodding shall match existing sodding. Sod shall be of firm texture having a compacted growth and good root development as approved.
- C. Sod shall be certified to meet Florida State Plant Board specifications, absolutely true to varietal type, and free from weeds or other objectionable vegetation, fungus, insects and disease of any kind.
- D. Before being cut and lifted the sod shall have been mowed three times with the final mowing not more than a week before cutting into uniform dimensions.

### 2.3 WATER

- A. CONTRACTOR shall provide water free of substances harmful to plant growth; free from chemicals or minerals that stain or discolor.

### 2.4 FERTILIZERS

- A. Fertilizer shall be a complete fertilizer, the elements of which are derived from organic sources. Fertilizer shall be a standard product complying with State and Federal fertilizer laws.
- B. Fertilizer shall be delivered to the site, mixed as specified, in the original unopened standard size bags showing weight, analysis and name of manufacturer. Containers shall bear the manufacturer's guaranteed statement of analysis, or a manufacturer's certificate of compliance covering analysis shall be furnished to the Engineer. Store fertilizer in a weatherproof place and in such a manner that it will be kept dry and its effectiveness will not be impaired.
- C. Superphosphate shall be composed of finely ground phosphate rock as commonly used for agricultural purposes containing not less than 20 percent available phosphoric acid.

## 2.5 EROSION-CONTROL MATERIALS

- A. Erosion-Control Blankets: Biodegradable wood excelsior, straw, or coconut-fiber mat enclosed in a photodegradable plastic mesh. Include manufacturer's recommended steel wire staples, 6 inches long.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas to be planted for compliance with requirements and other conditions affecting installation and performance of the Work.
  - 1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
  - 2. Suspend planting operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
  - 3. Uniformly moisten excessively dry soil that is not workable, or which is dusty.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Engineer and replace with new planting soil.

### 3.2 PREPARATION

- A. Protect structures; utilities; sidewalks; pavements; and other facilities, trees, shrubs, and plantings from damage caused by planting operations.
  - 1. Protect adjacent and adjoining areas from hydroseeding and hydromulching overspray.
  - 2. Protect grade stakes set by others until directed to remove them.
- B. Install 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.

### 3.3 FERTILIZING

- A. Apply specified fertilizer three (3) weeks after sod installation. Broadcast at rate of 1-1/2 pounds of nitrogen per 1,000 sq. ft. of sod. Water to saturate all fertilized areas immediately after installation.

### 3.4 PREPARATION FOR EROSION-CONTROL MATERIALS

- A. Prepare area as specified in "Turf Area Preparation" Article.
- B. For erosion-control mats, install planting soil in two lifts, with second lift equal to thickness of erosion-control mats. Install erosion-control mat and fasten as recommended by material manufacturer.
- C. Fill cells of erosion-control mat with planting soil and compact before planting.
- D. For erosion-control blanket, install from top of slope, working downward, and as recommended by material manufacturer for site conditions. Fasten as recommended by material manufacturer.
- E. Moisten prepared area before planting if surface is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.

### 3.5 SEEDING

- A. Sow seed with spreader or seeding machine. Do not broadcast or drop seed when wind velocity exceeds 5 mph.
  - 1. Evenly distribute seed by sowing equal quantities in two directions at right angles to each other.
  - 2. Do not use wet seed or seed that is moldy or otherwise damaged.
  - 3. Do not seed against existing trees. Limit extent of seed to outside edge of planting saucer.
- B. Sow seed at a total rate of 8 lb/1000 sq. ft.
- C. Rake seed lightly into top 1/8 inch of soil, roll lightly, and water with fine spray.
- D. Protect seeded areas with slopes exceeding 1:4 with erosion-control blankets installed and stapled according to manufacturer's written instructions.
- E. Protect seeded areas with erosion-control mats where indicated on Drawings; install and anchor according to manufacturer's written instructions.
- F. Protect seeded areas with slopes not exceeding 1:6 by spreading straw mulch. Spread uniformly at a minimum rate of 2 tons/acre to form a continuous blanket 1-1/2 inches in loose thickness over seeded areas. Spread by hand, blower, or other suitable equipment.
  - 1. Anchor straw mulch by crimping into soil with suitable mechanical equipment.

### 3.6 SODDING

- A. During delivery, prior to planting, and during the planting of the lawn areas, the sod panels shall at all times be protected from excessive drying and unnecessary exposure of the roots to the sun

or wind. Deliver sod on pallets. Do not deliver more sod than can be installed within 24 hours of delivery.

- B. After delivery but prior to planting, keep stored sod moist and under shade or covered with moistened burlap. Do not stack sod more than 2' deep, and do not tear, stretch, or drop sod. All sod shall be stacked during construction and planting so as not to be damaged by sweating or excessive heat and moisture.
- C. After completion of soil conditioning as specified above, sod panels shall be laid tightly together so as to make a solid sodded lawn area. On mounds and other slopes, the long dimension of the sod shall be laid perpendicular to the slope. Immediately following sod laying the lawn areas shall be rolled with a lawn roller customarily used for such purposes, and then thoroughly watered.
- D. Bring the sod edge in a neat, clean manner to the edge of all paving and shrub areas. Top dressing with approved, clean, weed free, sand may be required at no additional cost to the OWNER if deemed necessary by the Engineer.

### 3.7 LAWN ESTABLISHMENT

- A. The CONTRACTOR shall produce a dense, well established lawn. The CONTRACTOR shall be responsible for the repair and resodding of all eroded or bare spots until project acceptance. Repair sodding shall be accomplished as in the original work except that fertilizing may be omitted.
- B. Watering:
  - 1. Keep sod uniformly moist for the first two weeks after planting.
  - 2. After two weeks, supplement rainfall to produce total of approximately 1-1/2" of water per week or until sod has fully acclimated.
  - 3. Monitor all newly sodded areas to insure that the manual watering operations are providing sufficient water to sod until acceptance by the OWNER's representative.
- C. Mowing:
  - 1. Sod shall not be mowed for a period of three (3) weeks after installation.
  - 2. The initial mowing should remove approximately 2-inches of leaf but no more than 40% of leaf shall be removed in any single mowing.
  - 3. The SUBCONTRACTOR shall maintain all newly sodded areas until final acceptance by the OWNER's representative. Sod shall be mowed based on the following:
    - a. Argentine bahia: every 14 days, mow to 4-inches.
- D. Re-sod areas larger than 1-square foot not having uniform stand of grass.
- E. Weed Eradication: CONTRACTOR shall be responsible to insure that all newly sodded areas are maintained in a seed-free condition until acceptance by the OWNER's representative. Apply herbicides only upon approval by the OWNER's representative.



- F. The CONTRACTOR's maintenance period shall begin immediately after sod is installed and extend until acceptance by the OWNER's representative.

### 3.8 CLEANUP AND PROTECTION

- A. Promptly remove soil and debris created by turf work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.
- B. Remove surplus soil and waste material, including excess subsoil, unsuitable soil, trash, and debris, and legally dispose of them off Owner's property.
- C. Erect temporary fencing or barricades and warning signs as required to protect newly planted areas from traffic. Maintain fencing and barricades throughout initial maintenance period and remove after plantings are established.
- D. Remove nondegradable erosion-control measures after grass establishment period.

### 3.9 MAINTENANCE SERVICE

- A. Soil should be kept continuously moist, but not too wet, until seed has germinated and become well established. Request final inspection for acceptance when all specified work is completed.
- B. Replace rejected sod areas as directed by the Owner's representative.

END OF SECTION 329200

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## SECTION 330532 – HIGH DENSITY POLYETHYLENE PIPE

### 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 work shall comply and be installed per the latest JEA Water and Wastewater Standards Manual (January 2019 or latest) and the JEA Facilities Standards Manual.

#### 1.2 SUMMARY

- 1. High density polyethylene (HDPE) pipe water and force main sewer pipe and fittings, complete as shown on Drawings and as specified.
  - 2. Pipe or Piping: Refers to all pipe, fittings, material and appurtenances required to construct HDPE water and force main sewer pipe complete, in place.
  - 3. Equipment and materials specified are intended to be standard types used in transporting potable water and sewage.
- B. Related Requirements:
- 1. Section 310515 “Soils and Aggregates for Earthwork” for granular fill.
  - 2. Section 312333 “Trenching and Backfilling.”
  - 3. Section 321216 “Asphalt Paving.”

#### 1.3 COORDINATION

- A. Section 013100 “Project Management and Coordination” for coordination requirements.

#### 1.4 ACTION SUBMITTALS

- A. Section 013300, “Submittal Procedures” for submittals requirements.
- B. Product Data: Name of pipe and fitting manufacturers, materials list furnished by each manufacturer and catalog information for each product.
- C. Shop Drawings:
  - 1. Piping layouts and schedules including dimensioning, fittings, types and locations of valves and appurtenances, and joint details.

## 1.5 CLOSEOUT SUBMITTALS

- A. Section 017700 “Closeout Procedures” for submittals requirements.
- B. Project Record Documents: Document actual locations of installed HDPE piping
- C. Operation and Maintenance Data: per Section 017823.

## 1.6 QUALITY ASSURANCE

- A. Perform Work according to JEA Water and Wastewater Standards manual.
- B. Maintain a copy of each standard affecting Work of this Section on Site.
- C. HDPE pipe shall be from a single manufacturer. Supplier is responsible for provisions of test requirements specified in ASTM D 3034 and NSF 61 as applicable.
- D. Inspections of pipe may also be made by the Engineer or other representatives of the Owner after delivery.
  - 1. Pipe is subject to rejection at any time due to failure to meet any of the requirements specified, even though sample pipes may have been accepted as satisfactory at the place of manufacture.
  - 2. Marked for identification, rejected pipe and removed from job at once.

## 1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum ten years’ experience.
- B. Installer: Company specializing in performing Work of this Section with minimum five years’ experience.

## 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Section 016000, “Product Requirements” for transporting, handling, storing, and protecting products requirements.
- B. Delivery:
  - 1. Bundled or package items to provide adequate protection of ends during transportation to site. Pipe damaged in shipment will be replaced as directed by the Engineer.
  - 2. Where applicable, deliver materials in manufacturer's packaging including application instructions.
- C. Inspection: Accept materials on Site in manufacturer’s original packaging and inspect for damage.

1. Any gouges or scratches that extend 10 percent or more into the pipe wall shall be cause for rejection of that pipe.
2. The undamaged portion may cut off and used.
3. Clearly mark rejected materials as rejected. Segregate and remove from the site.

D. Storage: Per manufacturer's instructions, referenced standards and as specified

1. Adequately support stored pipe from below, at 3 feet (1 m) maximum intervals to prevent deformation. Pipe stored in stacks no higher than that given in the following table or the manufacturer's instructions whichever is more restrictive:
  - a. Pipe Diameter 8 inches (203 mm) or Less: Maximum Number of Rows Stacked: 5
  - b. Pipe Diameter 12 to 21 (305 to 533): Maximum Number of Rows Stacked: 4
  - c. Pipe Diameter 24 to 30 (610 to 762): Maximum Number of Rows Stacked: 3
  - d. Pipe Diameter 33 to 48 (838 to 1220): Maximum Number of Rows Stacked: 2
2. Do not store plastic manholes, pipe, and fittings in direct sunlight.
3. Store in a manner keeping materials at ambient outdoor temperatures.
4. No pipe or fitting is to be exposed to sunlight for more than 60 days.
5. Temporary shading as required to meet this requirement shall be provided.
6. Simple covering of the pipe and fittings which allows temperature buildup, or direct or indirect sunlight, will not be permitted.

E. Protection:

1. Pipe and fittings showing cracks, or which have received a blow that may have caused an incident fracture, even though no such fracture can be seen, are to be marked as rejected and removed at once from the work.
2. Thoroughly clean pipe and fittings before installation. Keep interior clean until testing
3. Store gaskets for mechanical and push-on joints in cool and dry location, out of direct sunlight, and not in contact with petroleum products.
4. Provide additional protection according to manufacturer instructions

## 1.9 EXISTING CONDITIONS

A. Field Measurements:

1. Verify field locations and sizes of connections to existing piping and equipment prior to submitting pipe lay drawings.
2. Document field measurements on Shop Drawings.

## 1.10 WARRANTY

- A. Section 017700 "Closeout Procedures" for warranty requirements.
- B. Furnish one-year manufacturer's warranty for HDPE pipe and fittings.

## PART 2 - PRODUCTS

### 2.1 SYSTEMS

- A. Contractor is responsible for compatibility between pipe materials, fittings and appurtenances.
- B. All force mains 4-inches and smaller shall be HDPE DR11.
- C. All underground reuse water and potable water 4-inches and smaller shall be HDPE DR11.

### 2.2 MATERIALS

- A. HDPE Pipes
- B. Only HDPE, CTS, SDR 11 and DR 11, colored green for force mains, blue for potable water and pantone purple 522C for reuse water will be allowed. HDPE pipe supplied shall minimize the number of joints by the use of HDPE rolls.
  - 1. Connections between ends of the force main shall be accomplished using approved heat fusion techniques.
- C. Connection between the 4" force main and the existing 4" force main shall be accomplished using a typical 4" Stainless Steel service saddle.
- D. If rework compounds are required, only those generated in the manufacturer's own plant from resin compounds of the same class and type from the same raw material supplier shall be used.
- E. The pipe shall be joined with butt, heat fusion joints (HDPE pipe to HDPE pipe) or electrocoupling according to ASTM D3261 or mechanical adapter for valve, fitting, or dissimilar pipe to pipe connections. All joints shall be made in strict compliance with the manufacturer's recommendations.
- F. All HDPE pipe and fittings shall be made from the same resin.
- G. Contractor to provide all fittings, transitions, and appurtenances needed for connections between High Density Polyethylene Pipe and Ductile Iron Pipe.
- H. Compliance with the above requirements must be certified in writing by the pipe supplier.
- I. All HDPE pipe shall be upsized to provide the required internal diameter of PVC and DI pipe unless otherwise specified in the Drawings or Specifications.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. HDPE pipe shall be installed in accordance with the instructions of the manufacturer, as shown on the Drawings and as specified herein. All heat fusion joints shall be done by a factory qualified joining technician as designated by the pipe manufacturer.

- B. Pipe shall be laid to the lines and grade and with bedding and backfill as shown on the Drawings.
- C. When laying is not in progress, including lunchtime, the open ends of the pipe shall be closed by fabricated plugs, or by other approved means. All plugs shall be outside diameter (OD) fitting type plugs. No plugs will be allowed that require insertion of the plug into pipe.
- D. Pipe shall be stored on clean level ground to prevent undue scratching or gouging. The handling of the pipe shall be in such a manner that the pipe is not damaged by dragging it over sharp and cutting objects. The maximum allowable depth of cuts, scratches, or gouges on the exterior of the pipe is 10 percent of wall thickness. The interior pipe surface shall be free of cuts, gouges, or scratches.
- E. Sections of pipe with cuts, scratches, or gouges deeper than allowed shall be removed completely and the ends of the pipeline rejoined.
- F. The pipe shall be joined by the method of thermal butt fusion, as outlined in ASTM D2657. All joints shall be made in strict compliance with the manufacturer's recommendations.
- G. Mechanical connections of the polyethylene pipe to auxiliary equipment such as valves, pumps, and tanks shall be through flanged connections that shall consist of the following:
  - 1. An HDPE flange adapter shall be thermally butt-fused to the pipe end. A Type 316 stainless steel back up ring shall be used in conjunction with the flange adapter.
  - 2. A Type 316 stainless steel back up ring on both sides of the connection shall be used as approved by the Engineer.
  - 3. Type 316 stainless steel bolts and nuts as specified in ASTM A726 and ASTM A307.
- H. Flange connections shall be provided with a full-face viton or teflon gasket.
- I. All HDPE pipe must be at the temperature of the surrounding soil at the time of backfilling and compaction.

### 3.2 INSPECTION AND TESTING

- A. All pipelines shall remain undisturbed for 24 hours to develop complete strength at all joints. Prior to backfilling, all pipelines shall be blown out and cleared of all sand and construction debris. All leaks shall be repaired as approved by the Engineer.
- B. Any material showing the slightest leakage (aside from drilled perforations) or structural and/or installation deficiencies shall be replaced as directed by the Engineer at no additional cost to the Owner.
- C. Pipeline Testing
  - 1. General – Hydrostatic testing shall consist of a pressure test and leakage test. Hydrostatic tests shall be conducted on all newly laid pressure pipes, joints, hydrants and valves including all service lines to the curb stops. Air testing of pressure pipes shall not be permitted under any circumstance. Tests shall be made on sections not exceeding 3,000 feet. Contractor shall furnish all necessary equipment and material, make all taps, and furnish all closure pieces in the pipe as required. Equipment to be furnished by the Contractor shall

include graduated containers, pressure gauges, hydraulic force pumps, and suitable hoses and piping. The Owner or their designated representative shall monitor and approve a satisfactory test. The basic provisions of ASTM F2164 – “Standard Practice for Field Leak Testing of Polyethylene (PE) Pressure Piping Systems Using Hydrostatic Pressure” shall apply.

2. The Contractor may conduct hydrostatic tests after the trench has been partially backfilled with the joints left exposed for inspection for his informational purposes only. The hydrostatic tests for acceptance shall only be conducted after the trenches have been completely backfilled and compacted as specified.

- a. Testing Criteria – All pipe sections to be pressure tested shall be subjected to a hydrostatic pressure no more than the pressure rating printed on the pipe. Force main pipes will be tested at 100 psi. Water main pipes will be tested at 150% of operating pressure or 150 psi, whichever is greater, never to exceed the pressure rating printed on the pipe. Reclaimed water mains will be pressure tested at 150% of operating pressure or 150 psi, whichever is greater, never to exceed the pressure rating printed on the pipe. If there is multiple pressure rated pipes or pipe material types on the project, it will be the Contractor’s responsibility to isolate the different pipes from each other. The duration of each pressure test shall be a maximum of eight (8) hours including time to pressurize, time for initial expansion, time at test pressure, and time to depressurize the test section. If during the test, the integrity of the tested line is in question, the Owner may require other pressure tests at no expense to the Owner. All line valves shall be hydrostatically tested for 15 minutes to ensure tight seal when closed.
- b. Initial Expansion Phase – Each section of pipe to be tested, as determined by the Owner, shall be slowly filled with water, and the specified test pressure shall be applied by means of a pump connected to the pipe in a satisfactory manner. Before applying the specified test pressure, all air shall be expelled from the pipe. To accomplish this, taps shall be made and appropriate valves installed to ensure bleeding of all air from the main. During the initial expansion phase, gradually pressurize the test section to test pressure and maintain the test pressure for three (3) hours; continue to add water to the test section to account for the expansion of the pipe. If defective pipes, fittings, valves, or hydrants are discovered during the pressure test, all such items shall be removed and replaced by the Contractor with sound material, and the test shall be repeated until satisfactory results are obtained. Prior to scheduling the Owner witnessed pressure test, the Contractor shall preliminarily test the main to ensure it will pass when the Owner is present.

- D. Failed Tests - If a section fails to pass the tests, the contractor shall locate, uncover, and replace the defective pipe, valve, fitting, or joint. Visible leaks shall be corrected regardless of total leakage. Lines which fail to meet these tests shall be retested as necessary. All testing and retesting shall be performed at the Contractor’s expense

### 3.3 CLEANING

- A. At the conclusion of the work, thoroughly clean all of the new pipelines to remove all dirt, stones, pieces of wood, or other material that may have entered during the construction period.



- B. Debris cleaned from the lines shall be removed from the job site. If, after this cleaning, any obstructions remain, they shall be removed.

#### 3.4 PROTECTION

- A. Section 017300 “Execution” for protecting finished Work requirements.

END OF SECTION 330532

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## SECTION 331310 - DOUBLE CONTAINMENT CHEMICAL 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.
- B. All Work shall be in accordance with latest JEA Water and Wastewater Standards (January 2019 or latest)

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Double containment chemical piping.
- B. Related Requirements:
  - 1. Section 312333 "Trenching and Backfilling"

#### 1.3 ACTION SUBMITTALS

- A. Submit, in accordance with Section 013300, shop drawings and product data including the following:
  - 1. Shop drawings including piping layouts and schedules shall be submitted to the Owner and Engineer and shall include dimensioning, fittings, types and locations of valves and appurtenances, joint details, methods and locations of supports, anchorage, grade of material and all other pertinent technical information for all items to be furnished.
  - 2. Shop drawing submittals for piping under this Section shall include all data and information required for the complete piping systems. All dimensions shall be based on the actual equipment to be furnished.

#### 1.4 REFERENCE STANDARDS

- A. American Society for Testing and Materials (ASTM)
  - 1. ASTM D1784 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
  - 2. ASTM D1785 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80 and 120.
  - 3. ASTM D2466 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
  - 4. ASTM D2467 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.

5. ASTM D2564 - Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems.
6. ASTM D2855 - Standard Practice for Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings.
7. ASTM F438 - Standard Specification for Socket-Type Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40.
8. ASTM F439 - Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.
9. ASTM F441 - Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80.
10. ASTM F493 - Standard Specification for Solvent Cements for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe and Fittings.
11. ASTM3222 - Standard Specification for National, Unpigmented, Virgin Polyvinylidene Fluoride (PVDF) Homopolymer.

- B. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

## 1.5 QUALITY ASSURANCE

- A. All double walled plastic pipe and fittings shall be a prefabricated system furnished by a single manufacturer who is experienced in the manufacture of the items to be furnished. The pipe and fittings shall be designed, constructed and installed in accordance with the best practices and methods and shall be suitable for the intended service.

## 1.6 QUALIFICATIONS

- A. Water Treatment Firm: Company specializing in disinfecting potable water systems specified in this Section with minimum ten years' documented experience.

## 1.7 SYSTEM DESCRIPTION – SODIUM HYPOCHLORITE

- A. Double walled piping systems shall be installed in those locations as shown on the Drawings.
- B. The equipment and materials specified herein are intended to be standard types of plastic pipe and fittings for use in transporting chemicals.
- C. Double walled piping systems shall be designed for the following chemical systems:

System:	Chemicals – Sodium Hypochlorite
Carrier Pipe and Fittings Material:	Schedule 80 PVC
Containment Pipe and Fittings Material:	Schedule 80 PVC Pipe and Fittings
Fluids:	15 % sodium hypochlorite

Pressure:	Atmosphere to 100 psig
Flow Velocity:	Up to 7 fps
Temperature:	35 to 100 degrees F

## 1.8 DELIVERY, STORAGE AND HANDLING

- A. All items shall be bundled or packaged in such a manner as to provide adequate protection of the ends during transportation to the site. Pipes and fittings damaged in shipment shall be replaced as directed by the Engineer.
- B. PVC items deteriorate in sunlight and are slightly brittle, especially at lower temperatures, so care shall be taken in loading, transporting and unloading items to prevent injury to the items. All items shall be examined before installation and no piece shall be installed which is found to be defective. Handling and installation of pipe and fittings shall be in accordance with the manufacturer's instructions, referenced standards and as specified herein.
- C. Pipe and fittings shall be stored in a manner that will keep them at ambient outdoor temperatures and out of sunlight. Temporary shading as required to meet this requirement shall be provided. Simple covering of the pipe and fittings that allows temperature buildup or direct or indirect sunlight will not be permitted.
- D. Any pipe or fitting showing a crack or which has received a blow that may have caused an incident fracture, even though no such fracture can be seen, shall be marked as rejected and removed at once from the work.

## PART 2 - PRODUCTS

### 2.1 GENERAL

- A. All buried chemical piping, fittings, and valves shall be a prefabricated double wall containment piping system.
- B. The sodium hypochlorite double wall piping system shall consist of Schedule 80 PVC primary piping system supported within a Schedule 80 PVC secondary containment housing.

### 2.2 PRIMARY CARRIER PIPE AND FITTINGS

- A. PVC and CPVC pipe and fittings for the buried pressurized chemical carrier pipes for the chemical systems shall be Schedule 80.

## 2.3 SECONDARY CONTAINMENT PIPING AND FITTINGS

- A. Containment pipe and fittings shall be based on the size of the primary carrier pipe as follows:

Carrier Pipe <u>Diameter</u>	Containment Pipe <u>Diameter</u>
½-in	2-in
¾-in	3-in
1-in	3-in
1- ½ -in	4-in
2-in	4-in

- B. The double walled chemical piping system shall be Guardian as manufactured by IPEX USA, LLC, New Baltimore, MI, or approved equal.

- C. Secondary Containment Pipe

1. PVC secondary containment pipe shall be manufactured from PVC compounds meeting ASTM D1784, Class 12454-B. The pipe shall be manufactured in accordance with ASTM D1785, PVC 1120. The pipe shall have a minimum hydrostatic design stress of 2,000 psi at 73 degrees F and shall be suitable for field cutting and solvent welding. Pipe shall be of the sizes indicated above and shall be Schedule 80 unless otherwise shown.
2. The CPVC secondary containment pipe and fittings shall be manufactured from CPVC compounds meeting ASTM D1784, Class 23447. Pipe shall be manufactured in accordance with ASTM F441, CPVC 4120. The pipe shall have a minimum hydrostatic design stress of 2000 psi at 73 degrees F and 500 psi at 180 degrees F and shall be suitable for field cutting and solvent welding. Pipe shall be of the sizes indicated on the Drawings and shall be Schedule 80.
3. Solvent cement for CPVC piping shall be as specified in ASTM F493. Solvent cement for PVC piping shall be as specified in ASTM D2564. Solvent cements shall be suitable for installation of lines for Sodium Hypochlorite applications.
4. The burst pressure of fittings shall be not less than the burst pressure of the size and thickness of the pipe with which it is to be used in accordance with ASTM D2467.

- D. Secondary Containment Fittings.

1. Double wall containment fittings shall be prefabricated. Splitting and rewelding of fittings and two piece gasketed fittings will not be accepted.
2. Interstitial supporting devices used to center and support the primary piping and fittings within the secondary containment piping and fittings shall be PVC for the PVC piping and CPVC for the CPVC piping and shall be installed prior to delivery of the pipe and fittings. The spacers shall be designed to permit the carrier and containment pipes to expand and contract without stress or wear on the pipes as well as provide for drainage and free air circulation.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. See Section 017300 "Execution" for installation examination requirements.

- B. Verify that piping system has been cleaned, inspected, and pressure tested.
- C. Perform scheduling and disinfecting activity with startup, water pressure testing, adjusting and balancing, and demonstration procedures, including coordination with related systems.

### 3.2 INSTALLATION

- A. Provide and attach required equipment to perform Work of this Section. Closely coordinate efforts with Owner for maintenance of site operations and for testing services.
- B. Flush, circulate, and clean until required cleanliness is achieved using municipal domestic water.
- C. Pipe spacers shall be attached to the carrier pipe every three feet prior to the installation on the containment piping. The spacers shall be designed to permit the carrier and containment pipes to expand and contract without stress or wear on the pipes as well as provide for drainage and free air circulation. Lay out the system, cut and dry fit the carrier piping, then place the containment pipe over the carrier pipe before joining. The containment pipe must be installed over the carrier pipe as the system is being assembled.
- D. If any defective pipe is discovered after it has been installed, it shall be removed and replaced with a sound pipe in a satisfactory manner at no additional cost to the Owner. All pipe and fittings shall be thoroughly cleaned before installation, shall be kept clean until they are used in the work and when laid, shall conform to the lines and grades required.
- E. Joints for PVC and CPVC pipe shall be solvent welded. In making solvent welded connections, clean dirt and moisture from the pipe, bevel pipe ends slightly with emery cloth to remove any shoulder or burrs created by the cutting of the pipe. Solvent welded joints shall be made in accordance with ASTM D2855 except that solvent cement formulated especially for and as specified above shall be used for joining CPVC pipe. Primer shall be used whenever recommended by the pipe manufacturer and in all cases for joints on the pipe systems 4-in in diameter or larger. IPS Weldon #724 Heavy bodied grey CPVC/PVC cement formulated for improved chemical resistance to caustics including Sodium Hypochlorite shall be used as manufactured by IPS Corporation Compton, CA or equal for installation of lines for Sodium Hypochlorite applications. Primer shall be used whenever recommended by the pipe manufacturer and in all cases for joints on the pipe systems 4-inch in diameter or larger.

### 3.3 FIELD QUALITY CONTROL

- A. See Section 017300 "Execution" for testing, adjusting, and balancing requirements.
- B. Field Testing- PVC and CPVC Pipe Systems
  - 1. All pipelines shall remain undisturbed for the minimum curing time specified for each type of pipe material but no less than 24 hours to develop full curing and complete strength at all joints. Primary carrier pipe systems shall be flushed clean and then subjected to a hydrostatic pressure test as required by St. Johns County Utility Department Standards and Specifications.
  - 2. After testing of the carrier pipe, the containment system shall be tested pneumatically at 5 psi for a duration of 2 hours prior to backfilling. All containment piping joints shall be checked for leaks by applying a soapy solution to the joints. Furnish all necessary

- equipment and labor to perform the air test, including air compressor, gauges, conduit caps, temporary pipe and connections, etc and complete the test to the satisfaction of the Owner and Engineer.
3. After backfilling is completed, a 5 psig air test of the containment pipe shall be conducted to the satisfaction of the Owner and Engineer.
  4. All leaks detected during the pressure test shall be repaired and the pressure/temperature test rerun.
  5. Prior to testing, the pipelines shall be supported in an approved manner to prevent movement during the tests.
  6. The Contractor shall notify the Owner a minimum of 48 hours prior to testing of containment and carrier pipe.

END OF SECTION 331300



## SECTION 333216.13 - PACKAGED SEWAGE GRINDER PUMPING UNITS

### PART 1 GENERAL

#### 1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required and install new prefabricated sewage grinder pump station including submersible wastewater grinder pumps, fiberglass fabricated wet well and valve vault, tankage, valves, motors, service entrance access ways, control panels, and other auxiliary equipment and materials as specified herein.
- B. The Contractor shall be responsible for furnishing and installing the complete grinder pump station units including pump control panel, wet well, valve vault, basin, concrete ballast, pumps, controls, wiring, etc., as specified herein, as shown on the Drawings and as directed by the Engineer.
- C. These Specifications are intended to give a general description of what is required, but do not purport to cover all details which will vary in accordance with the requirements of the equipment as offered. It is, however intended to cover the furnishing, the shop testing and delivery of all materials, equipment and appurtenances for the complete pumping units as herein specified, whether specifically mentioned in these specifications or not.
- D. For all units there shall be furnished all necessary and accessory equipment and auxiliaries as required to provide a complete, operating grinder pump station whether specifically mentioned in these Specifications or not.

#### 1.02 RELATED WORK

- 1. Section 033000 - Cast-in-Place Concrete: Requirements for anti-flotation collar.
- 2. Section 310515 – Soils and Aggregates for Earthwork: Wet well bedding, ballast, and backfill materials.
- 3. Section 312323 - Fill: Backfilling requirements.
- 4. Section 409513 - Process Control Panels and Hardware: Hardware requirements for pump control panel.

#### 1.03 SUBMITTALS

- A. Submit copies of all materials required to establish compliance with this Section. Submittals shall include the following:
  - 1. Certified shop and erection drawings showing all important details of construction, dimensions and anchor bolt locations.
  - 2. Descriptive literature, bulletins, and/or catalogs of the equipment.
  - 3. Data on the characteristics and performance of each pump. Data shall include guaranteed performance curves, based on actual shop tests of similar units, which show that they meet the specified requirements for head, capacity, efficiency, NPSHR, and horsepower. Curves shall be submitted on 8½-inch by 11-inch sheets, at as large a scale as is practical. Curves shall be plotted from no flow at shut off head to pump capacity at minimum specified total head. Catalog sheets showing a family of curves will not be acceptable.
  - 4. The total weight of the equipment including the weight of the single largest item.

5. A complete total bill of materials for all equipment.
  6. A list of the manufacturer's recommended spare parts with the manufacturer's current price for each item. Include gaskets, packing, etc. on the list. List bearings by the bearing manufacturer's numbers only.
  7. Certified agreement to the conditions of the warranty.
  8. Complete motor data in accordance with Section 16150.
  9. Complete control panel data.
  10. Anti-floatation calculations
  11. All submittal data required by the General Conditions.
- B. In the event that it is impossible to conform with certain details of this Section due to different manufacturing techniques, describe completely all nonconforming aspects. Nonconforming details not due to manufacturing techniques shall not be considered under this provision.
- C. Operation and Maintenance Data
1. Copies of an operating and maintenance manual for grinder pumping station shall be furnished to the Owner. The manuals shall be prepared specifically for this installation and shall include all required cuts, drawings, equipment lists, descriptions, etc, that are required to instruct operating and maintenance personnel unfamiliar with such equipment.
  2. A factory representative, who has complete knowledge of proper operation and maintenance, shall be provided for one 8-hour day to instruct representatives of the Owner on proper operation and maintenance. If there are difficulties in operation of the equipment due to the manufacturer's design or fabrication, additional service shall be provided at no additional cost to the Owner.

#### 1.04 REFERENCE STANDARDS

- A. Underwriters Laboratories (UL)
- B. National Sanitation Foundation (NSF)
- C. National Electric Manufacturers Association (NEMA)
- D. National Electrical Code (NEC)
- E. Occupational Safety and Health Administration (OSHA)
- F. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.
- G. Hydraulic Institute (HI)

#### 1.05 QUALITY ASSURANCE

- A. To assure unity of responsibility, the pump Manufacturer shall be responsible for the entire pumping system including wet wells, pumps, motors, guide rails and electrical controls as specified. The equipment furnished hereunder shall be the product of a company experienced in the design, manufacture and assembly of grinder pumping system specifically intended for use in low pressure sewage systems. All manufacturers proposing equipment for this project shall have at least five years of experience in the design and manufacture of units which are

mechanically similar to the specified units and of the same size. Furthermore, the manufacturer shall provide evidence of an established service support program including parts lists, service manuals and a continuing inventory of grinder pump replacement parts. The manufacturer shall also submit an installation list of not less than 20 installations with contact persons, phone numbers and dates of installation. An installation is defined as multiple pumps discharging into a common force main forming a low pressure sewer system or multiple pumps discharging into a common gravity sewer.

#### 1.06 SYSTEM DESCRIPTION

- A. All of the pumps and motors shall be by one manufacturer. All working parts shall be of standard dimension so that replacement parts and repairs can be obtained in the future. All parts shall be properly stamped for identification and location as shown on the Operation and Maintenance manuals furnished. Nameplates giving the name of the manufacturer, the rated capacity, head, speed and all other pertinent data shall be attached to each pump and motor.
- B. The grinder pumping station shall consist of a fiberglass wet well, readily accessible duplex submersible wastewater grinder pumps, controls, electronic monitoring panel with status indicators, discharge piping, valves, a valve vault and appurtenances as specified herein and shown on the Drawings.
- C. The pumps will take suction from the new grinder pump wet-well with water level variation and pump level settings as shown on the Drawings.
- D. The pumps shall be capable of handling raw, unscreened sewage. The pumps shall have a discharge connection which will allow the removal of the pumps from the basin without the need for personnel to enter the basin.
- E. The grinder pumps shall be installed as shown on the Drawings. The layout of the pumps has been made using the arrangement and dimensions recommended by one Manufacturer. The selection of the equipment is not limited to the product of one Manufacturer. If the equipment provided requires an arrangement of dimensions different from those indicated on the Drawings, the equipment supplier shall prepare and submit Drawings showing all necessary changes to Engineer for review. Such changes, including work, accessories, controls, etc. to accommodate the equipment, shall be made with no additional cost to Owner. The arrangement and dimensions of the equipment provided shall be in accordance with Manufacturer's recommendations.

#### 1.07 DELIVERY, HANDLING AND STORAGE

- A. All components shall be carefully packaged and properly protected so that no damage or deterioration will occur in transit or during a prolonged delay between the time of shipment and installation.
- B. Factory tested and assembled parts and components shall not be dismantled for shipment or during storage.
- C. Finished surfaces of all exposed pump openings shall be protected by sturdy wooden blanks, strongly built and securely bolted thereto.

- D. Finished iron or steel surfaces not painted shall be properly protected to prevent rust and corrosion.
- E. After hydrostatic or other factory tests have been completed, all entrapped water shall be drained from all pumps, piping and tankage prior to shipment and proper care shall be taken to protect parts from the entrance of water during shipment, storage and handling.
- F. Each box or package shall be properly marked to show its net weight in addition to its contents.

#### 1.08 MAINTENANCE

- A. A complete set of manufacturer's recommended spare parts shall be provided with each pump.
- B. Provide three spare core units including grinder pump, motor, controls, check valve, and wiring.
- C. All spare parts and tools shall be properly protected for long periods of storage and packed in containers which are clearly identified with indelible markings as to the contents.
- D. One volt/ohm meter and two sets of all wrenches, extensions, tools or other items needed to remove the pumping units for repair shall be provided. Tools and equipment provided under this Section shall be suitable for removing the equipment without the need to enter the pump chambers.

#### 1.09 WARRANTY

- A. The manufacturer shall provide a transferable warranty guarantying its product to be free from defects in material and factory workmanship for a period of one year from date of substantial completion as agreed to by the Engineer and Owner, provided the product is properly installed, serviced and operated under normal conditions and according to the manufacturer's instructions. Repair or parts replacement required as a result of such defect will be made free of charge during this period upon return of the defective parts or equipment to the manufacturer or its nearest authorized service center.
- B. The Contractor shall be responsible for the cost of extending the start of the warranty period from the date of shipment to the date of substantial completion.

### PART 2 PRODUCTS

#### 2.01 MATERIALS AND EQUIPMENT

- A. The pumps and equipment covered by these Specifications are intended to be standard pumping equipment of proven ability as manufactured by reputable concerns having experience in the production of such pumps and equipment. The pumps and equipment furnished shall be designed and constructed in accordance with the best practice and methods.
- B. All parts shall be so designed and proportioned as to have liberal strength and stiffness and to be especially adapted for the work to be done. Ample room and facilities shall be provided for inspection, repairs and adjustment.

- C. Stainless steel nameplates giving the name of the manufacturer, the rated capacity, head, speed, serial number, model number horsepower, voltage, amperes and all other pertinent data shall be attached to each pump.

## 2.02 SUBMERSIBLE GRINDER PUMPS

### A. General

1. The pumps shall be of the totally submersible grinder type designed to pump raw unscreened wastewater. The pumping units required under this section shall be complete including pumps and motors with proper alignment and balancing of the individual units. All parts shall be so designed and proportioned as to have liberal strength, stability, and stiffness and to be especially adapted for the work to be done. Ample room shall be provided for inspection, repairs, and adjustments.
2. The pumps shall be as manufactured by Flygt, KSB, Myers, Barnes or Hydromatic, in accordance with JEA Water and Wastewater Standards Manual, latest edition.
3. The pumps shall be standard dimensions such that parts will be interchangeable between like units and all units shall be supplied by the same Manufacturer.
4. The pumping equipment Manufacturer shall be responsible for all patents or licenses that exist because of the equipment that may be provided.
5. Manufacturer shall assume all costs of patent fees or licenses for the equipment or process and shall safeguard and save harmless Owner from all damages, judgments, claims and expenses arising from license fees, or claimed infringement of any letters, patent or patent rights or fees for the use of any equipment or process, structural feature or arrangement of any of the component parts of the installation, and the price bid shall be deemed to include payment of all such patent fees, licenses of other costs pertaining thereto.
6. Pump discharge shall be equipped manufacturer recommended check valves and ball valves in the locations as shown on the Drawings. Ball valves shall be 25% reduced port when fully open.
7. Motors shall come equipped with inherent protection against running overloads or locked rotor conditions

### B. Performance Requirements

1. When operating at the design output speed, each pump shall have a characteristic performance curve which meets all the minimum conditions listed in Table 11302-1. The pumps and drive motors shall be capable of operating satisfactorily under the full range of conditions as defined by Table 1. The intermediate pump capacity, head and efficiency defined in Table 1 shall be the "design point". Pump efficiency as defined herein takes into consideration all losses from the pump intake suction bell to the pump discharge connection.
2. There shall be no significant change in vibration and noise level over the entire listed range of flow for the pumping system.
3. Maximum motor speeds shall not exceed those listed in Table 1 to satisfy the specified hydraulic duty requirements. The pump "design speeds" shall be the motor output speed when operating at the pump "intermediate" capacity and head.
4. With the pumping units operating at full motor speed, the maximum brake horsepower required by the pumps shall not exceed the maximum horsepower listed in Table 1. If the pumping units require more than the maximum horsepower listed in Table 1 at the motor output shaft at any full motor speed operation point they will be rejected.

### C. Grinder Pump Construction

1. The pump and motor housing shall be cast iron with all parts coated with a sewage resistance coating. All exposed hardware shall be of Type 300 stainless steel. All mating surfaces where watertight sealing is required shall be machined and fitted with gaskets.
2. The pump shall be of the centrifugal type with the rotating cutter mounted on the pump shaft directly against the impeller. The stationary cutter shall be mounted in an adjustable bottom plate. The bottom plate shall be cast with grooves threading outward from the center opening of the plate to the outer diameter for grit handling. The impeller shall be a vane centrifugal type. The cutter material shall be primarily type 440C stainless steel with the addition of cobalt, vanadium and molybdenum for abrasion resistance. The cutter shall have a Rockwell C hardness of 58 - 62.
3. The common pump and motor shaft shall be Type 420 stainless steel supported by a heavy duty double row ball bearing and an upper sealed single row ball bearing. The cutting element shall be designed to keep overhung load distance to a minimum. All fasteners shall be Type 300 stainless steel.
4. Each pump shall be equipped with two seals. The lower shall be of the mechanical type with silicon carbide faces. The entire mechanical portion shall be enclosed in a Buna N boot to prevent solids from collecting in the mechanical portion. The seals shall require neither maintenance nor adjustment and shall be easily replaced.
5. The seals shall be separated by an oil chamber. An electronic probe shall be provided in the oil chamber to detect the leakage of water into the chamber.
6. The pump shall be removed from the basin by means of a 2-inch diameter type 304 stainless steel guide rail system and stainless steel cable. The removal shall be such that Owner 's personnel may remove the pump without draining or entering the basin. Each pump shall be supplied with a stainless steel lifting cable fastened to the pump and secured to the access cover. The cables shall be of a sufficient size to support the weight and force required to remove the pumps from the wet well.
7. Pump motors shall be explosion proof and shall be housed in a watertight casing and shall have Class F insulated windings which shall be moisture resistant. Motors shall be NEMA Design B rated 130°C maximum. Motors shall be equipped with an oil chamber moisture detector installed according to NEC standards. Motors shall be suitable for a Class I, Division 1, Group D hazardous location. Motor characteristics are noted in Table 333250-1. Pump motors shall have cooling characteristics suitable to permit continuous operation in a totally, partially or non-submerged condition. Each motor shall incorporate an ambient temperature compensated overheat sensing device and moisture sending device. The protective devices shall be wired into the pump controls in such a way that it either device operates the pump will shut down. The devices shall be self-resetting. The cable shall be fixed to the pump using a watertight trumpet assembly. The pump shall be capable of running continuously in a totally dry condition under full load without damage for extended periods. Before final acceptance, a field running test demonstrating this ability with at least 2 hours of continuous operation under the above conditions shall be performed for all pumps being supplied, if required by Owner. Pump motor cables shall be suitable for submersible pump applications and shall be properly sealed.
8. Each pumping unit and its driving equipment shall be designed and constructed to withstand the maximum turbine run-away speed of the unit due to back flow through the pump.
9. For Performance Requirements refer to Table 1.

2.03 VALVES AND PIPING

- A. A flanged-end full body swing check valve rated for 200 psi shall be inserted in the discharge line of each pump near the wastewater force main as shown on the Drawings. The valves shall be as manufactured by Val-Matic or equal.
- B. Furnish valves shown on the drawings in accordance with JEA Water and Wastewater Standards Manual, latest edition.

2.04 PUMPING STATION FIBERGLASS WET WELL

- A. An unobstructed sign shall be posted near the wet well with a telephone number for a point of contact in case of emergency. The sign shall be made of a durable weather resistant material and installed at an unobstructed and visible location.
- B. Wet wells shall be of one-piece, monolithic construction capable of withstanding live loads of 250 pounds per square foot, vertical earth loads based on 120 pounds per cubic foot unit weight of the soil, and lateral earth pressure loads of 90 pounds per cubic foot. No vertical seams or joints shall be allowed.
- C. Interior Surfacing Material: The inner surface exposed to the chemical environment shall be a resin-rich layer of 0.010 to 0.020 in. thick. The inner surface layer exposed to the corrosive environment shall be followed with a minimum of two passes of chopped roving of minimum length 0.5 in. to maximum length of 2.0 in. and shall be applied uniformly to an equivalent weight of 3 oz/ft<sup>2</sup>. Each pass of chopped roving shall be well-rolled prior to the application of additional reinforcement. The combined thickness of the inner surface and interior layer shall not be less than 0.10 in.
- D. Wall Construction Procedure: After inner layer has been applied, the Fiberglass wet well wall shall be constructed with chop and continuous strand filament wound manufacturing process for continuous reinforcement and uniform strength and composition. Seams shall be fiberglassed on the inside and the outside using the same glass-resin jointing procedure at the place of manufacture.
- E. The wet well shall have flat top as indicated on the drawings. The entrance riser shall have at least a 3-inch high reinforcement collar and a 4-inch min. width flat surface, at the top of the cast-in-place concrete.
- F. The pump Manufacturer shall furnish wet well access covers and frames as shown on the plans. The cover shall be made of aluminum with ¼" diamond plate finish. The cover shall have a single leaf flush fitting access door which opens to 90 degrees and locks open. Hinges and all fastening hardware shall be stainless steel. The cover shall be capable of bearing a live load of 300-pounds per square foot. The access leaf shall be equipped with a padlock hasp.
- G. The wet well shall be furnished with a 3-inch diameter tank vent as shown on Drawings.
- H. The fiberglass wet well shall be legibly waterproof marked with the name of the Manufacturer, the date of the wet well manufacture, and the mark number of the wet well on both the inside and outside of the wet well.

- I. Fiberglass wet well shall be anchored into a concrete base and shall have an antiflotation anchor ring or rings provided around the bottom of the fiberglass wall. The antiflotation (ballast) system shall be designed by the pump manufacturer and signed and sealed by an engineer licensed in the State of Florida. Factor of safety for flotation resistance shall be 1.10 for the dead load with the flood elevation at the top of the structure. The antiflotation system shall be designed in accordance with the geotechnical exploration details as described in the geotechnical report provided in paragraph 1.02.

## 2.05 PUMP CONTROL SYSTEM

### A. General

1. The control panel shall be designed for 480 volt, 3-phase, 60 Hz power supply service.
2. The control panel shall be constructed by a UL approved shop, be UL 508A/698A listed, and bear a UL label.

### B. Operation Requirements

1. The control panel shall consist of a main circuit breaker, a motor circuit breaker and magnetic starter for each of the two pump motors, and 15A, 120 volt branch circuit breakers as required. The control panel will be designed to operate the pumps with all control components mounted in one common enclosure. Control switches (Hand-Off-Auto) shall provide the means to operate each pump manually or automatically. Pump run lights and elapsed time meters, and pilot lights for control power on and for all fault conditions shall be provided.
2. When the control switches are in the "Auto" position pump control shall be through level float switches and a duplex alternator in a lead/lag configuration. Four float switches shall be provided as follows: Pumps off, Lead Pump On, Lag Pump On, and High Level. Float switches shall be powered through a 120/24VAC control power transformer.
3. Upon a high level condition, a separate deadfront panel light will illuminate, an alarm will be sent to the SCADA system of the plant.

### C. Construction:

1. The electrical control equipment shall be mounted within a pad-lockable NEMA Type 4X dead-front enclosure, constructed of 316 stainless steel and shall be equipped with a 3-point latch with all hardware and exterior components constructed of 316 stainless steel. The enclosure shall be equipped with an aluminum inner door and shall incorporate a removable aluminum back panel on which control components shall be mounted. Back panel shall be secured to enclosure with collar studs. Interior door shall be provided with locking feature to hold door open.
2. Components:
  - a. All motor branch circuit breakers, motor starters and control relays shall be of highest industrial quality, securely fastened to the removable back panels with screws and lock washers. Back panels shall be tapped to accept all mounting screws. Self-tapping screws shall not be used to mount any component.
  - b. A thermal-magnetic air circuit breaker, Type FH (65KAIC) as manufactured by Square D Company, or equal, shall be furnished for each motor and main breaker. All circuit breakers shall be sealed by the Manufacturer after calibration to prevent



- tampering. Each circuit breaker shall be adequately sized to meet the motor operating conditions.
- c. A mechanical disconnect mechanism shall be installed on each circuit breaker to provide a means of disconnecting power to the motors. These shall be pad-lockable in the "OFF" position.
  - d. An open frame, across-the-line, NEMA rated, magnetic motor starter, Class 8536 as manufactured by Square D Company, or equal, shall be furnished for each motor. All motor starters shall be equipped to provide under-voltage release and overload protection on all phases. Motor starter contacts shall be easily replaceable without removing the motor starter from its mounted position. Overload reset push-buttons shall be located on the exterior of the inner compartment door.
  - e. A duplex GFCI utility receptacle providing 120 volts, 60 Hertz, single phase current shall be mounted inside the enclosure.
  - f. Phase monitors shall be Diversified Electronics Model No. SLA-240-ALE automatic reset type.
  - g. Surge protective device.
  - h. The control diagrams and overload tables shall be laminated to the inside of the exterior door.
  - i. Print storage pockets shall be provided on the inside of the panel. Pocket shall be of sufficient size as required to hold all prints necessary to service the equipment. A set of reduced drawings shall be provided for each panel, sized to fit in the storage pocket.
  - j. All exterior mounted equipment shall be NEMA 4X rated.
  - k. All control panel wiring shall be numbered at both ends with typewritten heat shrinkable wire markers.
  - l. Wiring shall be stranded copper, minimum size #14 AWG (except for shielded instrumentation cable), with 600 volt, 90 degree C, flame retardant, Type MTW thermoplastic insulation.
  - m. All foreign voltage control wiring shall be yellow.
  - n. The control panel shall be provided with nameplates identifying each component, selector switches, pilot lights, etc. Nameplates shall be permanently affixed using an epoxy process (inner door nameplates shall be fastened with stainless steel screws). Nameplates shall be laminated plastic, engraved white letters with a black background unless noted otherwise.
  - o. The control panel shall be provided with a master nameplate located on the exterior door.
  - p. Corrosion Inhibitor Emitter: Inclusion of an industrial corrosion inhibitor emitter that shall protect internal components of control panel from corrosion for up to one year. One spare emitter shall be provided for each control panel.
  - q. All control relays shall be provided with LED indicators to show relay status.
  - r. Control power transformer shall be as required for the application.
  - s. Intrinsically safe relays shall be Gems SAF-PAK, Crouse-Hinds SA or SB Series, or approved equal.
  - t. Provide low voltage surge protection for all I/O signals, EDCO or approved equal.
  - u. The completed control panel assembly shall be U.L. certified. The minimum overall short-circuit withstand rating of the control panel and devices shall be 65,000 Amperes RMS symmetrical at 480 volts.

3. Operating Controls and Instruments:

- a. All operating controls and instruments shall be securely mounted on the inner deadfront door unless otherwise specified. All controls and instruments shall be clearly labeled to indicate function.
- b. Mode selector switches shall be Hand-Off-Auto type to permit over-ride of automatic control and manual actuation or shutdown of the motors. Operation of motors in manual mode shall bypass all safety shutdown circuits except motor overload shutdown. Switches shall be NEMA 4X full size operators as manufactured by Square D, Class 9001, Type K, providing three switch positions, each of which shall be clearly labeled according to function.
- c. Indicator lamps shall be LED full voltage type and mounted in NEMA 4X (800H) modules, as manufactured by Allen-Bradley or SKPI as manufactured by Square D. Lamp modules shall be equipped to operate at 24 or 120 volt input. Lamps shall be easily replaceable from the front of the inner compartment door without removing lamp module from its mounted position.
- d. A six digit, non-reset elapsed time meter shall be connected to each motor starter to indicate the total running time of each in "hours" and "tenth of hours."
- e. Provide the following dry contact remote outputs to the plant SCADA system:
  - 1) Pump No. 1 Running
  - 2) Pump No. 1 Fault
  - 3) Pump No. 1 In Auto
  - 4) Pump No. 2 Running
  - 5) Pump No. 2 Fault
  - 6) Pump No. 2 In Auto
  - 7) High Level Alarm
  - 8) Control Panel Power Fail

D. Floats

1. Pumps shall be controlled using float assemblies as shown on the Drawings. Floats shall be mercury-free Anchor Scientific Eco-Float or equal.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Installation shall be in strict accordance with Manufacturer's instructions and recommendations in the locations shown on the Drawings. Installation shall include furnishing the required oil and grease for initial operation. The grades of oil and grease shall be in accordance with Manufacturer's recommendations. Anchor bolts shall be set in accordance with Manufacturer's recommendations.

3.02 SHOP PAINTING

- A. Before exposure to weather and prior to shop painting, all surfaces shall be thoroughly cleaned, dry and free from all mill scale, rust, grease, dirt and other foreign matter.
- B. All pumps and motors shall be shop coated with Manufacturer's standard coating.

- C. All nameplates shall be properly protected during painting.
- D. Gears, bearing surfaces, and other similar surfaces obviously not be painted shall be given a heavy shop coat of grease or other suitable rust-resistant coating. This coating shall be maintained as necessary to prevent corrosion during periods of storage and erection and shall be satisfactory to Engineer up to the time of the final acceptance test.

### 3.03 SERVICES

- A. Contractor shall furnish the services of a Manufacturer's field service technician who has complete knowledge of proper operation and maintenance of the equipment for a period not less than two (2) days to inspect the installed equipment, supervise the initial test run, and to provide instruction to the plant personnel. The first day will be for checking and inspecting the equipment after it is installed. The second day will be to operate and supervise the initial field test.
- B. At least one (1) of the two (2) days shall be allocated solely to the instruction of plant personnel in operation and maintenance of the equipment. This instruction period shall be scheduled at least ten (10) days in advance with Owner and shall take place prior to plant start-up and acceptance by Owner.
- C. The final copies of operation and maintenance manuals specified in Section 01 30 00 must have been delivered to Engineer prior to scheduling the instruction period with Owner.

### 3.04 INSPECTION AND TESTING

#### A. General

- 1. The services of a factory representative shall be furnished for two (2) days and shall have complete knowledge of proper operation and maintenance to inspect the final installation and supervise the test run of the equipment.
- 2. Field tests shall not be conducted until such time that the entire installation is complete and ready for testing.

#### B. Pumps

- 1. After all pumps have been completely installed and working under the direction of Manufacturer, conduct, in the presence of Engineer, such tests that are necessary to indicate that pumps conform to the Specifications. Field tests shall include all pumps included under this Section. Test period will be for a minimum of two hours for each pump. Supply all electric power, water or wastewater, labor, equipment and incidentals required to complete the field tests.
- 2. If the pump performance does not meet the Specifications, corrective measures shall be taken or pumps shall be removed and replaced with pumps with satisfy the conditions specified. A 4-hour operating period of each pump will be required before acceptance. During this 4-hour operating period, Contractor shall supply all power necessary.

#### C. Motors

- 1. Contractor shall check direction of rotation of all motors and reverse connections if necessary.

D. Control Panel

1. The supplier shall test all equipment at the factory prior to shipment.
- E. Should any item of equipment fail to meet the Specifications, corrective measures shall be taken by Contractor or the item shall be removed and replaced with one which satisfies the conditions specified.
- F. All pump operating settings, alarms and shutdown devices shall be calibrated and tested during the field tests.
- G. Deliver six (6) copies of certified test results to Engineer upon completion of satisfactory testing of the equipment.

3.05 SUBMITTALS

- A. Manufacturer shall submit for approval pump curves and a pump data sheet indicating the principle operating characteristics of each pump prior to fabrication.
- B. Manufacturer shall supply the following information at the time of shipment:
  1. Pump outline drawing
  2. Typical installation guides
  3. Operation and maintenance instruction manuals
  4. Parts lists
- C. The guide rails shall be installed by the pump system Manufacturer.
  1. All submittals shall be in accordance with Section 01300.

TABLE 1

GRINDER PUMP DATA SHEET

1. Sewage Pumping Station
  - A. Location: JEA Rivertown Water Treatment Plant
  - B. Quantity: 1 Pumping Station ( 2 Pumps)
  - C. Pump used for Design: Hydromatic HGPH
  - D. Operating Conditions:
    1. Material to be Pumped: Raw sewage within a temperature range of 40°F to 104°F
    2. Pump Curve:

Design point: 30-gpm at 144 feet
    3. Pump Speed: 3,400  $\pm$  RPM
  - E. Specifications:
    1. Type: Submersible grinder type
    2. Minimum Solids Capacity: N/A
    3. Discharge Diameter Size: 2-inch
    4. Motor Data

Max Motor HP: 3  
Speed: 3,400  $\pm$ rpm  
Volts: 460  
Phases: 3  
Hertz: 60  
NEMA Type Motor Design: B

END OF SECTION 333216.13

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## SECTION 400506 - COUPLINGS, ADAPTERS, AND SPECIALS FOR PROCESS 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.
- B. All Work shall be in accordance with JEA Water and Wastewater Standards (January 2019 or latest).

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Pipe penetrations
  - 2. Restrained joints
  - 3. Sleeve-type couplings.
- B. Related Requirements:
  - 1. Section 099010 – Shop Painting
  - 2. Section 099100 – Painting
  - 3. Section 400531 Thermoplastic Process Pipe Section 331300 - Disinfecting of Water Utility Distribution: Disinfection of potable water piping
  - 4. Section 400507 - Hangers and Supports for Process Piping: Hangers, anchors, sleeves, and sealing of piping to adjacent structures
  - 5. Section 400519 - Ductile Iron Process Pipe: Ductile-iron piping materials and appurtenances
  - 6. Section 400551 - Common Requirements for Process Valves: Common product requirements for valves for placement by this Section

#### 1.3 DEFINITIONS

- A. FM: Factory Mutual Insurance Company; FM Global is the communicative name of the company.
- B. WH: Warnock Hersey; indicates compliance to relevant building codes, association criteria, and
- C. product safety and performance standards.

#### 1.4 COORDINATION

- A. Section 013100 “Project Management and Coordination”: Requirements for coordination.

- B. Coordinate Work of this Section with installation of piping, valves and equipment connections specified in other Sections and indicated on Drawings.

#### 1.5 PREINSTALLATION MEETINGS

- A. Section 013100 “Project Management and Coordination”: Requirements for preinstallation meeting.

#### 1.6 SUBMITTALS

- A. Section 013300 - Submittal Procedures: Requirements for submittals.
- B. Product Data:
  - 1. Submit manufacturer catalog information for each specified product, including installation instructions.
- C. Shop Drawings:
  - 1. Identification:
    - a. Submit list of wording, symbols, letter size, and color coding for pipe identification.
    - b. Comply with ASME A13.1.
  - 2. Indicate restrained joint details and materials.
  - 3. Submit layout drawings showing piece numbers and location, indicating restrained joint locations.
  - 4. Indicate layout of piping systems, including offsets, and swing joints.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- E. Manufacturer Instructions: Submit special procedures and setting dimensions.
- F. Source Quality-Control Submittals: Indicate results of factory tests and inspections.
- G. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.
- H. Qualifications Statements:
  - 1. Submit qualifications for manufacturer.

#### 1.7 CLOSEOUT SUBMITTALS

- A. Section 017700 “Closeout Procedures”: Requirements for submittals.
- B. Project Record Documents: Record actual locations of piping appurtenances.
- C. Identify and describe unexpected variations to pipe routing or discovery of uncharted utilities.



1.8 QUALITY ASSURANCE

- A. Materials in Contact with Potable Water: Certified to NSF Standards 61 and 372.
- B. Perform Work according to ASME B31.3 for installation of piping systems.
- C. Perform Work according to St. Johns County Utility Department standards.

1.9 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum ten years' experience.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Section 016000 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- C. Store materials according to manufacturer instructions.
- D. Protection:
  - 1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
  - 2. Furnish temporary end caps and closures on piping and fittings and maintain in place until installation.
  - 3. Provide additional protection according to manufacturer instructions.

1.11 EXISTING CONDITIONS

- A. Field Measurements:
  - 1. Verify field measurements prior to fabrication.
  - 2. Indicate field measurements on Shop Drawings.

1.12 WARRANTY

- A. Section 017700 "Closeout Procedures": Requirements for warranties.

## PART 2 - PRODUCTS

### 2.1 PIPE SLEEVES

- A. All construction except new concrete walls:
  - 1. Material: Schedule 40 galvanized steel conforming to ASTM A53.
  - 2. 2-inch minimum circumference water stop welded to exterior sleeve at midpoint
  - 3. Ends cut and ground to be:
    - a. Flush with ground
    - b. Flush with ceiling
    - c. 2 inches above finished floors
    - d. Sealed with caulking
    - e. Sized as required.
- B. New concrete with pipes 20 to 60 inches in diameter:
  - 1. Material: molded HDPE modular interlocking discs to make the width of the wall.
    - a. Corrugated
    - b. Cell-Cast as manufactured by Pipeline Seal & Insulator, Inc., Houston, TX, or equal.
- C. External wall penetrations:
  - 1. 36-in diameter and less may be made by means of a ductile iron sleeve capable of being bolted directly to the formwork:
  - 2. Seal of the annular space between the carrier pipe and the sleeve made by means of a confined rubber gasket and be capable of withstanding 350 psi.
  - 3. Sleeve to have an integrally cast waterstop of 1/2-in minimum thickness, 2-1/2-in minimum height.
  - 4. Manufacturers: Omni-Sleeve, Malden, MA or equal.

### 2.2 WALL CASTINGS

- A. Ductile iron conforming to ANSI/AWWA A21.51/C151, thickness Class 53.
- B. Conform to the 125-pound American National Standard.
- C. Diameter as required.
- D. Flanges and/or mechanical joint bells drilled and tapped for studs where flush with the wall.
- E. Castings provided with a 2-in minimum circumferential flange/waterstop integrally cast with or welded to the casting.
- F. Located as follows:
  - 1. for castings set flush with walls: located at the center of the overall length of the casting,

2. for castings which extend through wall: located within the middle third of the wall.

## 2.3 SEALING MATERIALS

### A. Mechanical seals:

1. Of rubber links shaped to continuously fill the annular space between the pipe and the wall opening or sleeve.
2. Link pressure plates molded of glass reinforced nylon:
  - a. colored throughout elastomer,
  - b. permanent identification of the size and manufacturer's name molded into the pressure plate and sealing element.
3. Hardware:
  - a. Mild steel with a 60,000 psi minimum tensile strength
  - b. 2-part Zinc Dichromate coating per ASTM B-633
  - c. Organic Coating, tested in accordance with ASTM B-117 to pass a 1,500-hour salt spray test.
  - d. Use Type 316 Stainless Steel hardware:
    - 1) in chemical areas
    - 2) for submerged service
4. Completed sealing system:
  - a. Duty pressure rated for 20 psig differential pressure.
  - b. EPDM for all services except fire rated assemblies
    - 1) fire rated seals use silicone link material.
  - c. Manufacturer: PSI-Thunderline/ Link-Seal as manufactured by Pipeline Seal & Insulator, Inc., Houston, TX, or pre-approved equal.

### B. Sealant:

1. A two-part foamed silicone elastomer manufactured by:
  - a. Dow Corning Co., Product No. 3-6548 silicone R.T.V.
  - b. 3M brand fire barrier products caulk C.P. 25 and 3M brand moldable putty MP+;
  - c. Flame-Safe fire stop systems FS-900 by Rectorseal.
2. Sealant bead configuration, depth and width in accordance with manufacturer's recommendations.

## 2.4 DISMANTLING JOINTS

### A. Manufacturers:

1. Romac Industries, Inc.
2. Approved Equal

### B. Description

1. Style DJ400 by Romac Industries, Inc. or approved equal.
2. Working pressure shall be equal to or greater than the maximum rating of the flange.
3. End ring and body shall be ASTM A536 65-45-12 ductile iron.
4. Bolts and nuts shall be 304 stainless steel.
5. Tie rods shall be 304 stainless steel
6. NSF 61 certified

### C. Finishes

1. Fusion bonded epoxy coated.

## 2.5 SLEEVE-TYPE COUPLINGS

### A. Manufacturers:

1. Xylem (Smith-Blair).
2. Substitutions: Owner approved equal.

### B. Description:

1. Comply with AWWA C213, C219.
2. Middle Ring: Steel.
3. Followers: Steel.
4. Gaskets:
  - a. Material: Buna-N.
  - b. Comply with ASTM D2000.
5. Bolts: 316 Stainless Steel.

### C. Finishes:

1. Factory fusion bonded epoxy coated.

## 2.6 FINISHES

### A. Prepare piping appurtenances for field finishes as specified in Section 099100 – Painting.

## 2.7 SOURCE QUALITY CONTROL

### A. Section 014000 - Quality Requirements: Requirements for testing, inspection, and analysis.

1. Provide shop inspection and testing of completed assemblies.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Section 017300 "Execution": Requirements for installation examination.
- B. Verify that field dimensions are as indicated on Drawings.
- C. Inspect existing flanges for nonstandard bolt hole configurations or design and verify that new pipe and flanges mate properly.
- D. Verify that openings are ready to receive sleeves.
- E. Verify that pipe plain ends to receive sleeve-type couplings are smooth and round for 12 inches from pipe ends.
- F. Verify that pipe outside diameter conforms to sleeve manufacturer's requirements.

### 3.2 PREPARATION

- A. Section 017300 "Execution": Requirements for installation preparation.
- B. Cleaning: Thoroughly clean end connections before installation.
- C. Close pipe and equipment openings with caps or plugs during installation.
- D. Surface Preparation: Clean surfaces to remove foreign substances.

### 3.3 INSTALLATION

- A. According to ASME B31.3.
- B. Coating: Finish piping appurtenances as specified in Section 099100 - Painting.
- C. Pipe Penetrations:
  1. Sleeves:
    - a. Exterior Watertight Entries: Seal with mechanical sleeve seals.
    - b. Set sleeves in position in forms and provide reinforcement around sleeves.
    - c. Extend sleeves through floors 1 inch above finished floor level and calk sleeves.
    - d. Provide close-fitting metal collar or escutcheon covers at both sides of penetration.

- e. Install stainless-steel escutcheons at finished surfaces.
- D. Air Release and Valves: Provide air release valves as indicated on Drawings and Specified in 400578.11.
- E. Disinfection: Disinfect potable water piping as specified in Section 331300 - Disinfecting of Water Utility Distribution.

### 3.4 FIELD QUALITY CONTROL

- A. Section 014000 - Quality Requirements: Requirements for inspecting and testing.
- B. After installation, inspect for proper supports and interferences.
- C. Repair damaged coatings with material equal to original coating.

### 3.5 CLEANING

- A. Sections 017300 "Execution" and 017700 "Closeout Procedures": Requirements for cleaning.
- B. Keep equipment interior clean as installation progresses.

END OF SECTION 400506

## SECTION 400507 - HANGERS AND SUPPORTS FOR PROCESS 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.
- B. All Work shall be in accordance with the JEA Water and Wastewater Standards (January 2019 or latest)
- C. Related Requirements:
  - 1. Section 033000 - Cast-in-Place Concrete: Execution requirements for placement of concrete housekeeping pads specified by this Section.
  - 2. Section 099010 – Shop Priming: Product and execution requirements for shop priming specified by this Section.
  - 3. Section 400506 – Couplings, Adapters, and Specials for Process Piping.
  - 4. Section 400519 – Ductile Iron Process Pipe

#### 1.2 COORDINATION

- A. Section 013100 “Project Management and Coordination”: Requirements for coordination.
- B. Coordinate Work of this Section with piping and equipment connections specified in other Sections and indicated on Drawings.

#### 1.3 PREINSTALLATION MEETINGS

- A. Section 013100 “Project Management and Coordination”: Requirements for preinstallation meeting.

#### 1.4 ACTION SUBMITTALS

- A. Section 013300 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit manufacturer's catalog data including load capacity.
- C. Shop Drawings: Submit scaled piping layouts for each system. Indicate flow stream, pipe size(s) material(s), schedule(s), lining(s), critical dimensions between pipes, and equipment. Indicate by schedule pipe support type and locations. Provide detail of each type of supports, anchors, and guides.
- D. Manufacturers' Instructions: Submit special procedures and assembly of components.

## 1.5 INFORMATIONAL SUBMITTALS

- A. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- B. Qualifications Statements:
  - 1. Submit qualifications for manufacturer.

## 1.6 DEFINITIONS

- A. Ferrous Metal: Iron, steel, stainless steel, and alloys with iron as principal component.
- B. Wetted or submerged: Submerged, less than 1-foot above liquid surface, below top of channel or tank wall, under cover or slab of channel or tank, or in other damp locations.
- C. "Pipe" or "piping" shall mean all piping, piping system(s), hose, tube, fittings, joints, valves, and similar appurtenances.
- D. Supports: wherever the word "supports" or "pipe supports" are used, they shall mean pipe supports, structural connections, concrete inserts (if allowed), anchors, guides, bolts, expansion units, restraints and all restraint, supporting, allowing controlled expansion, or other means of attaching piping along with the necessary appurtenances.

## 1.7 DELIVERY, STORAGE AND HANDLING

- A. All supports shall be crated, delivered and uncrated so as to protect against any damage.
- B. All parts shall be properly protected so that no damage or deterioration shall occur during a prolonged delay from the time of shipment until installation is completed.
- C. Finished metal surfaces not galvanized, that are not of stainless steel construction, or that are not coated, shall be grease coated, to prevent rust and corrosion.

## 1.8 QUALITY ASSURANCE

- A. Perform Work according to applicable authority for welding support attachments to building structure.

## 1.9 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this Section with minimum ten years' experience.
- B. Fabricator: Company specializing in fabricating products specified in this Section with minimum ten years' experience.



1.10 DELIVERY, STORAGE, AND HANDLING

- A. Section 016000 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Inspection: Accept materials on-Site in original factory packaging, labeled with manufacturer's identification.
- C. Protect products from weather and construction traffic, dirt, water, chemical, and damage by storing in original packaging.

1.11 EXISTING CONDITIONS

- A. Field Measurements: Verify field measurements prior to fabrication. Indicate field measurements on Shop Drawings.

1.12 WARRANTY

- A. Section 017700 "Closeout Procedures": Requirements for warranties.
- B. Furnish five-year manufacturer's warranty for pipe supports.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Support pipe and appurtenances connected to equipment to prevent any strain being imposed on the equipment. Comply with manufacturer's requirements regarding piping loads being or not being transmitted to their equipment.
- B. Support and secure all pipe and tubing in the intended position and alignment to prevent significant stresses in the pipe or tubing material, valves, fittings, and other pipe appurtenances.
- C. Contractor may propose minor adjustments to the piping arrangements in order to simplify the supports, or in order to resolve minor conflicts in the work. Such an adjustment might involve minor change to a pipe centerline elevation so that a single trapeze support may be used.
- D. Where flexible sleeve, split ring, vibration, or other couplings are required at equipment, tanks, etc., the end opposite to the piece of equipment, tank, etc., shall be rigidly supported to prevent transfer of force systems to the equipment. Do not install fixed or restraining supports between a flexible coupling and the piece of equipment.
- E. Pipe supports:
  - 1. Shall not induce point loadings but shall distribute pipe loads evenly along the pipe circumference.
  - 2. Provide supports at changes in direction and elsewhere as shown in the Drawings or as specified herein.

3. No piping shall be supported from other piping or from metal stairs, ladders, and walkways, unless specifically directed or authorized by the Engineer.
  4. Provide pipe supports to minimize lateral forces through valves, both sides of flexible split ring type couplings and sleeve type couplings, and to minimize all pipe forces on pump housings. Pump housings shall not be utilized to support connecting pipes.
  5. Piping along walls shall be supported by approved wall brackets with attached pipe rolls or saddles or by wall brackets with adjustable hanger rods. For piping supported from the ceiling, approved rod hangers of a type capable of screw adjustment after erection of the piping and with suitable adjustable concrete inserts or beam clamps shall be used.
- F. Insofar as is possible, floor supports shall be given preference. Where specifically indicated, concrete supports, as shown on the Drawings, shall be used. Base elbow and base tees shall be supported on concrete pedestals.
- G. Restraints, flexible connections, expansion items, and related items as included in other specifications and shown on the Drawings.

## 2.2 PERFORMANCE REQUIREMENTS/DESIGN CRITERIA

- A. All supports and appurtenances shall be standard products from approved manufacturers wherever possible, and shall be adequate to maintain the supported load in proper position under all operating conditions. Any reference to a specific figure number of a specific manufacturer is for the purpose of establishing a type and quality of product and shall not be considered as proprietary. Note that different materials required, as specified in Part 2 MATERIALS, may require different figures or model numbers than those shown.
- B. The pipe support system shall not impose loads on the supporting structures in excess of the loads for which the supporting structure is designed.

## 2.3 MATERIALS

- A. For support of metallic pipe:
1. Submerged, buried, or within outdoor structures (vaults, etc.): Type 316 stainless steel (SS).
  2. Within chemical areas: Vinyl ester fiberglass reinforced plastic (FRP) for pipe size up to 2 inch, epoxy coated steel for 2-1/2 inches size and larger.
    - a. Supports shall be compatible to a minimum 15 percent trade percent solution of commercial sodium hypochlorite solution.
  3. Other locations: galvanized steel.
  4. Additional requirements (including dielectric insulation): see following paragraphs.
- B. For support of non-metallic pipe:
1. Submerged, buried, or within vaults: Type 316 stainless steel or FRP.
  2. Within chemical areas: vinyl ester FRP.
  3. Other locations: galvanized steel.

- C. Wherever stainless steel is noted, it shall be Type 316 unless noted otherwise.

## 2.4 SUPPORT AND RESTRAINT SYSTEMS

### A. Steel or Ductile Iron Piping

1. Cast iron and ductile iron, steel, and stainless steel piping shall be supported at a maximum support spacing of 8 feet with a minimum of one support per pipe section at the joints for pipe sizes greater than 12 inches.
2. Spacing of pipe supports shall not exceed 20 feet on-center for pipe sizes 12 inches and larger.
3. Support spacing for ductile iron, steel, and stainless steel piping 2-in and smaller diameter shall not exceed 5 feet.

### B. Non-Metallic Piping

1. All uninsulated non-metallic piping such as PVC, CPVC, HDPE, etc., shall be protected from local stress concentrations at each support point. Protection shall be provided by non-metallic protection shields or other method as approved by the Engineer.
  - a. Where pipes are bottom supported 180 degrees, arc shields shall be furnished. Where 360-degree arc support is required, such as U-bolts, protection shields shall be provided for the entire pipe circumference. All U-bolts or clamps for non-metallic pipes shall be plastic coated.
  - b. Protection shields shall have an 18-gauge minimum thickness, not be less than 12 inches in length, and be securely fastened to pipe with Type 316 stainless steel straps not less than 1/2 inch wide.
2. Individually supported PVC pipes shall be supported as recommended by the pipe manufacturer.

## 2.5 SINGLE PIPE SUPPORTS FROM BELOW

- A. Single pipes located in a horizontal plane close to the floor shall be Pedestal type: Schedule 40 pipe stanchion, saddle, and anchoring flange.
1. Nonadjustable Saddle: MSS SP 58, Type 37 with U-Bolt
    - a. Anvil, Figure 259.
    - b. Cooper B-Line, Figure B3090.
  2. Adjustable Saddle: MSS SP 58, Type 38 without clamp
    - a. Anvil, Figure 264.
    - b. Cooper B-Line, Figure B3093.

- B. Pipes less than 3 inch in diameter
  - 1. Hold in position by supports fabricated from steel C channel, welded post base similar to Unistrut, Figure P2072A, where use of steel is allowed; and pipe clamps similar to Unistrut, Figures P1109 through 26.
  - 2. Where required to assure adequate support, fabricate supports using two vertical members and post bases connected by horizontal member of sufficient load capacity to support pipe.
  - 3. Fasten supports to nearby walls or other structural member to provide horizontal rigidity.
  - 4. More than one pipe may be supported from a common fabricated support.
- C. Pipes 3 inch in diameter and larger
  - 1. Support by adjustable stanchions.
  - 2. Provide at least 4 inch adjustment
  - 3. Flange mount to floor.
- D. Use yoked saddles for piping whose centerline elevation is 18 inch or greater above the floor and for all exterior installations.

## 2.6 WALL SUPPORTED SINGLE AND MULTIPLE PIPES

- A. Single or multiple pipes located adjacent to walls, columns, or other structural members shall be supported using welded steel wall brackets, where use of steel is allowed, as manufactured by Carpenter and Patterson, Figure No. 69, 84, or 139.
- B. Where noted, multiple pipes may be supported on C-channel with steel brackets similar to Unistrut pipe clamps; with pipe anchor chairs; or equal.
- C. Individual pipes, up to 8-in diameter, where noted, may use MSS Type 8 pipe clamps as noted on the Drawings.
- D. Securely fasten all members to wall, column, etc., using double-expansion shields or other method as approved by the Engineer. Provide additional wall bearing plates as required.

## 2.7 BASE ANCHOR SUPPORT

- A. Bend Support: Where pipes change direction from horizontal to vertical via a bend, install a welded or cast base bend support to carry the load. Fasten to the floor, pipe stanchion, or concrete pedestal using expansion anchors or other method as approved by the Engineer.
- B. Concrete Supports: Where indicated, securely fasten pipe bends to concrete supports with suitable metal bands as required and approved by the Engineer. Isolate piping from poured concrete with a neoprene insert.

## 2.8 SHOP FACTORY FINISHING

- A. Prepare and prime metallic (except stainless steel) supports in accordance with Division 09.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Section 013100 "Project Management and Coordination": Requirements for installation examination.
- B. Verify field dimensions as indicated on Drawings.

### 3.2 INSTALLATION

- A. Obtain permission from Engineer before using powder-actuated anchors.
- B. Obtain permission from Engineer before drilling or cutting structural members.
- C. Inserts:
  - 1. Install inserts for placement in concrete forms. Before setting inserts, all drawings and figures shall be checked that have a direct bearing on the pipe location. Responsibility for the proper location of pipe supports is included under this Section.
  - 2. Provide hooked rod to concrete reinforcement section for inserts carrying pipe 4 in and larger.
- D. Pipe Supports:
  - 1. Install according to: ASME B31.3.
  - 2. Support horizontal piping as indicated on Drawings, depending upon pipe size.
  - 3. Support riser piping independently of connected horizontal piping.
  - 4. Support piping independently so that equipment is not stressed by piping weight or expansion in piping system.
  - 5. Support large or heavy valves, fittings, and appurtenances independently of connected piping.
  - 6. Provide welded steel brackets where piping is to be run adjacent to building walls or columns.
  - 7. Use offset clamps where pipes are indicated as offset from wall surfaces.
  - 8. Proceed with installation of piping and supports only after any building structural work has been completed and new concrete has reached its 28-day compressive strength.
  - 9. The installation of pipe support systems shall not interfere with the operation of any overhead bridge cranes, monorails, access hatches, etc. No piping shall be supported from stairs, other pipes, ladders, and walkways unless authorized by the Engineer.
  - 10. Repair mounting surfaces to original condition after attachments are made.
  - 11. Brace horizontal pipe movements by both longitudinal and lateral sway bracing.
  - 12. Where supports are required in areas to receive chemical resistant seamless flooring, install supports prior to application of flooring system.
- E. Equipment Bases and Supports:
  - 1. Provide housekeeping pads as detailed on Drawings.

2. Using templates furnished with equipment, install anchor bolts and accessories for mounting and anchoring equipment.

F. Prime Coat:

1. Prime coat exposed steel supports.
2. Conform to Section 099010.

3.3 FIELD QUALITY CONTROL

- A. All pipe support systems shall be tested after installation in conjunction with the respective piping pressure tests. If any part of the pipe support system proves to be defective or inadequate, it shall be repaired, augmented or replaced to the satisfaction of the Engineer.
- B. After the work is installed, but before it is filled for start-up and testing, the Support System Design Engineer shall inspect the work and shall certify its complete adequacy. Each system shall be inspected and certified in the same way.
- C. Submit a report, including all field modifications and including all certificates.
  1. The report shall bear the stamp of a professional engineer registered in Florida and shall be subject to the review of the Engineer.

END OF SECTION 400507

## SECTION 400519 - DUCTILE IRON PROCESS PIPE

### 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 Work and Materials shall be in accordance with Section 350 and 351 JEA Water and Wastewater Standards (January 2019 or latest).
- C. Disinfecting of Water Supply Systems shall comply with the latest requirements listed in Section 350 and 351 JEA Water and Wastewater Standards (January 2019 or latest).

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Ductile-iron pipe.
  - 2. Ductile-iron, malleable-iron, and cast-iron fittings.
  - 3. Accessories.
- B. Related Requirements:
  - 1. Section 099000 - Painting and Coating: Product and execution requirements for painting specified by this Section.
  - 2. Disinfecting of Water Supply Systems shall comply with the latest requirements listed in Section 350 and 351 JEA Water and Wastewater Standards (January 2019 or latest).
  - 3. Section 400551 - Common Requirements for Process Valves: Common product requirements for valves for placement by this Section.

#### 1.3 COORDINATION

- A. Section 013100 "Project Management and Coordination": Requirements for coordination.
- B. Coordinate Work of this Section with piping and equipment connections specified in other Sections and indicated on Drawings.

#### 1.4 PREINSTALLATION MEETINGS

- A. Section 013100 "Project Management and Coordination": Requirements for preinstallation meeting.

## 1.5 SUBMITTALS

- A. Section 013300 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit manufacturer information regarding pipe and fittings.
- C. Shop Drawings: Indicate layout of piping systems, including equipment, critical dimensions, sizes, and materials lists.
- D. Manufacturer's Certificate: Prior to shipment of pipe, submit a certified affidavit of compliance from the pipe manufacturer stating that the pipe fittings, gaskets, linings and exterior coating for this project have been manufactured and tested in accordance with AWWA and ASTM standards and requirements specified herein.
- E. Delegated Design Submittals: Submit signed and sealed Shop Drawings with design calculations and assumptions for pipe sizing methods and calculations used.
- F. Source Quality-Control Submittals: Indicate results of factory tests and inspections.
- G. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.
- H. Qualifications Statements:
  - 1. Submit qualifications for manufacturer, installer, and licensed professional.
  - 2. Submit manufacturer's approval of installer.
- I. American Iron and Steel (AIS): Submit certification indicating compliance with AIS requirements.

## 1.6 CLOSEOUT SUBMITTALS

- A. Section 017700 "Closeout Procedures": Requirements for submittals.
- B. Project Record Documents: Record actual locations of piping, valves and other appurtenances, connections, and centerline elevations.
- C. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

## 1.7 QUALITY ASSURANCE

- A. Materials (including linings) in Contact with Potable Water: Certified according to NSF 61 and NSF 372.
- B. Hydrostatically test each length of ductile iron pipe at the point of manufacture to 500 psi for a duration of 10 seconds per AWWA C151. Furnish certified test results in duplicate to the Engineer prior to time of shipment.



- C. Inspect and test by Manufacturer the ductile-iron pipe and fittings at the foundry as required by the AWWA C600, Hydrostatic Testing. Furnish in duplicate to the Engineer sworn certificates of such tests and their results prior to the shipment of the pipe.
- D. Pipe and fittings to be installed under this Contract may be inspected at the plant for compliance with this Section by an independent testing laboratory selected by the Owner, at the Owner's expense.
- E. Engineer will inspect the pipe and fittings after delivery. Products are subject to rejection at any time on account of failure to meet any of the specified requirements, even though accepted as satisfactory at the place of manufacture. Immediately mark pipe rejected after delivery and remove from the job site.
- F. Permanently mark pipe and fittings with the following information:
  - 1. Manufacturer name and trademark
  - 2. Manufacturing date.
  - 3. Size, type, class, or wall thickness.
  - 4. Production Standard (AWWA, ASTM, etc.).
- G. Perform Work according to Section 351 JEA Water and Wastewater Standards (January 2019 or latest).

#### 1.8 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum five years' experience.
- B. Installer: Company specializing in performing Work of this Section with minimum five years' experience and approved by manufacturer.
- C. Licensed Professional: Professional engineer experienced in design of specified Work and licensed in State of Florida.

#### 1.9 DELIVERY, STORAGE, AND HANDLING

- A. Section 016000 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage. Photograph and provide written documentation of damaged materials.
- C. Store materials according to manufacturer instructions.
- D. Protection:
  - 1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
  - 2. Cover all openings to prevent entrance of dirt, water, and debris.
  - 3. Protect piping and appurtenances by storing off ground

4. Limit stacking height to manufacturers specified maximum
5. Provide additional protection according to manufacturer instructions.

#### 1.10 EXISTING CONDITIONS

##### A. Field Measurements:

1. Verify field measurements prior to fabrication.
2. Indicate field measurements on Shop Drawings.

### PART 2 - PRODUCTS

#### 2.1 DUCTILE IRON PIPE AND FITTINGS

##### A. Piping:

1. Comply with AWWA C150, AWWA C151 and Section 350 JEA Water and Wastewater Standards (January 2020 or latest)
2. Thickness Class: As indicated on Drawings.
3. Pressure class: 350
4. Ductile Iron pipe as manufactured by U.S. Pipe and Foundry Company, Inc.; American Cast Iron Pipe Company; all divisions of the McWane Company or an approved equal who is a member of the Ductile Iron Pipe Research Association (DIPRA).

##### B. Fittings:

1. Material: AWWA C110, ductile iron.
2. Pressure Rating: Minimum working pressure of 250 psi.
3. Mechanical Joints:
  - a. Comply with AWWA C111.
  - b. Glands: Ductile iron
  - c. Push-on Joints: Comply with AWWA C111.
4. Restrained Joints: Comply with AWWA C111.
5. Flanged Joints: Comply with AWWA C110 and AWWA C115.
  - a. Assembly bolts: square headed carbon steel machine bolts with hexagon nuts per ANSI B18.2. Threads conform to ANSI B1.1. Bolt length: 1/8" to 5/8" protrusion from nut after torqueing.
6. Grooved joints: Comply with AWWA C606
  - a. Rigid couplings: Style 31 couplings as manufactured by Victaulic, Anvil International, or approved equal.
  - b. For direct connection of ductile pipe to steel pipe of IPS sizes: Victaulic Style 307 transition coupling with offsetting, angle-pattern, bolt pads.

- c. Grooved end fittings for AWWA ductile iron pipe: Conform to ANSI A21.10/AWWA C110 for center-to-end dimensions and ANSI A21.10/AWWA C110 or AWWA C153 for wall thickness, with AWWA C606 grooved ends.
- 7. Sleeve type couplings: Dresser Style 38 or 138 as manufactured by Dresser Industries, or equivalent products of Smith-Blair, Romac Industries, Ford Meter Box Co or approved equal.
- 8. Flanged coupling adaptors:
  - a. Used only if no other method is possible.
  - b. Manufactured to ASTM A536 standards.
  - c. Smith-Blair Type 913, or equivalent products of Klamflex Pipe Couplings (PTY) LTD, Robar Industries LTD or approved equal.

C. Cement-Mortar Lining:

- 1. Comply with ANSI Standard A21.4 (AWWA C104)
- 2. Type: thin cement lined with a seal coat, in accordance with Section 350 JEA Water and Wastewater Standards (January 2020 or latest)
- 3. High speed cement lining (offered by American Pipe) is acceptable with no seal coat.
  - a. Submit a certified affidavit of compliance with manufacturer's instructions and requirements specified herein.

D. Exterior Coating:

- 1. Exposed Service: As specified in Section 350 JEA Water and Wastewater Standards (January 2020 or latest) .
- 2. Exterior bituminous coating as specified in ANSI A21.51.
- 3. If required, coatings "hold-backs" to be provided at pipe and fitting ends for satisfactory installation for joint connections in the field.
- 4. Provide all necessary coating materials to perform field coating applications at joints compatible with or equal to the shop applied material.
- 5. Field repair of pipe with damaged coating shall receive prior approval of the Engineer. If, in the opinion of the Engineer coating damage is beyond repair, pipe to be replaced at the expense of the Contractor.
- 6. All flange bearing surfaces shall be uncoated.
- 7. Mechanically clean or brush blast all surfaces to have exterior coating applied to ductile iron surfaces. Chemical cleaning or wiping with solvent is not acceptable.

## 2.2 SOURCE QUALITY CONTROL

- A. Section 014000 - Quality Requirements: Requirements for testing, inspection, and analysis.
- B. Provide shop inspection and testing of completed assembly.
- C. Owner Inspection:
  - 1. Make completed piping components available for inspection at manufacturer's factory prior to packaging for shipment.

2. Notify Owner at least seven days before inspection is allowed.

D. Certificate of Compliance:

1. If manufacturer is approved by authorities having jurisdiction, submit certificate of compliance indicating Work performed at manufacturer's facility conforms to Contract Documents.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Section 017300 "Execution": Requirements for installation examination.
- B. Verify that field dimensions are as indicated on Drawings.
- C. Inspect existing flanges for nonstandard bolt hole configurations or design and verify that new pipe and flange mate properly.

### 3.2 PREPARATION

- A. Section 017300 "Execution": Requirements for installation preparation.
- B. Thoroughly clean pipe and fittings before installation.
- C. Surface Preparation:
  1. Clean surfaces to remove loose rust, mill scale, and other foreign substances by power wire brushing.
  2. Touch up shop-primed surfaces with primer as specified in Section 099000 - Painting and Coating.
  3. Solvent-clean surfaces that are not shop primed.

### 3.3 INSTALLATION

- A. Buried Service Piping: As specified in Section 331116 - Site Water Utility Distribution Piping.
- B. Exposed Service Piping:
  1. According to ASME B31.3.
  2. In compliance with manufacturer's instructions.
  3. Run piping straight along alignment as indicated on [**Shop**] Drawings, with minimum number of joints.
  4. Clean each length prior to installation.
  5. Support per Section 400507.
  6. Do not use equipment flanges for support; support pipe separately.

C. Fittings:

1. According to manufacturer instructions.
  2. Clean gasket seats thoroughly, and wipe gaskets clean prior to installation.
  3. Tighten bolts progressively, drawing up bolts on opposite sides until bolts are uniformly tight; use torque wrench to tighten bolts to manufacturer instructions.
  4. Flanged joints to be made using gaskets, bolts, bolt studs with a nut on each end, or studs with nuts where the flange is tapped. The number and size of bolts to conform to the same ANSI Standard as the flanges.
  5. Provide required upstream and downstream clearances from devices as indicated on Drawings.
- D. Make taps to ductile iron piping only with service saddle, tapping boss of a fitting or valve body, or equipment casting.
- E. Install piping with sufficient slopes for venting or draining liquids and condensate to low points.
- F. Support exposed piping as specified in Section 400507 - Hangers and Supports for Process Piping.
- G. Provide expansion joints as specified in Section 400506 - Couplings, Adapters, and Specials for Process Piping, and pipe guides as specified in Section 400507 - Hangers and Supports for Process Piping, to compensate for pipe expansion due to temperature differences.
- H. Disinfection: Disinfect potable water piping as specified in Section 331300 - Disinfecting of Water Utility Distribution.
- I. Dielectric Fittings: Provide between dissimilar metals.
- J. Field Cuts: According to pipe manufacturer instructions. Cutting by abrasive saw only, leaving a smooth cut at right angles to the axis of the pipe. Damage to the lining repaired to the satisfaction of the Engineer. Seal Field cut ends approved epoxy coating in accordance with manufacturer's instructions.
- K. For pipe 20 inch and larger, unless approved otherwise by JEA, a foundation bed of granular material shall be placed under and around all ductile iron fittings and valves for additional support of heavy system components. Comply with Section 350 JEA Water and Wastewater Standards (January 2020 or latest).
- L. Finish primed surfaces according to Section 350 JEA Water and Wastewater Standards (January 2020 or latest) .
- M. Installation Standards: Install Work according to JEA Water and Wastewater Standards, latest edition standards.

3.4 TOLERANCES

- A. Section 014000 - Quality Requirements: Requirements for tolerances.
- B. Laying Tolerance: As specified in Section 331116 "Site Water Utility Distribution Piping."

- C. Deflection at joints not to exceed that recommended by the pipe manufacturer.
- D. Supply and install fittings, in addition to those shown on Drawings, in areas where conflict exists with existing facilities.

### 3.5 FIELD QUALITY CONTROL

- A. Section 014000 "Quality Requirements" for inspecting and testing requirements.
- B. Inspection:
  - 1. Inspect for damage to pipe lining or coating and for other defects that may be detrimental as determined by Engineer.
  - 2. Repair damaged piping or provide new, undamaged pipe at no additional cost to the project.
  - 3. After installation, inspect for proper supports and interferences.
- C. Pressure Testing:
  - 1. Test Pressure: Not less than 150 psig in excess of maximum static pressure, or 150 percent of maximum operating design pressure., whichever is greater
  - 2. Conduct hydrostatic test for minimum two hours.
  - 3. Filling:
    - a. Fill section to be tested with water slowly and expel air from piping at high points.
    - b. Install corporation cocks at high points.
    - c. Close air vents and corporation cocks after air is expelled.
    - d. Raise pressure to specified test pressure.
  - 4. Observe joints, fittings, and valves under test.
  - 5. Remove and renew cracked pipe, joints, fittings, and valves showing visible leakage and retest.
  - 6. Leakage:
    - a. Correct visible deficiencies and continue testing at same test pressure for additional two hours to determine leakage rate.
    - b. Maintain pressure within plus or minus 5 psi of test pressure.
    - c. Leakage is defined as quantity of water supplied to piping necessary to maintain test pressure during period of test.
    - d. Compute maximum allowable leakage by following formula:
      - 1)  $L = SD \times \sqrt{P}/C$ .
      - 2) L = testing allowance in gph.
      - 3) S = length of pipe tested in feet.
      - 4) D = nominal diameter of pipe in inches.
      - 5) P = average test pressure during hydrostatic test in psig.
      - 6) C = 148,000.
      - 7) If pipe under test contains sections of various diameters, calculate allowable leakage from sum of computed leakage for each size.

- e. If test of pipe indicates leakage greater than allowed, locate source of leakage, make corrections, and retest until leakage is within allowable limits.
- f. Correct visible leaks regardless of quantity of leakage.

### 3.6 CLEANING

- A. Sections 017300 “Execution” and 017700 “Closeout Procedures” specify requirements for cleaning.
- B. Keep pipe interior clean as installation progresses.
- C. After installation, clean pipe interior of soil, grit, and other debris.

END OF SECTION 400519

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## SECTION 400531 - THERMOPLASTIC PROCESS PIPE

### PART 1 - GENERAL

#### 1.1 POLYVINYL CHLORIDE (PVC) PIPING – PRESSURE PIPE

- A. All PVC pipe and fittings shall be as specified and installed per JEA Water and Wastewater Standards Manual (January 2019 or latest), Standards for Disinfection Systems.
- B. All PVC Ball Valves shall be as specified and installed per JEA Water and Wastewater Standards Manual (January 2019 or latest), Standards for Disinfection Systems
- C. Disinfecting of Water Supply Systems shall comply with the latest requirements listed in Section 350 and 351 JEA Water and Wastewater Standards (January 2019 or latest).

#### 1.2 POLYVINYL CHLORIDE (PVC) PIPING – GRAVITY WASTEWATER

- A. All below grade PVC pipe and fittings shall be as specified and installed per JEA Water and Wastewater Standards Manual (January 2019 or latest), for Gravity Wastewaters (Section 428)

END OF SECTION 400531

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## SECTION 400551 - COMMON REQUIREMENTS FOR PROCESS VALVES

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Common requirements for valves.
2. Common requirements for valve actuators.
3. Valve tags.
4. Valve Schedule.

B. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for execution requirements for placement of concrete as required by this Section.
2. Section 055000 "Metal Fabrications" for miscellaneous metalwork and fasteners specified by this Section.
3. Section 099000 "Painting and Coating" for product and execution requirements for painting specified by this Section.
4. Section 220523.12 "Ball Valves for Plumbing Piping" for miscellaneous plumbing valves as required by Project.
5. Section 400507 "Hangers and Supports for Process Piping" for product and execution requirements for valve supports specified by this Section.
6. Section 400557 "Actuators for Process Valves and Gates."
7. Section 400593.23 "Low-Voltage Motor Requirements for Process Equipment" for single- and three-phase motor requirements for equipment specified in this Section.

#### 1.2 COORDINATION

- A. Section 013100 "Project Management and Coordination": Requirements for coordination.
- B. Coordinate Work of this Section with individual process valve specifications.

#### 1.3 ACTION SUBMITTALS

- A. Section 013300 "Submittal Procedures" for submittal requirements.
- B. Valve Schedule:
1. Submit valve schedule populated with all Division 40 process valves specified for this project. Include all information shown on the Sample Valve Schedule included in this project.
  2. Approval of valve schedule submittal to precede all individual valve submittals. All subsequent individual valve submittals to include the approved valve tag number or group on the submittal cover sheet.

C. Valve Tags:

1. Materials, dimensions and thickness of tags, materials and gauge of cable and splicing hardware.
2. Color palate for Owner selection.
3. Full scale drawing of sample with lettering dimensions and scribe depth.
4. Valve tag lettering provided with Valve Schedule above.

D. Power Actuator Data:

1. Sizing calculations:
  - a. Provide fluid pressure and velocity sizing basis.
  - b. Provide maximum valve torque based on disc shape and flow direction.
  - c. Clearly indicate safety factors and mechanical ratios of any intermediate gearing.
2. Maximum output torque of actuator and intermediate gearing.
3. Details of actuator mounting, including orientation of actuator and intermediate gearing.
4. Dimensional drawing of actuator assembled on valve.
5. Pneumatic/Hydraulic pressure requirements, electrical power supply, plumbing connection sizes and locations.
6. Wiring diagram, control wiring and protocol
7. Valve cavitation limits for positioning, modulating and control valves mated to power actuator.

E. Shop Drawings: Valve and actuator model number and size, valve parts list, materials of each part including material standard designation (ASTM or other), position indicators, limit switches, actuator mounting.

F. Provide certified hydrostatic test data, per manufacturer's standard procedure or MSS-SP-61 for all valves.

1.4 DELEGATED DESIGN SUBMITTALS

- A. Submit signed and sealed Shop Drawings with design calculations and assumptions for sizing of control valves.

1.5 INFORMATIONAL SUBMITTALS

- A. Manufacturer Instructions: Submit installation and operation instructions for each component including valve, actuator, gearbox, and any included instrumentation.
- B. Source Quality-Control Submittals: Indicate results of integrators facility tests and manufacturers factory tests and inspections.
- C. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.
- D. Manufacturer Certification of Installation: Certify that equipment has been installed according to manufacturer instructions.

E. Qualifications Statement:

1. Submit qualifications for manufacturer and licensed professional.

1.6 CLOSEOUT SUBMITTALS

- A. Section 017700 “Closeout Procedures” for submittal requirements.
- B. Section 017839 “Project Record Documents” for record actual locations of valves and actuators.

1.7 QUALITY ASSURANCE

- A. Maintain clearances as indicated on Drawings and Shop Drawings.
- B. Ensure that materials of construction of wetted parts are compatible with process liquid.
- C. Mate valves to actuators at manufacturer’s or integrator’s facility. Fully test assembled product and certify ready for installation prior to shipment to the job site.
  1. Only in special cases for extremely large assemblies where installation requires disassembly, may actuators be mounted to the valves in the field.
- D. Materials in Contact with Potable Water: Certified to NSF 61 and NSF 372.
- E. Furnish affidavit of compliance with testing and manufacturing standards referred in this specification and the individual valve specifications.
- F. Obtain Manufacturer’s Certification of Proper Installation for Specified valves and valve assemblies.
- G. Perform Work according to JEA Water and Wastewater Standards Manual, latest edition.

1.8 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing valves and actuators with minimum ten years' experience.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Section 016000 “Product Requirements” for requirements for transporting, handling, storing, and protecting products.
- B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- C. Deliver factory rated power actuated valves on rigid wooden skids, fully braced and strapped to prevent damage to valve, actuator or coupling system.

- D. Store materials according to manufacturer instructions.
- E. Protection:
  - 1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
  - 2. Protect valve ends from entry of foreign materials by providing temporary covers and plugs.
  - 3. Provide additional protection according to manufacturer instructions.

#### 1.10 EXISTING CONDITIONS

- A. Field Measurements:
  - 1. Verify field measurements prior to materials ordering or any fabrication.
  - 2. Indicate field measurements on Shop Drawings.

#### 1.11 WARRANTY

- A. Section 017700 "Closeout Procedures": Requirements for warranties.
- B. Furnish **one**-year manufacturer's warranty for valves and actuators.

### PART 2 - PRODUCTS

#### 2.1 VALVES

- A. Description: Valves, operator, actuator, handwheel, chainwheel, extension stem, floor stand, worm and gear operator, operating nut, chain, wrench, and other accessories as required.
- B. All valves of the same type shall be the product of one manufacturer
- C. Valve Ends: Compatible with adjacent piping system and as indicated on valve schedule.
- D. Operation:
  - 1. Close by turning clockwise.
  - 2. Cast directional arrow on valve or actuator with OPEN and CLOSE cast on valve in appropriate location.
- E. Valve Marking and Labeling:
  - 1. Marking: Comply with MSS SP-25.
  - 2. As indicated in valve schedule.
  - 3. Labeling (valve tags):
    - a. Brass, 1/8-inch thick, 3-inch diameter.

- b. Lettering 1/16-inch thick of silk screening or other permanent embedment of subsurface printed graphics, permanently sealed.
- c. Colors of lettering and backing as selected by Owner.
- d. One, 1/4-inch clear opening 316 stainless steel grommets at each end, center of hole 3/8-inch from tag edge.
- e. 3/32-inch 316 SS cable and splice hardware.

F. Valve Construction: As Specified in Valve Sections.

G. Van Stone flanges shall not be used with pinch valves, industrial butterfly valves; elastomer bellows style expansion joints or other piping system components having an elastomer liner (rubber seat) that is used as a gasket.

## 2.2 VALVE ACTUATORS

- A. Provide actuators in accordance with the valve schedule included on the Drawings.
- B. Provide mechanical position indicators for power actuated and gearbox actuated valves.
- C. Comply with AWWA C541 (Pneumatic and Hydraulic actuators) and C542 (Electric Motor Actuators) as applicable.
- D. Provide chain actuators for shutoff valves mounted greater than 7-feet above operating floor level.
- E. Gear and Power actuators as specified in Section 400557.00 – Actuators for Process Valves and Gates.

## 2.3 FINISHES

- A. Valve Coating: Comply with AWWA C550.
- B. Factory finishes are included in individual valve sections.
- C. Exposed Valves: As specified in Section 099000 - Painting and Coating.
- D. Stainless Body Valves: Do not coat.
- E. Do not coat flange faces of valves unless otherwise specified.

## 2.4 SOURCE QUALITY CONTROL

- A. Section 014000 “Quality Requirements”: Requirements for testing, inspection, and analysis.
- B. Testing: Test valves according to manufacturer's standard testing protocol, including hydrostatic, seal, and performance testing.
- C. Certificate of Compliance:

1. If manufacturer is approved by authorities having jurisdiction, submit certificate of compliance indicating Work performed at manufacturer's facility conforms to Contract Documents.
2. Specified shop tests are not required for Work performed by approved manufacturer.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify that piping system is ready for valve installation.
- B. Fully examine valves for debris, damage and interior finish blemishes prior to installation. Do not install valves with soiled interior or any visible damage to seats, discs or interior finish.
- C. Identify any piping, plant or equipment clearance issues prior to installation, bring to Engineer's attention via job meetings, submittal process or request for information process.

### 3.2 INSTALLATION

- A. Install valves, actuators, extensions, valve boxes, and accessories according to manufacturer instructions.
- B. Inspect valve interiors before line closure for the presence of debris. At the option of the Engineer, internal inspection of valve and appurtenances may be required any time that the likelihood of debris is a possibility. Clean connecting pipes prior to installation, testing, disinfection and final acceptance.
- C. Disinfect valves installed in potable water lines with approved pipeline disinfection process.
- D. Rigidly support valves to avoid stresses on piping.
- E. Coat studs, bolts and nuts with anti-seizing lubricant.
- F. Dielectric Fittings: Provide between dissimilar metals.
- G. Clean field welds of slag and splatter to provide a smooth surface.
- H. Mate, adjust and fully test gearboxes, electric, hydraulic and pneumatic actuators to valves at manufacturer's or integrator's facility.
  1. Only in special cases for extremely large assemblies where installation requires disassembly may actuators be mounted to the valves in the field. These circumstances require preinstallation meetings.
- I. In no case shall stems be installed vertically downward.
- J. Unless otherwise indicated on the Drawings:
  1. Install Gate, Globe, Ball valves with stem vertical in the 12 o'clock position.



2. Install Plug valves with stem horizontal and plug opening to the top of the body unless position will not allow proper actuator access, in which case stem may be vertical in the 12 o'clock position.
  3. Install Butterfly valves 12 inch and smaller with stem horizontal or vertical in the 12 o'clock position,
  4. Install Butterfly valves 14 inch and larger with the stem horizontal unless position will not allow proper actuator access, in which case stem may be vertical in the 12 o'clock position.
  5. Install Control valves in horizontal pipelines with top works vertically upward.
- K. Install all brackets, extension rods, guides, the various types of operators and appurtenances as indicated. Before properly setting these items, check all drawings and figures which have a direct bearing on their location.
- L. Inspect all materials for defects in construction and materials. Clean debris and foreign material out of openings, etc. Valve flange covers shall remain in place until connected piping is in place. Verify operability of all operating mechanisms for proper functioning. Check all nuts and bolts for tightness. Repaired or replace valves and other equipment which do not operate easily or are otherwise defective.
- M. Where installation is covered by a referenced standard, installation shall be in accordance with that standard, except as herein modified, and the Contractor shall certify such. Also note additional requirements in other parts of this Section.
- N. Unless otherwise noted, joints for valves and appurtenances shall be made up utilizing the same procedures as specified under the applicable type connecting pipe joint. Install valves and other items as recommended by the manufacturer. Verify manufacturers' torqueing requirements for all valves.
- O. Coordinate direction of flow through offset type and shaped butterfly valve discs with the mated actuator torque capacity.
- P. Rotate valve operators and indicators to display toward normal operation locations. Consult with Engineer prior to installing valves with handwheels to confirm final position of handwheel.
- Q. Vertically center floor boxes, valve boxes, extension stems, and low floor stands over the operating nut, with couplings as required.
1. Adjust elevation of the box top to conform to the elevation of the finished floor surface or grade at the completion of the Contract.
  2. Support boxes and stem guides during concrete placement to maintain vertical alignment.
- R. Install brass male adapters on each side of valves in copper-piped system and solder adapters to pipe.
- S. Install 1-inch ball valves with cap for drains at main shutoff valves, low points of piping, bases of vertical risers, and equipment.
- T. Install valves with clearance for installation of insulation and to allow access.
- U. Provide access where valves and fittings are not accessible.

- V. Pipe Hangers and Supports: As specified in Section 400507 - Hangers and Supports for Process Piping.
- W. Installation Standards: Install Work according to JEA Water and Wastewater Standards Manual, latest edition.

### 3.3 FIELD QUALITY CONTROL

#### A. Valve Field Testing:

1. Test for proper alignment.
2. If specified by valve Section, field test equipment to demonstrate operation without undue noise, vibration, or overheating.
3. Functional Test:
  - a. Prior to system startup, inspect valves and actuators for proper alignment, quiet operation, proper connection and satisfactory performance.
  - b. After installation, open and close all manual valves in the presence of the Engineer to show the valve operates smoothly from full open to full close and without leakage.
  - c. Cycle valves equipped with electric, pneumatic or hydraulic actuators 5 times from full open to full closed in the presence of the Engineer to exhibit operation without vibration, jamming, leakage, or overheating.
  - d. Operate pressure control and pressure relief valves in the presence of the Engineer to show they perform their specified function at some time prior to placing the piping system in operation and as agreed during construction coordination meetings.
4. Field test pipe lines in which the valves and appurtenances are to be installed. During these tests, adjust, remove or replace defective valve or appurtenance, or otherwise make acceptable to the Engineer. Test regulating valves, strainers, or other appurtenances to demonstrate conformance with the specified operational capabilities. Correct deficiencies, replace device or otherwise made acceptable to the Engineer.

END OF SECTION 400551

## SECTION 400553 - IDENTIFICATION FOR PROCESS 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. Nameplates.
2. Tags.
3. Stencils.
4. Pipe markers.
5. Labels.
6. Lockout devices.

- B. Related Requirements:

1. Section 099100 - Painting: Requirements for painting as specified by this Section.
2. Section 400551 - Common Requirements for Process Valves: Basic materials and methods for valves.

#### 1.3 PREINSTALLATION MEETINGS

- A. Section 013100 "Project Management and Coordination": Requirements for preinstallation meeting.
- B. Convene minimum one week prior to commencing Work of this Section.

#### 1.4 SUBMITTALS

- A. Section 013300 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit manufacturer's catalog literature for each specified product.
- C. Shop Drawings:
  1. Indicate list of wording, symbols, letter size, spacing of labels, and color-coding for mechanical identification and valve chart and schedule.
  2. Indicate valve tag number, location, function, and valve manufacturer's name and model number.

- D. Samples: Submit two tags, labels, and pipe markers for each size to be used on Project.
- E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- F. Manufacturer Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures.
- G. Qualifications Statement:
  - 1. Submit qualifications for manufacturer.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Section 017700 "Closeout Procedures": Requirements for submittals.
- B. Project Record Documents: Record actual locations of tagged valves; include valve tag numbers.

#### 1.6 QUALITY ASSURANCE

- A. Piping Color Scheme and Lettering Size: Comply with ASME A13.1.
- B. Perform Work according to St. Johns County Utility Department standards.
- C. Comply with recommended water treatment plant color coding from the latest version of Ten State Standards unless otherwise requested by Owner.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Section 016000 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- C. Store materials according to manufacturer instructions.
- D. Protection:
  - 1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
  - 2. Provide additional protection according to manufacturer instructions.

## PART 2 - PRODUCTS

### 2.1 NAMEPLATES

- A. Manufacturers:
  - 1. Craftmark Pipe Markers,
  - 2. Kolbi Pipe Marker Co.,
  - 3. Pipemarket.com (Brimar Industries, Inc.),
  - 4. Seton Identification Products
  - 5. Furnish materials according to St. Johns County Utility Department standards.
- B. Description: Laminated three-layer plastic with engraved black letters on light, contrasting background color.

### 2.2 TAGS

- A. Metal Tags:
  - 1. Manufacturers:
    - a. Brady ID,
    - b. Craftmark Pipe Markers,
    - c. Kolbi Pipe Marker Co,
    - d. Marking Services, Inc.,
    - e. Pipemarket.com (Brimar Industries, Inc.),
    - f. R&R Identification Co.
    - g. Seton Identification Products
    - h. Substitutions: Not permitted.
  - 2. Description:
    - a. Stainless-steel construction; stamped letters.
    - b. Minimum Tag Size and Configuration: 2 inches; diameter with finished edges.
    - c. Provide with brass hooks suitable for attaching the tag to the valve operator.
    - d. Stamp or etch tags with the valve number and information on the valve schedule coded in a system provided by the Owner.

### 2.3 STENCILS

- A. Manufacturers:
  - 1. Kolbi Pipe Marker Co,
  - 2. Marking Services, Inc.,
  - 3. Pipemarket.com (Brimar Industries, Inc.),
  - 4. R&R Identification Co.
  - 5. Seton Identification Products
  - 6. Substitutions: Not permitted.

B. Description:

1. Quality: Clean-cut symbols.
2. Letters:

OUTSIDE DIAMETER  
OF PIPE

SIZE OF LETTERS

3/4-in to 1-1/4-in  
1-1/2-in to 2-in  
2-1/2-in to 6-in  
8-in to 10-in  
Over 10-in

1/2-in  
3/4-in  
1-1/2-in  
2-1/2-in  
3-in

C. Stencil Paint:

1. Description: Semigloss enamel.
2. As specified in Section 099100 - Painting.

2.4 PIPE MARKERS

A. Plastic Tape Pipe Markers:

1. Manufacturers:
  - a. Brady ID,
  - b. Craftmark Pipe Markers,
  - c. Kolbi Pipe Marker Co.,
  - d. Marking Services, Inc.,
  - e. Pipemarket.com (Brimar Industries, Inc.),
  - f. Seton Identification Products
  - g. Substitutions: Not permitted.
2. Description:
  - a. Flexible, 3.5 mil vinyl film tape with pressure-sensitive adhesive backing and printed markings.
  - b. Letter sizes per Paragraph 2.3B.
  - c. Color shall be white or black depending on background color.

B. Plastic Underground Pipe Markers:

1. Manufacturers:
  - a. Kolbi Pipe Marker Co.,
  - b. Marking Services, Inc.,
  - c. Pipemarket.com (Brimar Industries, Inc.),
  - d. Rhino Marking and Protection System,
  - e. Seton Identification Products
  - f. Substitutions: Not permitted.

2. Description:

- a. Brightly colored, continuously printed plastic ribbon tape.
- b. Minimum Size: 6 inches wide by 4 mils thick.
- c. Manufactured for direct burial service.
- d. Letter sizes per Paragraph 2.3B.

2.5 LABELS

A. Manufacturers:

- 1. Brady ID,
- 2. Seton Identification Products
- 3. Substitutions: Not permitted.

B. Description:

- 1. Material: Aluminum
- 2. Minimum Size: 1.9 by 0.75 inches.
- 3. Adhesive backed, with printed identification.

2.6 LOCKOUT DEVICES

A. Lockout Hasps:

1. Manufacturers:

- a. Brady ID,
- b. Master Lock Company, LLC
- c. Substitutions: Not permitted.

2. Description:

- a. Material: Anodized aluminum
- b. Furnish hasp with erasable label surface.
- c. Minimum Size: 7-1/4 by 3 inches.

B. Valve Lockout Devices:

1. Manufacturers:

- a. Brady ID,
- b. Master Lock Company, LLC
- c. Substitutions: Not permitted.

2. Description:

- a. Material: Steel
- b. Furnish device to restrict access to valve operator and to accept lock shackle.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Section 017300 "Execution": Requirements for installation preparation.
- B. Degrease and clean surfaces to receive adhesive for identification materials.
- C. Stencil Painting: Prepare surfaces as specified in Section 099000 - Painting and Coating.

### 3.2 INSTALLATION

- A. According to manufacturer instructions.
- B. Apply stencil painting as specified in Section 099000 - Painting and Coating.
- C. Install identifying devices after completion of coverings and painting.
- D. Install plastic nameplates with corrosion-resistant mechanical fasteners or adhesive.
- E. Labels:
  - 1. Install labels with sufficient adhesive for permanent adhesion and seal with clear lacquer.
  - 2. For unfinished covering, apply paint primer before applying labels.
  - 3. Titles:
    - a. Locate a maximum 26 feet apart.
    - b. Locate directly adjacent to pipeline breaches on each side wall.
    - c. Locate adjacent to each side of the valve regulator, flow meter, strainer, cleanout and all pieces of equipment.
    - d. Identify the contents by complete name at least once in each room or space and thereafter may be labeled by generally recognized abbreviations.
- F. Tags:
  - 1. Identify valves in main and branch piping with tags.
  - 2. Install tags using corrosion-resistant chain.
  - 3. Number tags consecutively by location.
- G. Install underground plastic pipe markers 6 to 8 inches below finished grade, directly above buried pipe.
- H. Piping:
  - 1. Identify piping, concealed or exposed, with plastic tape pipe markers.
  - 2. Use tags on piping 3/4-inch diameter and smaller.
  - 3. Identify service, flow direction, and pressure.
  - 4. Install in clear view and align with axis of piping.



5. Locate identification not to exceed 20 feet on straight runs, including risers and drops, adjacent to each valve and tee, at each side of penetration of structure or enclosure, and at each obstruction.

END OF SECTION 400553

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## SECTION 400561 - GATE VALVES

### 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 Work shall be in accordance with JEA Water and Wastewater Standards (January 2019 or latest)

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Solid wedge, resilient-seated gate valves
- B. Related Requirements:
  - 1. Section 400551 - Common Requirements for Process Valves: Basic materials and methods related to valves commonly used for process systems.

#### 1.3 DEFINITIONS

- A. Outside screw and yoke (os&y) valve: A valve in which the operating screw is driven by a threaded nut that is built into the handle.

#### 1.4 SUBMITTALS

- A. As specified in Section 400551 – Common Requirements for Process Valves: Submittal requirements for compliance with this section.

#### 1.5 QUALITY ASSURANCE

- A. Test valves in accordance with AWWA C500, C509, C515.
- B. Provide Installation Inspection and Operator Training per Section 400551.
- C. Provide testing and inspection certificates.

## PART 2 - PRODUCTS

### 2.1 SOLID WEDGE, RESILIENT-SEATED GATE VALVES – TAG TYPE GV4

#### A. Manufacturers:

1. Mueller Co. A2360, A2361
2. American Flow Control “2400 Series”
3. AVK (S/S Stem) “Series 45”
4. Clow Valve “F-6100”
5. Kennedy “8571”
6. M&H “4067”
7. U.S. Pipe “250”
8. United Water Products “2010”
9. American-RD “D100”
10. Substitutions: Owner approved equal.

#### B. Description:

1. Comply with AWWA C509.
2. Minimum Working Pressure: 250 psig at 72 deg. F.
3. Maximum Process Fluid Temperature: 72 deg. F.
4. End Connections: ASME B16.1, ASME B16.5, and ASME B16.42, flanged, and Mechanical joint.
5. Gear Actuators for Manual Valves: Comply with AWWA C509.
6. Body: no recesses in valve body.

#### C. Operation:

1. As specified in Section 400551 - Common Requirements for Process Valves.
2. Stem: Non-rising.
3. Able to withstand torque of 700 ft. lbs. without compromising operation.
4. Handwheel.
5. Furnish gear operators for valves 8 inches and larger.

#### D. Materials:

1. Wedge: Resilient ASTM A126, cast iron, fully encapsulated with molded rubber.
2. Body and Disc: ASTM A126, cast iron or ASTM A536, ductile iron, AWWA C509, vulcanized rubber coated.
3. Stem, Stem Nuts, Glands, and Bushings: Type 316 stainless steel.
4. Connecting Hardware: Type 316 stainless steel.

#### E. Finishes:

1. As specified in Section 400551 - Common Requirements for Process Valves.
2. Body, internal and external, including bonnet: AWWA C550, Epoxy, 4-mil minimum thickness.

## 2.2 TAPPING VALVES AND SLEEVES – Tag Type TPGV

### A. Manufacturers:

1. Tapping Valves: Mueller Co., T2360.
  - a. Substitutions: Approved equal.
2. Tapping Sleeves: JCM Model 432, SS.
  - a. Substitutions: Approved equal.

### B. Description:

1. Tapping Valves: Tapping valves shall be iron body, bronze mounted gate valves, non-rising stem, open left, resilient seat, 2 inch square operating nut, for vertical mounting on buried water lines.
2. Tapping Sleeves: Tapping sleeves shall be stainless steel. The tapping sleeve including the flange, nuts and bolts shall be 304 stainless steel. The pilot flange shall be recessed for tapping in accordance with MSS SP-60 and rated Class D per AWWA C207 with a 125 pound drilling conforming to ANSI B16.
3. As specified in Section 400551 - Common Requirements for Process Valves.
4. Gate Guide: Plugged, bottom flush port
5. Include tap for pressure/leak testing
6. Pass full, normal sized cutter

### C. Connection:

1. The valve ends shall be MSS-SP-60, Mechanical joint for use with ductile iron pipe on one side, and ASME B16.1, ASME B16.5, and ASME B16.42, flanged on the other side.
2. Tapping service port

### D. Materials:

1. Wedge Disc: iron and fully encapsulated with molded rubber.

## 2.3 SOURCE QUALITY CONTROL

- A. Section 014000 - Quality Requirements: Requirements for testing, inspection, and analysis.
- B. As specified in Section 400551 - Common Requirements for Process Valves.
- C. Testing: Test gate valves according to AWWA C509 and latest JEA Standards.
- D. UL and FM approved

PART 3 - EXECUTION

3.1 INSTALLATION

- A. According to AWWA C509 and latest JEA Standards.

END OF SECTION 400561

## SECTION 400563 - BALL VALVES

### 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 Work shall be in accordance with JEA Water and Wastewater Standards (January 2019 or latest).

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Rubber-seated ball valves.
  - 2. Plastic ball valves.
- B. Related Requirements:
  - 1. Section 400551 - Common Requirements for Process Valves: Basic materials and methods related to valves commonly used for process systems.

#### 1.3 SUBMITTALS

- A. As specified in Section 400551 - Common Requirements for Process Valves: Submittal requirements for compliance with this Section.

#### 1.4 QUALITY ASSURANCE

- A. Test valves in accordance with AWWA C504, API 598, MSS SP61 as applicable for types listed herein.
- B. Provide Installation Inspection and Operator Training per Section 400551.
- C. Provide testing and inspection certificates.

### PART 2 - PRODUCTS

#### 2.1 PLASTIC BALL VALVES FOR SODIUM HYPOCHLORITE

- A. Manufacturers:

1. ASAHI-America

B. Up to 4 Inches:

1. AWWA C507, Class 150.
2. Minimum Working Pressure: 150 psig at 73 deg. F.
3. Design minimum fluid velocity: 35 feet per second.
4. Body:
  - a. Material: PVC
  - b. Seats and Seals: PTFE.
5. Ball:
  - a. Material: PVC.
  - b. Opening: Full port.
  - c. Vented
6. End Connections:
  - a. True Union
7. Operator: Manual quarter turn.

## 2.2 BALL VALVES FOR WATER SERVICE

A. Manufacturers:

1. Conbraco Ind. "Apollo 76F Series"

B. Description:

1. Threaded or flanged as shown on the drawings
2. AWWA C507, Class 150.
3. Rated 125 SWP
4. 200-pound WOG
5. Body:
  - a. Material: 316 stainless steel body and trim
  - b. Seats and Seals: PTFE.
  - c. Two or three piece design
  - d. No internal ring for the ball shall be acceptable
6. Ball:
  - a. Material: 316 stainless steel
  - b. Opening: Full bore port.



C. Actuator:

1. Valves shall be supplied with stainless steel manual lever or “T” handle. Valves used as moisture drains shall be installed at low points of the line and piped to drain.
2. Gear Actuators for Manual Valves: Comply with AWWA C504.

2.3 SOURCE QUALITY CONTROL

- A. Section 014000 - Quality Requirements: Requirements for testing, inspection, and analysis.
- B. As specified in Section 400551 - Common Requirements for Process Valves.
- C. Testing: Test ball valves according to AWWA C507.

PART 3 - EXECUTION

3.1 INSPECTION

- A. As specified in Section 400551 - Common Requirements for Process Valves: Submittal requirements for compliance with this Section.

3.2 INSTALLATION

- A. According to AWWA C507.
- B. As specified in Section 400551 – Common Requirements for Process Valves.

END OF SECTION 400563

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## SECTION 400564 - BUTTERFLY VALVES

### 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 Work shall be in accordance with JEA Water and Wastewater Standards (January 2019 or latest).

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. AWWA butterfly valves.

#### 1.3 SUBMITTALS

- A. Product Data: Submit manufacturer's catalog information, indicating materials of construction and compliance with indicated standards. The manufacturer shall submit an affidavit of compliance stating that the valves have been manufactured and tested in accordance with AWWA C504 and specifically listing all exceptions.
- B. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- C. Source Quality-Control Submittals: Indicate results of factory tests and inspections and provide required certifications.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.
- B. Qualifications Statement:
  - 1. Submit qualifications for manufacturer.
  - 2. American Iron and Steel (AIS): Submit certification indicating compliance with AIS requirements

#### 1.5 QUALITY ASSURANCE

- A. Test valves in accordance with AWWA C504
- B. Provide Installation Inspection and Operator Training per Section 400551.

- C. Provide testing and inspection certificates.

## PART 2 - PRODUCTS

### 2.1 AWWA BUTTERFLY VALVES

A. Manufacturers:

1. GA Series 800, worm gear with handwheel
2. Val-Matic 500 Series with handwheel

B. Description:

1. Comply with AWWA C504, Class 150B.
2. Butterfly valves for above grade shall be Class 125. ANSI 125/150 flanged end with face-to-face dimensions in accordance with Table 2 of AWWA C504 for short-body valve.
3. Valves shall have a minimum 150 psi pressure rating or higher as noted on the Drawings
4. Valve Seats
  - a. Valve seats shall be in the valve body and retained in accordance with AWWA C504. Seats shall be synthetic rubber (EPDM). Valve discs shall be constructed of cast iron, ASTM A48, Class 40; Ni-resist, ASTM A436, Type 1; or ductile iron, ASTM A536, Grade 65-45-12. The service class shall be AWWA Class 150B for all valves.
5. Spray coat interior wetted ferrous surfaces with an AWWA and U.S. Food and Drug Administration two-component epoxy approved for potable water.
6. Shaft Seals/Packing
  - a. The valve body shall be constructed of close-grain cast iron per ASTM A126, Class B with integrally cast hubs for shaft bearing housings of the through boss type. Permanently self-lubricating body bushings shall be provided and shall be sized to withstand bearing loads.
  - b. Stuffing box of liberal dimensions shall be provided at the operator end of the vane shaft.
  - c. Packing shall be of the self-compensating V-type. A sealing element utilizing O-rings shall also be acceptable.
  - d. Packing shall be held in place by a bolted corrosion-resistant retainer plate or gland. Retainer clips are not acceptable.
  - e. Replacement of seals, for all size butterfly valves, shall not require removal of the valve from the line.
7. The valve shaft and steel torque tube shall be turned, ground, and polished 18-8 Type 316 stainless steel and designed for both torsional and shearing stresses when the valve is operated under its greatest dynamic or seating torque. No reductions of shaft diameter will be allowed, except at the operator connection. Any reduction shall have a full radius fillet. The use of shafts having a hexagonal cross section will not be acceptable. Attach disc to shaft with stainless steel tapered pins and locking nuts.

8. Actuators:
  - a. The butterfly valve actuator shall conform to the requirements of AWWA C504, insofar as applicable and as specified herein.
  - b. Gearing for the actuators, where required, shall be totally enclosed in a gear case in accordance with AWWA C504.
  - c. The manual actuators shall conform to AWWA C504, insofar as applicable. Actuators shall have permanent indicators with raised or engraved marks to show position of the valve disc.
9. A foundry stamp consisting of foundry identification symbol, material identification, heat number, and serial number shall be cast into the surface of the pressure boundary parts of the valve body and cover. Manufacturer's identification shall be cast adjacent to the foundry cast. Additionally, valve size, class, and year of manufacture shall be cast into the body.

## 2.2 SOURCE QUALITY CONTROL

- A. Section 014000 - Quality Requirements: Requirements for testing, inspection, and analysis.
- B. Testing: Test butterfly valves for 15 minutes at 150 psi and conform to AWWA C504.
- C. Submit an affidavit of compliance stating that the valves have been manufactured and tested in accordance with AWWA C504 and specifically list all exceptions.

## PART 3 - EXECUTION

### 3.1 Examination

- A. As specified in Section 400551 - Common Requirements for Process Valves: Submittal requirements for compliance with this Section.

### 3.2 INSTALLATION

- A. As specified in Section 400551 – Common Requirements for Process Valves.
- B. According to Manufacturer's Instructions

END OF SECTION 400564

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## SECTION 400565.33 – RUBBER FLAPPER CHECK VALVES

### 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. Rubber flapper check valves 6 inches and larger.

- B. Related Requirements:

- 1. Division 09: Coating and touchup of shop-primed surfaces with primer.
  - 2. Section 220523 “General-Duty Valves for Plumbing Piping”: Miscellaneous plumbing valves as required by Project.
  - 3. Section 400551 “Common Requirements for Process Valves”: Basic materials and methods related to valves commonly used for process systems.

#### 1.3 COORDINATION

- A. Section 400551 “Common Requirements for Process Valves” for valve schedules.
- B. Coordinate Work of this Section with piping and equipment connections as specified in other Sections and as indicated on Drawings.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: Submit manufacturer's catalog information, indicating materials of construction and compliance with indicated standards.
- B. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- C. Source Quality-Control Submittals: Indicate results of factory tests and inspections and provide required certifications.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

B. Qualifications Statement:

1. Submit qualifications for manufacturer.
2. American Iron and Steel (AIS): Submit certification indicating compliance with AIS requirements.

1.6 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of piping, valves and other appurtenances, connections, and centerline elevations.

1.7 QUALITY ASSURANCE

- A. Materials in Contact with Potable Water: Certified according to NSF 61 and NSF 372.
- B. Perform Work according to latest JEA Water and Wastewater Standards.
- C. Maintain one copy of each standard affecting Work of this Section on Site.

1.8 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum 10 years' documented experience.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- B. Store materials according to manufacturer instructions.
- C. Protection:
1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
  2. Protect valves and appurtenances by storing off ground.
  3. Protect valve ends from entry of foreign materials by providing temporary covers and plugs.
  4. Provide additional protection according to manufacturer instructions.

1.10 WARRANTY

- A. Furnish one-year manufacturer's warranty for rubber flapper check valves.



## PART 2 - PRODUCTS

### 2.1 RUBBER FLAPPER CHECK VALVES 6-INCH AND LARGER - TAG TYPE RFCV

#### A. Manufacturers:

1. Surgebuster® Swing Check Valve by Val-Matic®

#### B. Description:

1. The valve body to be full flow equal to nominal pipe diameter at all points through the valve.
2. The seating surface shall be on a 45-degree angle to minimize disc travel.
3. A threaded port with pipe plug shall be provided on the bottom of the valve to allow for field installation of a backflow actuator or oil cushion device without special tools or removing the valve from the line.
4. Non-slam closing characteristics shall be provided through a short 35-degree disc stroke and a disc accelerator to provide a cracking pressure of 0.3 psig.
5. Comply with AWWA C508.
6. Type: Swing, rubber encapsulated metal disc, movement provided via flexing of reinforced rubber tab.
7. Seat: resilient, bronze, integral with rubber disc encapsulation.
8. Minimum Working Pressure: 150 psi
9. Accessories:
  - a. Position limit switch (mechanical type):  
Rating: NEMA 4 and shall have U.L. rated 5 amp, 125 VAC contacts.  
Manufacturer: Model 802B Compact as Manufactured by Allen Bradley, or approved equal.
10. Mounting: Horizontal or vertical.
11. End Connections: Flanged, ASME B16.1.

#### C. Materials:

1. Body and Cover: Ductile iron, ASTM A536 Grade 65-45-12 or ASTM A126 class B gray iron.
2. Disc: molded Buna-N (NBR), ASTM D2000-BG.
3. Disc Accelerator: Type 302 stainless steel
4. Seat: integral to disc encapsulation.

#### D. Controls

1. Position switches: lever type, NEMA 7 enclosure, SPST, 120VAC, 6A, Square D Type 9007CR or approved equal.
2. Bracket and hardware: Type 316 stainless steel.

#### E. Finishes: As specified in Section 400551 "Common Requirements for Process Valves."

## 2.2 SOURCE QUALITY CONTROL

- A. Section 014000 “Quality Requirements”: Requirements for testing, inspection, and analysis.
- B. Section 400551 “Common Requirements for Process Valves.”
- C. Testing:
  - 1. Hydrostatically test check valves at twice rated pressure according to AWWA C508.
  - 2. Permitted Leakage at Indicated Working Pressure: None.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Section 017300 “Execution”: Requirements for installation examination.
- B. Verify that field dimensions are as indicated on Shop Drawings.
- C. Inspect existing flanges for nonstandard bolt-hole configurations or design and verify that new valve and flange mate properly.

### 3.2 PREPARATION

- A. Section 017300 “Execution”: Requirements for installation preparation.
- B. Thoroughly clean valves before installation.
- C. Surface Preparation:
  - 1. Solvent-clean surfaces that are not shop primed.
  - 2. Clean surfaces to remove loose rust, mill scale, and other foreign substances by power wire brushing.
  - 3. Prime surfaces as specified in Division 09.

### 3.3 INSTALLATION

- A. According to AWWA C508 and manufacturer instructions.
- B. Dielectric Fittings: Provide between dissimilar metals.
- C. Installation Standards: Install Work according to JEA’s latest Water and Wastewater Standards Manual.

### 3.4 FIELD QUALITY CONTROL

- A. Section 017300 “Execution”: Requirements for inspecting and testing.
- B. Inspection:
  - 1. Inspect for damage to valve lining or coating and for other defects that may be detrimental as determined by Engineer.
  - 2. Repair damaged valve or provide new, undamaged valve.
  - 3. After installation, inspect for proper supports and interferences.
- C. Pressure test valves with piping.

### 3.5 CLEANING

- A. Section 017300 “Execution” and 017700 “Closeout Procedures”: Requirements for cleaning.
- B. Keep valve interior clean as installation progresses.
- C. After installation, clean valve interior of soil, grit, loose mortar, and other debris.

END OF SECTION 400565.33

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## SECTION 400578.11 - AIR RELEASE VALVES FOR WATER SERVICE

### 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: Air release valves for water treatment facilities.
- B. Related Requirements:
  - 1. Section 400507 - Hangers and Supports for Process Piping: Anchors and supports.
  - 2. Section 400551 - Common Requirements for Process Valves: Typical product and installation requirements for valves specified in this Section.

#### 1.3 COORDINATION

- A. Section 013100 "Project Management and Coordination": Requirements for coordination.
- B. Coordinate Work of this Section with installation of process piping.

#### 1.4 PREINSTALLATION MEETINGS

- A. Section 013100 "Project Management and Coordination": Requirements for preinstallation meeting.
- B. Section 400551 – Common Requirements for Process Valves.

#### 1.5 SUBMITTALS

- A. Section 013300 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit manufacturer catalog information.
- C. Shop Drawings: Submit assembly drawings indicating materials, dimensions, weights, and end connections.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- E. Manufacturer Instructions: Submit special procedures and setting dimensions.

- F. Source Quality-Control Submittals: Indicate results of tests and inspections and provide required certifications.
- G. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.
- H. Manufacturer Reports: Certify that equipment has been installed according to manufacturer instructions.
- I. Qualifications Statements:
  - 1. Submit qualifications for manufacturer and installer.
  - 2. Submit manufacturer's approval of installer.
  - 3. American Iron and Steel (AIS): Submit certification indicating compliance with AIS requirements.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Section 017700 "Closeout Procedures": Requirements for submittals.
- B. Project Record Documents: Record actual locations of air release valves.

#### 1.7 QUALITY ASSURANCE

- A. Materials in Contact with Potable Water: Certified to NSF 61 and NSF 372.
- B. Perform Work according to JEA Water and Wastewater Standards (latest edition).

#### 1.8 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum five years' experience.

#### 1.9 DELIVERY, STORAGE, AND HANDLING

- A. Section 016000 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- C. Store materials according to manufacturer instructions.
- D. Protection:
  - 1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
  - 2. Furnish temporary end caps and closures on piping and fittings and maintain in place until installation.

3. Provide additional protection according to manufacturer instructions.

#### 1.10 EXISTING CONDITIONS

##### A. Field Measurements:

1. Verify field measurements prior to fabrication.
2. Indicate field measurements on Shop Drawings.

#### 1.11 WARRANTY

- A. Section 017700 "Closeout Procedures": Requirements for warranties.
- B. Furnish one-year manufacturer's warranty for air release valves.

### PART 2 - PRODUCTS

#### 2.1 AIR RELEASE VALVES FOR WATER SERVICE – Tag Type ARV1

##### A. Manufacturers:

1. Crispin
2. Val-Matic Valve & Manufacturing Corp.

##### B. Description:

1. Comply with AWWA C512.
2. Small orifice assembly air release valves shall automatically release air accumulations from pipe while under positive pressure. When valve body fills with air, float mechanism shall fall to open small orifice and exhaust air to atmosphere. When air has been exhausted, float mechanism shall be buoyed up and shall tightly close small orifice.
3. Air release valves shall be supplied with shutoff gate, butterfly or ball valves.

##### C. Materials for Metal Valves:

1. Body and Cover: Ductile iron
2. Float: Type 316 stainless steel
3. Seat: Buna-N.
4. Hardware: Type 316 stainless steel

##### D. Working Pressure: 150 psig.

##### E. Size: As indicated on Drawings.

##### F. End Connections:

1. Size 1/2 to 3 Inches: Threaded.
2. Size 4 Inches and Larger: Flanged.

## 2.2 SOURCE QUALITY CONTROL

- A. Section 014000 - Quality Requirements: Requirements for testing, inspection, and analysis.
- B. Provide shop inspection and testing of completed assembly.
- C. Certificate of Compliance:
  - 1. If fabricator is approved by authorities having jurisdiction, submit certificate of compliance indicating Work performed at fabricator's facility conforms to Contract Documents.
  - 2. Specified shop tests are not required for Work performed by approved fabricator.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Section 017300 "Execution": Requirements for installation examination.
- B. Verify that field dimensions are as indicated on Drawings.
- C. Inspect existing flanges for nonstandard bolt hole configurations or design, and verify that new pipe and flanges mate properly.
- D. Van Stone flanges shall not be used with pinch valves, industrial butterfly valves; elastomer bellows style expansion joints or other piping system components having an elastomer liner that is used as a gasket.

### 3.2 PREPARATION

- A. Section 017300 "Execution": Requirements for installation preparation.
- B. Thoroughly clean end connections before installation.
- C. Close pipe and equipment openings with caps or plugs during installation.
- D. Cleaning: Clean surfaces to remove foreign substances.

### 3.3 INSTALLATION

- A. According to manufacturer instructions.
- B. Provide access for operation, removal, and maintenance, and to avoid discharge to occupied areas or other equipment.
- C. Vent the valve properly and pipe outlet to nearest drain or as directed by the Engineer.



### 3.4 FIELD QUALITY CONTROL

- A. Section 014000 - Quality Requirements: Requirements for inspecting and testing.
- B. Inspect for interferences and proper supports.
- C. Testing:
  - 1. As specified in Section 400551 - Common Requirements for Process Valves.
  - 2. Demonstrate operation without undue noise or vibration.
- D. Equipment Acceptance:
  - 1. Adjust, repair, modify, or replace components failing to perform as specified and rerun tests.
  - 2. Make final adjustments to equipment under direction of manufacturer's representative.
  - 3. Repair damaged coatings with material equal to original coating.
- E. Furnish installation certificate from equipment manufacturer's representative attesting that equipment has been properly installed and is ready for startup and testing.

### 3.5 CLEANING

- A. Sections 017300 "Execution" and 017700 "Closeout Procedures": Requirements for cleaning.
- B. Keep interior of air release valves clean as installation progresses.

### 3.6 DEMONSTRATION

- A. Section 017900 "Demonstration and Training": Requirements for demonstration and training.
- B. Demonstrate equipment startup, shutdown, routine maintenance, and emergency repair procedures to Owner's personnel.

END OF SECTION 400578.11

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## SECTION 400578.13 - AIR/VACUUM VALVES FOR WATER SERVICE

### 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: Air release/vacuum breaker valves for water treatment facilities.
- B. Related Requirements:
  - 1. Section 099010 "Shop Priming" Preparing and priming, including field-applied and equipment finishing.
  - 2. Section 099100 "Painting" Painting surfaces, including field-applied and equipment finishing.
  - 3. Section 400507 - Hangers and Supports for Process Piping: Anchors and supports.
  - 4. Section 400551 - Common Requirements for Process Valves: Typical product and installation requirements for valves specified in this Section.

#### 1.3 COORDINATION

- A. Coordinate Work of this Section with installation of process piping.

#### 1.4 SUBMITTALS

- A. Section 013300 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit manufacturer catalog information.
- C. Shop Drawings: Indicate materials, dimensions, weights, and end connections on assembly drawings.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- E. Manufacturer Instructions: Submit special procedures and setting dimensions.
- F. Manufacturer Reports: Certify that equipment has been installed according to manufacturer instructions.

1.5 QUALITY ASSURANCE

- A. Materials in Contact with Potable Water: Certified to NSF 61 and NSF 372.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum five years' experience.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Section 016000 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- C. Store materials according to manufacturer instructions.
- D. Protection:
  - 1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
  - 2. Furnish temporary end caps and closures on piping and fittings and maintain in place until installation.
  - 3. Provide additional protection according to manufacturer instructions.

1.8 EXISTING CONDITIONS

- A. Field Measurements:
  - 1. Verify field measurements prior to fabrication.
  - 2. Indicate field measurements on Shop Drawings.

1.9 WARRANTY

- A. Section 017700 "Closeout Procedures": Requirements for warranties.
- B. Furnish one year manufacturer's warranty for air release/vacuum breaker valves.

## PART 2 - PRODUCTS

### 2.1 AIR/VACUUM RELIEF VALVES FOR WATER SERVICE – TAG TYPE AVR V

#### A. Manufacturers:

1. Val-Matic
2. Crispin
3. or approved equal.

#### B. Description:

1. Type: Fully automatic, float operated.
2. Comply with AWWA C512.
3. Size: As indicated on Drawings.
4. Suitable for potable water service.
5. Pressure Rating: 150 psig or Maximum service pipeline pressure.
6. Maximum Operating Temperature: 85 deg. F.
7. Valves shall be designed to release large amounts of air during pipeline filling, release small amounts of air accumulated during pipeline operation, and allow large volume of air during pipeline drainage or pipe break. Valves shall have an intake orifice area equal to nominal size of valve.
8. Discharge of pressurized air shall be controlled by seating and unseating of a small orifice needle on the control float. Venting of large quantities of air during pipeline filling shall be accomplished through a large orifice at top of valve. Vacuum relief shall be accomplished through the large orifice when the control float falls due to negative pressure in the pipeline. Valve design shall incorporate an over pressure safety feature that will fail without an explosive effect, such as is normally the case when highly compressed air is released suddenly. Feature shall consist of easily replaceable gaskets.
9. Pipeline air and vacuum relief valves shall be supplied with shutoff ball valves.

#### C. Materials:

1. Body and Cover: Cast iron, ASTM A126 or Ductile iron, ASTM A536I
2. Float: Type 316 stainless steel
3. Trim: Type 316 Stainless steel
4. Seats: Buna-N or VITON
5. Seals: Buna-N/Nitrile
6. Hardware: Type 316 Stainless steel

#### D. End Connections:

1. 1-inch or 2-inch threaded, NPT.
2. Material: brass.
3. Accessories: Furnish one additional NPT connections.

#### E. Accessories:

1. Backwash accessories, including inlet shutoff valve, blowoff valve, rubber supply hose, and quick-disconnect couplings.

2. Epoxy lining.
3. 2" and larger: Antislam device

## 2.2 VACUUM BREAKER

### A. Manufacturer and Model:

1. Watts LF288A, or approved equal.

## 2.3 FINISHES

- ### A.
- Prepare piping appurtenances for field finishes as specified in Section 099010 – Shop Priming.

## 2.4 SOURCE QUALITY CONTROL

- ### A.
- Section 014000 - Quality Requirements: Requirements for testing, inspection, and analysis.
- ### B.
- Provide shop inspection and testing of completed assembly.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- #### A.
- Section 017300 "Execution": Requirements for installation examination.
- #### B.
- Verify that field dimensions are as indicated on Shop Drawings.
- #### C.
- Inspect existing flanges for nonstandard bolt hole configurations or design and verify that new pipe and flanges mate properly.

### 3.2 PREPARATION

- #### A.
- Section 017300 "Execution": Requirements for installation preparation.
- #### B.
- Thoroughly clean end connections before installation.
- #### C.
- Close pipe and equipment openings with caps or plugs during installation.
- #### D.
- Surface Preparation: Clean surfaces to remove foreign substances.

### 3.3 INSTALLATION

- #### A.
- According to manufacturer instructions.

- B. Provide access for operation, removal, and maintenance, and to avoid discharge to occupied areas or other equipment.
- C. Installation Standards: Install Work according to St. Johns County Utility Department standards.

### 3.4 FIELD QUALITY CONTROL

- A. Section 014000 - Quality Requirements: Requirements for inspecting and testing.
- B. Inspect for interferences and proper supports.
- C. Testing:
  - 1. As specified in Section 400551 - Common Requirements for Process Valves.
  - 2. Demonstrate operation without undue noise or vibration.
- D. Manufacturer Services: Furnish services of manufacturer's representative experienced in installation of products furnished under this Section for not less than 1 day on Site for installation, inspection, startup, field testing, and instructing Owner's personnel in operation and maintenance of equipment.
- E. Equipment Acceptance:
  - 1. Adjust, repair, modify, or replace components failing to perform as specified and rerun tests.
  - 2. Make final adjustments to equipment under direction of manufacturer's representative.
  - 3. Repair damaged coatings with material equal to original coating.
- F. Furnish installation certificate from equipment manufacturer's representative attesting that equipment has been properly installed and is ready for startup and testing.

### 3.5 CLEANING

- A. Section 017300 "Execution" and 017700 "Closeout Procedures": Requirements for cleaning.
- B. Keep interior of air release valves clean as installation progresses.

### 3.6 DEMONSTRATION

- A. Section 017900 "Demonstration and Training": Requirements for demonstration and training.
- B. Demonstrate equipment startup, shutdown, routine maintenance, and emergency repair procedures to Owner's personnel.

END OF SECTION 400578.13

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## SECTION 400593.23 – LOW-VOLTAGE MOTOR REQUIREMENTS FOR PROCESS 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. Single- and three-phase motors for application on process equipment provided under other Sections.
  - 2. Motors furnished loose to Project.
- B. The manufacturer of the driven equipment shall provide the associated motor.
- C. Related Requirements:
  - 1. Section 260526, "Grounding and Bonding for Electrical Systems".
  - 2. Section 260553, "Identification for Electrical Systems".

#### 1.3 DEFINITIONS

- A. NETA ATS: Acceptance Testing Specification.
- B. VFC: Variable-frequency motor controller. See VFD.
- C. VFD: Variable-frequency drive. Used interchangeably with the term VFC.

#### 1.4 SUBMITTALS

- A. Product Data: For each type and rating of motor indicated.
  - 1. Include construction details, material descriptions, dimensions, profiles, and finishes.
  - 2. Include nameplate data, compliance with specified standards, electrical ratings and characteristics, physical dimensions, frame size, weights, mechanical performance data, support points and the following:
    - a. Descriptive bulletins, including full description of insulation system.
    - b. Bearing design data.
    - c. Efficiency at  $\frac{1}{2}$ ,  $\frac{3}{4}$  and full load.
    - d. Power factor at  $\frac{1}{2}$ ,  $\frac{3}{4}$  and full load.
    - e. Conduit entry points and sizes.

- f. Special features and accessories (i.e. space heaters, temperature detectors, etc.).
  - g. Power factor correction capacitor rating and type (when required).
- B. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- C. Qualifications Statements:
  - 1. Submit qualifications for manufacturer and testing agency.

#### 1.5 QUALITY ASSURANCE

- A. Electric motors driving identical equipment shall be identical
- B. Motors shall be listed under UL recognized component file as applicable.
- C. Motor manufacturer to maintain a documented ISO 9001 quality assurance program implementing suitable procedures and controls to monitor all aspects of production and testing.
- D. When electrically driven equipment differs from that indicated, adjust the motor size, wiring and conduit systems, disconnect devices, and circuit protection to accommodate the equipment actually installed.
- E. Testing Agency Qualifications: Member company of NETA or NICET.

#### 1.6 DELIVERY, STORAGE AND HANDLING

- A. Ship motor fully assembled, capable of being lifted in one piece. Comply with Section 016000, "Product Requirements" for transporting, handling, storing, and protecting products.
- B. Inspection: Accept materials on site in manufacturer's original packaging and inspect for damage.
- C. Storage:
  - 1. Store materials according to manufacturer instructions.
  - 2. Energize motors furnished with space heaters to prevent condensation throughout the storage and construction period. Perform periodic motor insulation resistance tests per manufacturer's storage recommendations.
  - 3. For extended outdoor storage, remove motors from equipment and store separately.
  - 4. Maintain bearings during storage and construction period, and periodically rotate the motor shaft per manufacturer's storage recommendations.
  - 5. Lubricate per manufacturer's recommendations and inspect purged grease for water, rust, or other contaminants.
- D. Protection:
  - 1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
  - 2. Provide additional protection according to manufacturer instructions.

## 1.7 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of motors that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Three-year(s) from date of Substantial Completion for inverter duty motors.
  - 2. Warranty Period: Five-year(s) from date of Substantial Completion for constant speed severe-duty motors.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Acceptable Manufacturers:
  - 1. Nidec (US Motors)
  - 2. ABB (Baldor-Reliance)
  - 3. TECO-Westinghouse
  - 4. Toshiba
  - 5. WEG
  - 6. General Electric
  - 7. Or equal

### 2.2 GENERAL MOTOR REQUIREMENTS

- A. Comply with requirements in this Section except when stricter requirements are specified in equipment schedules or Sections.
- B. Comply with the latest revision of the following as applicable:
  - 1. NEMA MG 1, "Motors and Generators".
  - 2. IEEE 841 for TEFC motors where driven equipment specification indicates equipment requires motors to be severe-duty, chemical duty, or mill duty.
- C. Unless otherwise noted, all motors ½ through 100 horsepower shall be rated 230/460 Volt, three-phase, 60 Hertz A.C.; motors 125 horsepower and above shall be rated 460 Volt, three-phase, 60 Hertz; and motors below ½ horsepower shall be rated 115/230 Volt, single phase, 60 Hertz A.C.
- D. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.
- E. 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.
- F. Horsepower rating: Size for operation within the full load nameplate rating without applying the service factor, throughout the full range of mechanical or hydraulic operating condition.

- G. Specific motor application data such as Hp, rpm, enclosure type, accessories, etc., are specified under the detailed driven mechanical equipment specification.
- H. Nameplates: Engrave or emboss on 316 stainless steel fastened to the motor frame with stainless steel screws or drive pins with information per NEMA MG 1.
- I. Space heater: Include 120-volt space heater for moisture control on all motors rated 50 horsepower and larger.
- J. Service Factor: 1.15 service factor on sine wave power and 1.0 service factor on VFD power in a 40 degrees C ambient, unless otherwise noted.
- K. Motors and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- L. Enclosures: Conform to one of the NEMA standard enclosure designs as specified under the detailed driven mechanical equipment specification. If no enclosure type is specified, provide TEFC (Totally Enclosed Fan Cooled) enclosures.
- M. Motors connected to VFCs: Inverter duty rated and comply with NEMA MG 1, Part 31. First or second torsional critical speed shall be outside the operating speed range for all VFC controlled motors.
- N. Three-phase motors:
  - 1. Description: NEMA MG 1, Design B, medium induction motor.
  - 2. Efficiency: Meet or exceed requirements for NEMA MG 1, Part 12 for Premium Efficient motors 1 HP and larger.
  - 3. Service Factor: 1.15.
  - 4. Multispeed Motors: Variable torque.
    - a. For motors with 2:1 speed ratio, consequent pole, single winding.
    - b. For motors with other than 2:1 speed ratio, separate winding for each speed.
  - 5. Rotor: Random-wound, squirrel cage.
  - 6. Code Letter Designation:
    - a. Motors 15 HP and Larger: NEMA starting Code F or Code G.
    - b. Motors Smaller Than 15 HP: Manufacturer's standard starting characteristic.
  - 7. Accessories: Where specified herein, or under process mechanical specification.

## 2.3 THREE PHASE MOTOR CONSTRUCTION

- A. Enclosure and Frame:
  - 1. NEMA enclosure type as specified in the process equipment specification.
  - 2. NEMA frame for the associated horsepower.
  - 3. Motor frames: Cast iron or welded heavy plate steel construction, stiff enough to withstand the rotating forces and torques generated and designed to limit or avoid any undesirable harmonic resonances.

4. Provide a threaded, forged steel, shouldered eyebolt blind tapped into the motor frame for lifting on all frames 254T and larger.
5. Condensate drain openings: Locate drain holes at the low points in the end brackets to allow removal of accumulated moisture from enclosures. Provide corrosion resistant, breather drain plugs for severe-duty motors.
6. Hardware: Hex head, SAE Grade 5 or better, plated for corrosion protection.
7. Nameplates: Engraved or embossed stainless steel plates fastened to the motor frame with stainless steel screws or drive pins. Clearly indicate all items of information listed in the applicable part of NEMA MG 1.
8. Main terminal box: Fabricated steel or cast iron, sized per the NEC for number and size of conduit connections and conductor bending and terminations as indicated on the Drawings. Split box top to bottom with capability to rotate entry point to any quadrant. Provide gaskets between the box and motor frame and between box and its cover. Include ground lug for equipment grounding conductor termination.
9. Bearing housings: Provide machined surfaces for attaching a magnet mounted accelerometer to monitor the motor vibration in the vertical, horizontal, and axial directions at each bearing housing.
10. Frame grounding: provide motor frame grounding pad or threaded stud where supplemental grounding to frame is indicated on the drawings.
11. Corrosion resistant mill and chemical duty paint.

B. Windings:

1. Copper
2. Insulation rating: Class F.
3. Temperature rise: Class B at 1.0 SF, Class F at 1.15 SF.
4. Insulation: Non-hygroscopic, epoxy encapsulated windings for enclosure types WP I and WP II. Provide upgraded insulation by additional dips and bakes to increase moisture resistance for totally enclosed designs. Provide vacuum pressure impregnated (VPI) epoxy insulation for moisture resistance for outdoor motors.
5. Provide chemical and humidity resistance insulation system when IEEE 841 motors are specified.
6. Provide winding surge withstand capability per NEMA 1, Part 31 for VFC driven motors.
7. Provide specified temperature sensing devices for VFC driven equipment. If not specified, provide a winding temperature detector per the accessories paragraph.

C. Motor leads: Non-wicking type, minimum Class F temperature rating and permanently numbered for identification.

D. Stator: Built up core using high grade, low loss silicon steel laminations keyed or dovetailed to the stator frame and securely held in place at each end.

E. Rotor:

1. Forged or rolled steel shaft, machined, smooth finished, with sufficient strength for operation including 25 percent overspeed condition.
2. Shaft end coordinated with driven equipment coupling.
3. Entire assembly coated with protective coating.
4. Inpro seals on both ends of the shaft to prevent grease leakage and entrance of foreign materials, such as water and dirt, into the bearing area while running, coasting, or at rest. Severe duty motors to have improved sealing per IEEE 841.

5. Vertical Motor Shafts:
  - a. Provide hollow shaft and P flange mounting to allow driven shaft to extend through provide for vertical pump applications.
  - b. Coupling for connecting the motor shaft to the driven shaft is located in the top of the motor.
  - c. Where solid shaft is provided couple the driven shaft below the P flange face.
6. Rotor Core:
  - a. Solid, built-up stack of fully processed and coated, high-grade, low-loss silicon steel laminations.
  - b. Die cast aluminum or fabricated copper bars or their respective alloys.
  - c. Rotors on frames 213T and above to be keyed to shaft and rotating assembly dynamically balanced.
7. Rotor Assembly:
  - a. Coated with corrosion resistant epoxy insulating varnish or other protective coating, thermally stable, statically and dynamically balanced.
  - b. Balance weights securely attached to the rotor resistance ring by welding or similar permanent method.

F. Horizontal Bearings: roller type, grease lubricated.

1. Bearings: Anti-friction open or single-shield, vacuum-degassed steel ball or roller bearings, electric motor quality, designed for 45 degrees C maximum temperature rise. Metric size bearings are not acceptable.
2. Life: L 10 life of 100,000 hours for direct coupled applications and 26,000 hours for belted applications based. IEEE 841 motors, L 10 life increased to 150,000 and 50,000 hours respectively.
3. Shaft seals: Provide to prevent grease leakage and the entrance of foreign materials, such as water and dirt, into the bearing area while running, coasting, or at rest.
4. Shaft currents: Provide mitigation per process equipment specification.
5. Comply with ABMA and refer to process equipment specification for stricter or additional requirements.

G. Vertical Bearings: per manufacturer, thrust type.

1. Bearings: Manufacturer's standard design, constructed with thrust bearings on top to allow inspection and/or replacement without requiring complete disassembly of motor, of type and size to satisfy thrust loading requirements.
2. Life: Rated for an in-service L 10 life of 8800 hours, designed to support the weight of the rotor plus, if required, the weight of the rotating driven equipment parts and the hydraulic thrust created by the driven equipment, with a 40 degrees C maximum temperature rise. Metric bearings are not acceptable.
3. Shaft seals: Provide to prevent grease leakage and the entrance of foreign materials, such as water and dirt, into the bearing area while running, coasting, or at rest.
4. Shaft currents: Provide mitigation per process equipment specification.
5. Comply with ABMA and refer to process equipment specification for stricter or additional requirements.

## 2.4 THREE PHASE MOTOR ACCESSORIES

- A. Space heaters: Silicone rubber strip type, accessible for inspection, rated 120 Volt, single phase, designed to prevent condensation inside the enclosure when the motor is idle, with leads brought out to a separate terminal box. Emboss the heater wattage and voltage on the motor nameplate.
- B. Winding temperature switch: Three embedded bi-metallic temperature thermostat switches with **normally open contacts** and leads terminating in the main conduit box.
- C. Motor shaft currents: insulate the ODE bearing and provide a shaft grounding strap. Insulate bearing probes to prevent shorting out bearing insulation.
- D. Shaft grounding rings: maintenance free, circumferential micro fiber type, AEGIS™ SGR by electro Static Technology or equal to discharge shaft currents to ground.
- E. Anti-Backspin Device: Provide shaft mounted, mechanical non-reverse ratchet rated at 100 percent of motor full load torque for immediate protection against reversing due to phase reversals or from backspin at shutdown.
- F. Encoder for vector drive motors: Provide encoder on opposite drive end to sense rotor speed and provide closed loop feedback (quadrature signal with line driver output) to a control device. Provide sufficient length of encoder cable to connect encoder to variable frequency controller.

## 2.5 POWER FACTOR CORRECTION CAPACITORS

- A. Select the PFCC rating to provide an operating power factor of the motor between 93 to 95 percent at full load and 95 to 98 percent when partially loaded. The capacitor current shall not exceed the motor no-load magnetizing current.
- B. Provide the required capacitor and capacitor information to the motor control center (MCC) manufacturer for inclusion inside the MCC.
- C. Capacitors: UL listed, NEMA rated and tested, three phase dry film or non-PCB dielectric liquid insulated, with three current limiting fuses rated for 100 kA interrupting capacity at 480 Volts, equipped with internal discharge resistors and fuse loss indicators, mounted in hermetically sealed steel enclosures suitable for conduit connection. Covers shall be gasketed, bolt-on type.

## 2.6 SINGLE-PHASE MOTORS

- A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
  - 1. Permanent-split capacitor.
  - 2. Split phase.
  - 3. Capacitor start, inductor run.
  - 4. Capacitor start, capacitor run.
- B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.

- C. Motors 1/20 HP and Smaller: Shaded-pole type.
- D. 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.
- E. Insulation: Class F or better, with Class B temperature rise of 80 degrees C above ambient, 1.15 service factor. Locked rotor current to be no greater than specified in NEMA MG 1, Design "N".
- F. Standard enclosure: Fully gasketed, totally-enclosed air over or fan cooled in conformance with NEMA MG 1.
- G. Washdown duty enclosure: Where motor is installed in wet or corrosive areas routinely exposed to washdowns, high humidity or caustic chemicals, provide stainless steel, paint free washdown motors with Inpro bearing isolators, stainless steel T-type condensation drains, nitrile conduit box gasket, and corrosion resistant fans.
- H. Bearings: Sealed ball bearings permanently lubricated for 10 years normal use, furnished with shaft slinger.
- I. Class 1, Division 1 and 2 locations: Explosion proof, marked with a T3B temperature code label, and UL listed for use in Class 1, Division 1, Groups C & D, and Class II, Groups E, F, & G hazardous location. The temperature code marking to appear on the nameplate.

## 2.7 SOURCE QUALITY CONTROL

- A. Section 014000 - Quality Requirements: Requirements for testing, inspection, and analysis.
- B. Factory Testing: Prior to shipment perform manufacturer's standard tests in accordance with NEMA MG 1 and IEEE 112.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Upon delivery of motor and prior to unloading, inspect equipment for damage.
- B. Comply with DELIVERY, STORAGE, AND HANDLING article within this specification.

### 3.2 INSTALLATION

- A. Prepare rigid foundation or mounting surface to minimize vibration and maintain alignment between motor and load shaft.
- B. Install the motors per manufacturer's installation instructions.



- C. Anchor motor base to load bearing surface with grade 5 steel bolts or better.
- D. Align the motor shaft with driven equipment according to manufacturer's written instructions. Adjust axial position of motor frame with respect to load shaft.
- E. Accurately adjust flexible couplings for direct drive according to machine manufacturer's guidelines. Check alignment to minimize vibrations. Coupling spacing shall be according to coupling manufacturer guidelines.
- F. Install motor branch circuit conduits and conductors in accordance with NEC and local code requirements. Connect motors to rigid conduit system by a short section of liquid-tight flexible conduit to isolate the conduit system from motor vibration. Where motors are installed outdoors, bring conduit into bottom of motor terminal box to avoid standing water at connection point.
- G. Terminate the motor leads as shown on the connection diagrams using products intended for vibration applications.
- H. Ground equipment according to Section 26056, "Grounding and Bonding for Electrical Systems."
- I. Tighten electrical connections and terminals according to manufacturers' published torque values.
- J. Install conduit and wiring between motor auxiliary devices and associated indicators, controllers and protective devices in accordance to installation drawings.
- K. Connect devices sensitive to electromagnetic interferes such as RTD's, thermistors, thermal protector switches, vibration sensors with shielded instrumentation wiring per installation drawings.
- L. Comply with NECA 1.
- M. Seismic Bracing: Comply with requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."

### 3.3 IDENTIFICATION

- A. Comply with requirements for identification specified in Section 260553, "Identification for Electrical Systems." Identify field-installed conductors, interconnecting wiring, and components.

### 3.4 PROTECTION

- A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions until motors are ready to be energized and placed into service.
- B. Lubrication and Shaft Rotation: Lubricate parts and rotate shaft periodically according to manufacturer's written instructions until motors are ready to be energized and placed into service.

### 3.5 FIELD QUALITY CONTROL

- A. Perform inspections and tests. Inspect and test according to the Inspection and Test Procedures for Rotating Machinery state in NETA Acceptance Testing Specification paragraph 7.15.1. Options tests are not required unless called for within the process equipment specification.
- B. Perform the following infrared (thermographic) scan tests and inspections, for all motors 250 hp and larger, and prepare reports:
  - 1. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each motor exterior for detection of hot spots in stator or bearings.
  - 2. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each motor 11 months after date of Substantial Completion.
  - 3. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
- C. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Motors will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports, including a certified report that identifies the motor and describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations made after remedial action.

### 3.6 STARTUP AND ADJUSTMENT

- A. Complete installation and startup checks according to manufacturer's written instructions. Confirm motor is structurally, mechanically, and electrically ready for start-up. Checks include support system, vibration isolation, alignment, lubrication system, and cleanliness.
- B. Start-up motor in accordance with process equipment specification.
- C. Verify correct phase rotation at motor with driven equipment uncoupled. Correction for phase rotation to be made in the motor terminal box.
- D. Prepare inspection and test reports.

### 3.7 DEMONSTRATION / SYSTEM FUNCTION TESTS

- A. Run motor for system testing as required in motor controller and driven equipment specifications.
- B. Confirm correct operation of all protective and metering devices.
- C. Measure voltage and motor running current and evaluate relative to load conditions and nameplate full load amperes. Corrective action is required for any current imbalance 10 percent or greater.

- D. Prepare driven equipment system testing report. Include results of all tests and check made, meter readings and recordings, and summary adjustments made. Clearly identify any discrepancies and concerns.

END OF SECTION 400593.23

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## SECTION 406100 - PROCESS CONTROL AND ENTERPRISE MANAGEMENT SYSTEMS GENERAL PROVISIONS

### 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 procurement of the services of a Process Control System Supplier (PCSS) to furnish and install all materials, equipment, labor and services, required to achieve a fully integrated and operational system as specified herein, in "Related Requirements" under this Article, and in related drawings, except for those services and materials specifically noted.
- B. Summary of the PCSS activities is as follows:
  - 1. Furnish and install instrumentation as indicated on the P&IDs and as described in the instrument Specifications.
  - 2. Additional equipment shall be connected to the main PLC including, but not limited to, pump VFDs, process instrumentation, generator controls, and other electrical equipment, as detailed in the Drawings and Specifications. Utilize existing spare I/O points or furnish additional I/O modules of the same types as existing, as needed.
  - 3. Furnish new control panels as detailed in Drawings and Specifications.
  - 4. Furnish and install radio, antenna, antenna tower, and cabling and appurtenances, for connection to Well Nos. 2 and 3.
  - 5. Furnish, terminate and test new fiber optic cable as detailed in Drawings and Specifications.
  - 6. Provide testing and documentation as required in Specifications.
- C. Work does not include the following:
  - 1. Owner will perform all PLC and human-machine interface (HMI) programming and development, and will provide the PC Workstation.
  - 2. Owner will perform all necessary work to establish radio communication with the remote SCADA network.
- D. Include auxiliary and accessory devices necessary for system operation or performance, such as transducers, relays, signal amplifiers, intrinsic safety barriers, signal isolators, software, and drivers to interface with existing equipment or equipment provided by others under other Sections of these specifications, whether indicated on the Drawings or not.
- E. All equipment and installations shall satisfy applicable Federal, State and local codes. Refer to Electrical drawings for area classifications for Class and /Division ratings.

- F. Use the equipment, instrument, and loop numbering scheme indicated on the Drawings and in the specifications in the development of the submittals. Do not deviate from or modify the numbering scheme.

### 1.3 DEFINITIONS

- A. PCSS – Process Control System Supplier.
- B. AECS - Applications Engineering System Supplier.
- C. “Section 4062XX - Sections for Computer System Hardware” – The XX in the number indicates all spec sections starting with the first 4 numbers (indicating a category described in the accompanying text) are included in the reference.

### 1.4 PREINSTALLATION MEETINGS

- A. Conduct a project kickoff coordination meeting within two weeks after submitting the Project Plan. The purpose of the meeting is to discuss the PCSS's Project Plan, to summarize the PCSS's understanding of the project; discuss any proposed substitutions or alternatives; schedule testing and delivery deadline dates; provide a forum to coordinate hardware and software related issues; and request any additional information required from the Owner. The meeting will last up to 4 hours.
- B. Regular coordination meetings with Engineer, Contractor, and Owner as required prior to any field start-up or activity testing begins.

### 1.5 ACTION SUBMITTALS

- A. Project Plan, Deviation List, and Schedule Submittal:
  - 1. Submit, within 45 calendar days after Notice to Proceed, a Project plan. The Project Plan is required to be submitted and approved before further submittals shall be accepted. The Project Plan shall contain the following:
    - a. Overview of the proposed control system describing the understanding of the project work, a preliminary system architecture drawing, interfaces to other systems, schedule, startup, and coordination. Include a general discussion of startup, replacement of existing equipment with new, switchover (Maintaining Plant Operations during system transition), approach to testing and training, and other tasks as required by these specifications.
    - b. Project personnel and organization including the PCSS project manager, project engineer, and lead project technicians. Include resumes of each these individuals and specify in writing their commitment to this project. These do not need to be submitted again if already submitted in the Qualification submittal.
  - 2. The Deviation List shall consist of a paragraph by paragraph review of the Specifications indicating acceptance or any proposed deviations, the reason for exception, the exact nature of the exception and the proposed substitution so that an evaluation may be made

by the Engineer. If no exceptions are taken to the specifications or drawings the PCSS shall make a statement as such. If there is no statement by the PCSS, then it is acknowledged that no exceptions are taken.

3. PCSS is required to prepare a project schedule in Gantt chart format clearly showing task linkages for all tasks and identifying critical path elements. PCSS schedule must be based on the General Contractor schedule and must meet all field installation, testing, and start-up milestones in that schedule. The project schedule will illustrate I&C related major project milestones including the following:
  - a. Schedule for all subsequent project submittals. Include the time required for Contractor submittal preparation, Engineer's review time, and a minimum of two complete review cycles.
  - b. Proposed dates for all project coordination meetings.
  - c. Hardware purchasing, fabrication, and assembly (following approval of related submittals).
  - d. Software purchasing and configuration (following approval of related submittals).
  - e. Shipment of instrument and control system equipment.
  - f. Installation of instrument and control system equipment.
  - g. Testing: Schedule for all testing.
  - h. Schedule for system cutover, startup, and/or going on-line for each major system. At a minimum include the schedule for each process controller and HMI server/workstation provided under this Contract.
  - i. Schedule for all training including submittal and approval of O&M manuals, factory training, and site training.

B. Input/Output (I/O) List Submittal:

1. Submit, within 60 days after Notice to Proceed, a complete system Input/Output (I/O) address list for equipment connected to the control system under this Contract.
2. I/O list shall be based on the P&ID's, the Drawings, the design I/O list (if included), and requirements in the Specifications.
3. The I/O list shall be submitted in both a Microsoft Excel readable electronic file format and an 8-1/2 inch by 11-inch hard copy.
4. The I/O list shall reflect all active and spare I/O points. Add points to accommodate spare I/O as required in the specifications.
5. The I/O list shall be arranged such that each control panel has a dedicated worksheet. At a minimum, I/O worksheet shall include the following information:
  - a. TAG NUMBER(S): As indicated on the Drawings, the identifier assigned to a device that performs a function in the control system. As part of this information, the loop number of the tag shall be broken out to allow for sorting by loop.
  - b. DESCRIPTION: A description of the function of the device (text that includes signal source, control function, etc.) Include the text "Spare Points" for all I/O module points that are not connected to equipment.
  - c. PHYSICAL LOCATION: The Control Panel designation of where the I/O point is wired to.
  - d. PHYSICAL POINT ADDRESS: Rack, Slot, and Point (or Channel) assignment for each I/O point.
  - e. I/O TYPE: use DO - Discrete Output, DI - Discrete Input, AO - Analog Output, AI - Analog Input, PI - Pulse Input, or PO - Pulse Output.

- f. RANGE/STATE: The range in engineering units corresponding to an analog 4-20 mA signal, or, the state at which the value of the discrete points are "1."
  - g. ENGINEERING UNITS: The engineering units associated with the Analog I/O.
  - h. ALARM LIMITS: Include alarm limits based on the control descriptions and the Drawings.
  - i. P&ID - the P&ID or drawing where the I/O point appears on. Mark as "NA" (Not Applicable) if the I/O point is derived from a specification requirement and is not on the P&IDs.
  - j. LOGICAL POINT ADDRESS: I/O address of each point
  - k. EXISTING or NEW I/O POINT: Indicate if point is existing (E) or new (N).
  - l. CONDITION OF EXISTING SIGNAL: Condition of existing I/O signals shall be noted as functional (F) if working properly or if not functioning (NF) with issue described.
6. The I/O list shall be sorted in order by:
- a. Physical location.
  - b. I/O Type.
  - c. Loop Number.
  - d. Device Tag.
7. Once the I/O list is approved, the PLC I/O addresses shall not be modified without approval by the Engineer.
- C. Field Instruments Submittal:
- 1. Refer to the Section 407000 for submittal requirements.
- D. Hardware Packages Submittal:
- 1. Refer to the sections below for equipment required as part of the Hardware and Software Packages submittal:
    - a. Section 4063XX - Sections for Control System Equipment.
    - b. Section 4066XX - Sections for Network and Communication Equipment.
    - c. Sections 4067XX and 4078XX - Sections for Control System Equipment Panels and Racks.
  - 2. For each hardware and software packages component specified in the sections above, submit a cover page that lists, at a minimum, date, specification number, product name, manufacturer, model number, location(s), and power required. Preferred format for the cover page is ISA-TR20.00.01-2007, general data sheet; however, other formats will be acceptable provided they contain all required information.
  - 3. Complete system architecture drawing(s) showing in schematic form showing the interconnections between major hardware components including, control panels, computers, networking equipment, control panels with PLC systems and I/O modules, local operator interfaces, process equipment vendor panels with PLCs, and networked peripherals such as power monitors, security cameras, etc.
  - 4. The system architecture drawing(s) shall be developed in accordance with the following information and guidelines at a minimum:



- a. All communication cable types should be uniquely identified with a specific linetype and cable characteristics clearly indicated in a key or legend located on drawing(s). For example, 50/125 micron multimode mode fiber, or CAT-6E Ethernet copper cabling. Any multiconductor communication cables will be clearly labeled above each individual communication with a note added to drawing that states if no quantity exists above a linetype, there is only one communication cable between devices. If a multi-conductor cable has multiple colors, legend shall clearly indicate which colors are used for which networks (i.e., a multi-pair fiber optic cable used for dedicated networks such as SCADA, Electrical, Security, HVAC, etc.)
- b. All communication cables need to be assigned a unique cable identification label and shown in either a table or above the communication line.
- c. Network protocols shall be clearly identified for each communication path or for system and indicated in a key or legend as appropriate. Examples are Allen-Bradley EtherNet/IP, Modbus TCP/IP, or DNP3.
- d. Any device that has multiple ports or connection points, shall clearly indicate which port or connection number the communication cable is terminating at. For multiple devices, this could be shown once in a key or legend and noted on architecture as appropriate.
- e. For each PLC control panel or network communication enclosure provided by PCSS, the architecture drawing shall clearly reference other drawings provided by the PCSS for detailed panel wiring diagrams with a note near that PLC panel or communication enclosure indicating referenced drawing numbers. A placeholder is acceptable at the time of submission if these drawings are to be submitted at a later date.
- f. Use symbology and/or icons whenever possible to represent a device and differentiate between devices that are different form factors (i.e. tower computer vs. desktop computer vs. rack mounted). Vendor CAD libraries are preferred for symbols.
- g. The intent of this specification requirement is to develop a diagram that will allow a qualified technician to interconnect all equipment without having to refer to additional manuals or literature.
- h. Sheet size shall be 11"x17". Using more than one sheet is acceptable with a logical breakout between sheets (i.e., head end on one sheet and plant control system on another). Line continuations must between drawings must be clearly identified.

E. Panel Layout Drawings and Wiring Diagrams Submittal:

1. Panel Layout Drawings: Submit Drawings for all new panels specified, and for all existing panel modifications as required to show the modifications. Panel assembly and elevation drawings shall be drawn to scale and detail all equipment in or on the panel. Panel drawings shall be 11"x17" in size. At a minimum, the panel drawings shall include the following:
  - a. A legend sheet clearly indicating all symbols used on drawings and with voltage, color and size of each wire clearly indicated and in accordance with requirements of Section 406733 – Panel Wiring.
  - b. Interior and exterior panel elevation drawings to scale.
  - c. Nameplate schedule.
  - d. Conduit access locations.
  - e. Panel construction details.

- f. Cabinet assembly and layout drawings to scale. Assembly drawing shall include a bill of material on the drawing with each panel component clearly defined. Bill of material shall be cross-referenced to the assembly drawing so that a non-technical person can readily identify all components of the assembly by manufacturer and model number.
- g. Fabrication and painting specifications including color (or color samples).
- h. Construction details, NEMA ratings, intrinsically safe barrier information, gas sealing recommendations, purging system details, etc. for panels located in hazardous locations or interfacing to equipment located in hazardous areas.
- i. For every control panel, heating and cooling calculations for each panel supplied indicating conformance with cooling requirements of the supplied equipment and environmental conditions. Calculations shall include the recommended type of equipment required for both heating and cooling.
- j. Submit evidence that all control panels shall be constructed in conformance with UL 508A and bear the UL seal confirming the construction. Specify if UL compliance and seal application shall be accomplished at the fabrication location or by field inspection by UL inspectors. Costs associated with obtaining the UL seal and any inspections shall be borne by Contractor.

2. Wiring Diagrams Submittal:

- a. Where direct hardwired interfaces exist between the PCSS control panels and vendor provided control panels furnished under other Divisions, Contractor shall provide to PCSS approved submittals in order for PCSS to provide complete wiring diagrams showing all wiring connections in the I/O system. This includes but is not limited to terminal block numbering, relay contact information, instruments, equipment, and control panel names. These drawings shall be included in Final O&M submittal. Leaving this information blank on Final Documentation drawings is not acceptable.
- b. Panel wiring diagrams depicting wiring within and on the panel as well as connections to external devices. Panel wiring diagrams shall include power and signal connections, UPS and normal power sources, all panel ancillary equipment, protective devices, wiring and wire numbers, and terminal blocks and numbering. Field device wiring shall include the device ISA-tag and a unique numeric identifier. Diagrams shall identify all device terminal points that the system connects to, including terminal points where I/O wiring lands on equipment not supplied by the PCSS. Wiring labeling used on the drawings shall match that shown on the Contract Documents or as developed by the PCSS and approved by the Engineer. I/O wiring shall be numbered with rack number, slot number, and point number. Two-wire and four-wire equipment shall be clearly identified, and power sources noted. Submit final wire numbering scheme. Panel drawings shall be 11" x 17" in size.

F. Testing Plan Submittals:

- 1. Refer to Section 406121 - for specific testing submittal requirements.

## 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For all PCSS supplied hardware to include in **operation** and maintenance manuals.
1. Submit in accordance with Section 017823 - Operation and Maintenance Data.
  2. The operations and maintenance manuals shall, at a minimum, contain the following information:
    - a. Table of Contents:
      - 1) A Table of Contents shall be provided for the entire manual with the specific contents of each volume clearly listed. The complete Table of Contents shall appear in each volume.
    - b. Instrument and Equipment Lists:
      - 1) The following lists shall be developed in Microsoft Excel format:
        - a) An instrument list or spreadsheet for all instruments supplied including tag number, description, specification section and paragraph number, manufacturer, model number, calibrated range, location, manufacturer phone number, local supplier name, local supplier phone number, completion year replacement cost, and any other pertinent data.
        - b) An equipment list or spreadsheet for all non-instrument devices supplied listing description, specification section and paragraph number, manufacturer, model number, location, manufacturer phone number, local supplier name, local supplier phone number, completion year replacement cost, and any other pertinent data.
    - c. Equipment Operations and Maintenance Information:
      - 1) ISA-TR20.00.01-2007 data sheets shall be provided for all field instruments. For non-field instrumentation devices, provide a cover page for each device, piece of equipment, and OEM software that lists date, specification number, product name, manufacturer, model number, Location(s), and power required. Preferred format for the cover page is ISA-TR20.00.01-2007, general data sheet; however, other formats will be acceptable provided they contain all required information.
      - 2) Vendor O&M documentation for each device, piece of equipment, or OEM software shall be either new documentation written specifically for this project or modified standard vendor documentation. All standard vendor documentation furnished shall have all portions that apply clearly indicated with arrows or circles. All portions that do not apply shall be neatly lined out or crossed out. Groups of pages or sections that do not apply at all to the specific model supplied shall be removed.
      - 3) Provide the record documentation of the completed test forms with sign-offs as specified in Section 406121 - Testing.
      - 4) Include instrument/equipment calibration and configuration forms developed as specified in Section 406121 - Testing.

d. As-Built Drawings:

- 1) Complete as-built drawings, including all drawings and diagrams specified in this section under the "Submittals" section. These drawings shall include all termination points on all equipment the system is connected to, including terminal points of equipment not supplied by the PCSS. Provide electronic files for all drawings produced. Drawings shall be in AutoCAD ".dwg" format and in Adobe Acrobat format. Drawings shall be provided using the AutoCAD eTransmit feature to bind external references, pen/line styles, fonts, and the drawing file into individual zip files.
- 2) As built documentation shall include information from submittals, as described in this Specification, updated to reflect the as-built system. Errors in or modifications to the system resulting from the Factory and/or Functional Acceptance Tests shall be incorporated in this documentation.

B. Electronic O&M Information:

1. In addition to the hard copy of O&M data, provide an electronic version of all equipment manuals and data sheets, along with any software back-up of configuration files, on DVD or USB thumb drive. Electronic documents shall be supplied in Adobe Acrobat format.
2. Provide electronic files for all custom-developed manuals including training manuals. Text shall be supplied in both Microsoft Office format and Adobe Acrobat format.
3. Provide electronic files for all drawings produced. Drawings shall be in AutoCAD ".dwg" format and in Adobe Acrobat format. Drawings shall be provided using the AutoCAD eTransmit feature to bind external references, pen/line styles, fonts, and the drawing file into individual zip files.
4. Each computer system hardware device shall be backed up onto DVD or USB thumb drive after Substantial Completion and shall be turned over to the Owner.

1.7 MAINTENANCE MATERIAL SUBMITTAL

- A. Furnish extra materials from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Refer to individual specification sections for spare equipment requirements and provide one comprehensive spare parts submittal for project
- B. All spare parts shall be packed in individual cartons and labeled with indelible markings clearly indicating component(s) inside. Complete ordering information paperwork including manufacturer's contact information (address and phone number), part name, part number, equipment name and tag number(s) for which the part is to be used (if applicable) shall be supplied with the required spare parts. The spare parts shall be delivered and stored in a location directed by the Owner or Engineer.

1.8 QUALITY ASSURANCE

- A. Fabricator Qualifications: PCSS shall hold a valid UL-508 certification for their panel fabrication facility.

- B. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer
- C. The PCSS as a minimum shall be responsible for the technical supervision of the installation by providing on site supervision to the installers of the various components.
- D. The Process Control System Supplier (PCSS) shall be a "systems integrator" regularly engaged in the design and the installation of instrumentation systems and their associated subsystems as they are applied to the municipal water and wastewater industry. For the purposes of this Specification Section, a "systems integrator" shall be interpreted to mean an organization that complies with all of the following criteria:
  - 1. Employs personnel on this project who have successfully completed ISA or manufacturers training courses on general process instrumentation and configuration and implementation of the specific programmable controllers, computers, and software proposed for this project. Key personnel shall hold ISA CCST Level 1 certification or have a minimum of 10 years of verifiable plant startup experience. Key personnel shall include, as a minimum, the lead field technician.
  - 2. Has successfully completed work of similar or greater complexity on at least three previous projects within the last five years. Successful completion shall be defined as a finished project completed on time, without any outstanding claims or litigation involving the PCSS. Potential references shall be for projects where the PCSS's contract was of similar size to this project.
  - 3. Has been actively engaged in the type of work specified in this Section for a minimum of five years.
- E. The PCSS shall maintain a permanent, fully staffed and equipped service facility within <xxx> miles of the project site with full time employees capable of designing, fabricating, installing, calibrating, and testing the systems specified herein. At a minimum, the PCSS shall be capable of responding to on-site problems within 12 hours of notice. Provide an on-site response within 4 hours of notification starting at two months before scheduled startup to two months after startup completion.
- F. The selected PCSS shall be one of the following:
  - 1. DSI Innovations LLC  
13400 Sutton Park Dr S, Suite 1001  
Jacksonville, FL 32224  
TEL: (336) 893-8385  
ATTN: Damien Johns
  - 2. Infamation Technologies Group (ITG)  
11235 St. John's Industrial Parkway North, Unit #2  
Jacksonville, FL 32246  
TEL: (904) 425-4760  
ATTN: Dale Young
- G. Being listed in this specification does not relieve any potential PCSS from meeting the qualifications specified in this Section.

## 1.9 DELIVERY, STORAGE, AND HANDLING

- A. Refer to Section 016000 "Product Requirements" for delivery, storage, and handling requirements.

## 1.10 FIELD CONDITIONS

- A. Environmental Requirements. Refer to Electrical Specifications and Electrical Drawings for specific environmental and hazardous area classifications.
- B. Elevation: Equipment shall be designed to operate at the project ground elevation.
- C. Temperature:
  - 1. Outdoor areas' equipment shall operate between -30 to 50 C degrees ambient.
  - 2. Equipment located in indoor locations shall operate between 10 to 35 C degrees ambient minimum.
  - 3. Storage temperatures shall range from 0 to 50 C degrees ambient minimum.
  - 4. Additional cooling or heating shall be furnished if required by the equipment as specified herein.
  - 5. Relative Humidity. Air-conditioned area equipment shall operate between 20 to 95 percent relative, non-condensing humidity. All other equipment shall operate between 5 to 100 percent relative, condensing humidity.
- D. None of the control system equipment located in the control room shall be shipped to the site until the control room areas comply with specified ambient temperature and humidity and free of dust and debris.

## PART 2 - PRODUCTS

### 2.1 GENERAL

- A. Electrical Requirements for Control System:
  - 1. Equipment shall operate on a 60 Hertz alternating current power source at a nominal 120 volts, plus or minus 10 percent, except where specifically noted. Regulators and power supplies required for compliance with the above shall be provided between power supply and interconnected instrument loop. Where equipment requires voltage regulation, constant voltage transformers shall be supplied.
  - 2. With the exception for field device network connected devices, all electronic instrumentation shall utilize linear transmission signals of isolated 4 to 20 mA DC (milliampere direct current) capable of driving a load up to 750 ohms, unless specified otherwise. However, signals between instruments within the same panel or cabinet may be 1-5 VDC (volts direct current).
  - 3. Outputs of equipment that are not of the standard signals as outlined, shall have the output immediately raised and/or converted to compatible standard signals for remote transmission. No zero-based signals will be allowed.

4. Discrete inputs and outputs shall be 120VAC unless otherwise noted. Discrete outputs shall be isolated. Interposing relays shall be provided for all circuits where the current exceeds the PLC output rating or additional contacts are required.
5. It is intended that all discrete outputs from PLC to equipment be maintained contact outputs, such that seal-in contacts are not required in the control circuit.
6. All switches shall have double-pole, double-throw contacts rated at a minimum of 600 VA, unless noted otherwise.
7. Switches and/or signals indicating an alarm, failure or upset condition shall be wired in a fail-safe manner as shown on the P&IDs. A fail-safe condition is when an open circuit generates an alarm state (i.e. contact opens).
8. Materials and equipment shall be UL approved whenever such approved equipment and materials are available.
9. All equipment furnished shall be designed and constructed so that in the event of power interruption, the systems specified herein shall go through an orderly shutdown with no loss of memory and shall resume normal operation without manual resetting when power is restored, unless otherwise noted.
10. Surge protection requirements for control system power, signal, and communication lines are specified in Section 407856 – Isolators, Intrinsically Safe Barriers, and Surge Suppressors.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

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

#### 3.2 GENERAL INSTALLATION

- A. The shield on each process instrumentation cable shall be continuous from source to destination and be grounded at only one ground point for each shield.
- B. Provide sunshades for equipment mounted outdoors in direct sunlight. Include sunshades standoffs to allow air circulation around the cabinet. Orient equipment outdoors to face to the North to minimize the impact of glare and ultraviolet exposure on digital readouts.

#### 3.3 STARTUP SERVICE

- A. Refer to Section 406121 - Process Control System Testing.
- B. Engage a factory-authorized service representative to perform startup service as specified in individual hardware and instrument specifications.
- C. Periodic on-site coordination meetings with Engineer, Contractor, Vendors, and Owner as required during active construction period.

END OF SECTION 406100



## SECTION 406121 - PROCESS CONTROL SYSTEM TESTING

### 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. Refer to Section 40 61 00.

### 1.2 SUMMARY

- A. Section includes PCSS testing requirements.
- B. Furnish all labor, materials, equipment and incidentals required to complete the testing of all devices and systems furnished and installed as detailed on Drawings, and as specified herein.
- C. Refer to Section 406100 for other general requirements.

### 1.3 ACTION SUBMITTALS

- A. Refer to Section 406100. Submit the following testing related documents for review:
- B. Test Forms:
  - 1. Develop and submit project-specific I/O Status signoff forms to be used during each phase of testing described herein, to organize and track each loop's inspection, adjustment, calibration, configuration, and testing status and sign off. Include sign-off forms for each testing phase showing all loops.
    - a. Example forms are shown in the Appendices.
    - b. Separate forms for factory and field testing can be used, or they can be combined, at the discretion of the PCSS.
    - c. Submit testing forms prior to start of testing.
  - 2. Testing Procedures:
    - a. Submit detailed procedures proposed to be followed for each of the tests specified herein. The test procedures serve as the basis for the execution of the required tests to demonstrate that the system meets and functions as specified.
    - b. Documents shall be structured in an orderly and easy to follow manner to facilitate an efficient and comprehensive test.
    - c. Test procedures shall indicate all pre-testing setup requirements, all required test equipment, and simulation techniques to be used.
    - d. Test procedures shall be structured in a cause and effect manner where the inputs are indicated, and the outputs are recorded.
    - e. Test procedures shall include the demonstration and validation under normal operating conditions and under various failure scenarios as specified in Contract Documents.

f. Testing may not start until all Testing Submittals have been approved.

C. Calibration form:

1. For any component or instrument requiring dip switch settings, calibration, or custom configuration, maintain a calibration form in field documenting this information. These forms shall provide a summary of the actual settings used in the field to allow an Instrument technician to replace the device entirely and configure it to function as it did before.
2. The form shall list Project Name, Loop Number, ISA Tag Number, I/O Module Address, Manufacturer, Model Number/Serial Number, Output Range and Calibrated Value.
3. Some examples of required information are:
  - a. For Discrete Devices: Actual trip points and reset points.
  - b. For Instruments: Any configuration or calibration settings entered into instrument
  - c. For Controllers: Mode settings (PID).
  - d. For I/O Modules: Dip switch settings, module configuration (if not documented in native programming documentation).

D. Test Documentation:

1. Upon completion of each required test and calibration, document by submitting a copy of the signed-off forms. Testing shall not be considered complete until the signed-off forms have been submitted and approved. Submittals of other test documentation, including "highlighted" wiring diagrams with field technician notes, are not acceptable substitutes for the formal test documentation.

1.4 COST OF TRAVEL

- A. Witnessed tests will only be attended once by Engineer /Owner. If a test is not successful, all subsequent re-tests will be performed at Contractor's expense. Reimburse Owner for all costs, including labor and expenses, invoiced by Engineer and incurred by Owner for re-tests.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 TESTING - GENERAL

- A. Refer to Section 406100.
- B. Results of all testing shall be tracked on a project specific status sign off form or similar document. PCSS shall be responsible for maintaining the sheet. Appendix of this Section has an example template for this sheet.
- C. Tests the PCSS is required to perform are as follows:
1. Factory Testing:

Process Control System Testing[contractor Performs  
Programming]

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- a. Unwitnessed Factory Test (UFT).
    - b. Witnessed Factory Test (WFT).
  - 2. Field Testing:
    - a. Operational Readiness Test (ORT).
  - D. Wherever possible, perform tests using actual process variables, equipment, and data. Where it is not practical to test with real process variables, equipment, and data, provide all special testing materials and equipment required for a suitable means of simulation.
  - E. PCSS shall coordinate all required testing with Contractor, affected Subcontractors, Engineer, and Owner.
  - F. No equipment shall be shipped to jobsite until Engineer or Owner has received all Factory Testing results and approved the system as ready for shipment.
  - G. Engineer reserves the right to test or re-test any functions.
  - H. Correction of Deficiencies:
    - 1. Deficiencies in workmanship and/or items not meeting specified testing requirements shall be corrected to meet specification requirements at no additional cost to Owner.
    - 2. Testing, as specified herein, shall be repeated after correction of deficiencies is made until specified requirements are met. This work shall be performed at no additional cost to Owner.
- 3.2 FACTORY TESTING - UNWITNESSED FACTORY TEST (UFT)
- A. Purpose of UFT is for PCSS to check system prior to Engineer and/or Owner attending factory testing. This type of testing shall be part of any quality firm's internal QA/QC procedures.
  - B. Temporary network connections will be required to confirm the network configuration. Temporary wiring of primary elements, final control elements, and field-mounted transmitters is not required.
  - C. Hardware to be tested shall include all control system devices shown on System Architecture drawings and provided by PCSS.
  - D. Tests to be performed shall include, but not be limited to, the following. Each of these tests shall be specifically addressed in Test Procedure submittal.
    - 1. All panels and enclosures being provided shall undergo a thorough inspection to verify integrity of cabinet enclosures, frame structures, paint work and finish, etc. Review panel drawings to ensure they accurately reflect panel layout and wiring.
    - 2. Perform a system audit to verify all components have been staged for test and have been documented properly with correct model numbers, serial numbers, etc. Following documentation of audit shall be provided at factory test and submitted as part of O&M Manual Documentation:

- a. For each workstation and server, list of all software installed (including the operating system), with software revision number, software improvement modules or patches installed, license number and owner registration information, warranty period, vendor and local distributor names and contacts.
    - b. For each microprocessor-based component connected to control communication backbone in system (PLCs, managed switches, protocol converters, communication cards on final field devices, radios, etc.), list firmware revision, vendor and local distributor information, and system, warranty information, configuration parameters (e.g., communication settings, fail position settings, etc.)
  3. Panel wire pull tests shall be performed to ensure all wiring has been connected with appropriate torque to prevent wires from coming loose.
  4. UPS shall be tested to verify UPS switch power correctly while keeping all UPS powered loads online. Testing of UPS to determine if they have been sized correctly to maintain specified run time shall be performed during field testing.
  5. A 100 percent I/O point checkout shall be performed to verify proper operation of input/output points from panel terminations to HMI and OIT nodes. At a minimum, I/O checkout shall consist of four steps.
    - a. Discrete input signals shall be jumpered at field terminal blocks in control panels to verify proper status in HMI and OIT nodes.
    - b. Analog input signals shall be connected to a signal generator at field terminal blocks in control panels to verify proper status in HMI and OIT nodes and signals shall be verified at zero percent, 50 percent, and 100 percent of full scale.
    - c. Discrete output signals shall be tested by switching equipment to manual control at HMI and OIT nodes and turning the output on or other means to turn the output on. Then verify the output is on by connecting a digital multimeter to measure continuity at terminations, thus verifying command from PLC has properly executed contact closure.
    - d. Analog output signals shall be tested by switching the equipment to manual control at HMI and OIT nodes and turning output on or other means to turn the output on. Then verify output by utilizing a digital multimeter to measure current or voltage generated at termination points.
  6. For each hardware enclosure, inspection shall include, but not be limited to, cabinet enclosures, frame structure, paint work and finish, dimensions, and hardware operability (i.e., fans, door hinges, keylocks, etc.).
  7. For each subpanel, inspection shall include, but not be limited to, I/O subsystem physical layout, power supply sizing and mounting, cable routing, wire runs across hinges properly installed, fans and blowers unobstructed and mounted to maximize air flow, power conditioning correctly installed, and overall layout and installation of components meets manufacturer's recommendations and standard industry accepted practices.
  8. All other control panel circuitry.
- E. Upon successful completion of UFT, PCSS shall submit a record copy of test results as specified in PART 1. As part of this test results submittal, notify Engineer and Owner in writing that system is ready for WFT. No other notice of Factory test will be accepted. Engineer and/or Owner shall schedule a test date within 30 days of receipt of this submittal.

### 3.3 FACTORY TESTING - WITNESSED FACTORY TEST (WFT)

- A. Purpose of WFT is to allow Engineer or Owner representatives to witness functionality, performance, and stability of entire hardware and software system as a complete integrated system. WFT shall be run by PCSS and conducted at PCSS's facility.
- B. Required Documents for Test:
  - 1. Clean set of approved panel drawings and wiring diagrams.
  - 2. Set of Contract Documents - all drawings and specifications.
  - 3. All design-change related documentation.
  - 4. Master copy of the PCSS developed factory testing signoff forms.
  - 5. Testing procedures.
- C. System shall operate continuously throughout WFT without failure, except where initiated per established test procedures. Unanticipated failures may, at Owner or Engineer's option, result in overall WFT being deemed unsuccessful. All deficiencies identified during these tests shall be corrected and re-tested prior to completing WFT or shipment of panels to jobsite as determined by Owner/Engineer.
- D. Tests to be performed during the WFT shall include, but not be limited to, the following:
  - 1. A repeat of all tests specified in the UFT.
- E. Daily schedule during these tests shall be as follows:
  - 1. Morning meeting to review the day's test schedule.
  - 2. Scheduled tests and sign-offs.
  - 3. End of day meeting to review day's test results and to review or revise next day's test schedule.
  - 4. Unstructured testing period by witnesses.
- F. Upon successful completion of WFT, PCSS shall submit a record copy of test results as specified in PART 1.

### 3.4 FIELD TESTING - OPERATIONAL READINESS TEST (ORT)

- A. Purpose of ORT is to check that process equipment, instrument installation, instrument calibration, instrument configuration, field wiring, control panels, and all other related system components are ready to monitor and control the processes. This test will determine if equipment is ready for operation.
- B. This test shall take place prior to FDT and startup. Prior to starting this test, relevant process equipment shall be installed and mechanically tested, instruments installed, control panels installed, and field wiring complete.
- C. Required Documents for Test:
  - 1. Master copy of the PCSS developed field testing signoff forms.
  - 2. Testing procedures.

3. Calibration forms.
- D. These inspections, calibrations, and tests do not require witnessing. However, Engineer may review and spot-check testing process periodically. All deficiencies found shall be corrected by PCSS prior to commencement of Functional Demonstration Test.
- E. PCSS shall maintain Sign-off forms and Calibration forms at job site and make them available to Engineer/Owner at any time.
- F. Following tests shall be performed as part of ORT:
  1. Instrument calibration, configuration, and set-up.
  2. Input/Output (I/O) Testing to HMI and OITs.
- G. Instrument calibration, configuration, and set-up:
  1. Calibrate, configure, and set-up all components and instruments to perform specified functions.
  2. Maintain a copy of the calibration forms in field during testing and make them available for inspection at any time.
  3. For any device that allows a software back-up of configuration files to a laptop, make configuration files available to Engineer/Owner for inspection. Submit as part of Final System Documentation as specified in Section 40 61 00.
- H. I/O Testing:
  1. Purpose of I/O testing is to check that process equipment, instrument installation, calibration, configuration, field wiring, and control panels are set-up correctly to monitor and control the processes. This test is commonly referred to as a "loop test" or an I/O checkout.
  2. PCSS in conjunction with Contractor shall test signals under process conditions. Preferred test method will always be to execute test wherever possible to end elements. For example, preferred test will prove valve open/close limit switches by operating valve, not by installing a jumper on limit switch contacts. However, if equipment or process is not available to test a signal over its entire calibrated range, PCSS may test using a simulation method and make a note on sign-off form.
  3. The following I/O tests shall be performed:
    - a. Discrete Input: At device or instrument, change signal condition from inactive to active state. Observe results on all indicators within loop such as HMI screens, OIT screens, pilot lights, horns, beacons, etc.
    - b. Analog Input: Test analog signal over entire engineering range at various intervals including 0, 50%, and 100% as well as on increasing and decreasing range. Observe results on all indicators within loop such as HMI screens, OIT screens, recorders, digital indicators, etc.
    - c. Discrete output signals shall be tested by switching equipment to manual control at the HMI and OIT nodes and turning output on or using other means to turn output on. Then verify equipment responds accordingly.
    - d. Analog output signals shall be tested by switching equipment to manual control at HMI and OIT nodes and turning output on or other means to turn output on. Then verify equipment responds accordingly.

- I. Repeat all systems tests specified under factory testing.
- J. Upon successful completion of ORT, PCSS shall submit a record copy of test results as specified in PART 1.

END OF SECTION 406121

**APPENDIX 40 61 21-A: EXAMPLE INPUT/OUTPUT (I/O) STATUS SIGN OFF FORM**

An example template for I/O Status signoff form to be used for documenting testing results to Owner is attached. PCSS is required, prior to testing, to create a project specific I/O Status signoff form based on attached template or approved equal. PCSS may obtain an electronic copy of template from Engineer or develop it on their own.

**APPENDIX 40 61 21-B: EXAMPLE AUTOMATIC CONTROL STRATEGIES SIGN OFF FORM**

An example template for Automatic Control Strategies signoff form to be used for documenting testing results to Owner is attached. PCSS is required, prior to testing, to create a project specific Automatic Control Strategies signoff form based on attached template or approved equal. PCSS may obtain an electronic copy of template from Engineer or develop it on their own.



[Project Name] Appendix A - Input/Output (I/O) Status Sign-Off Form

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All Sections below are required to be filled out by PCSS as part of Field Testing.														
Instrument Alarm Setpoint - Setpoint for any alarms safety PCSS														
Wiring Complete - Signal wired from field device to PLC														
I/O Tested - Signal tested from field device to SCADA HMI														
PLC	Signal Tag	Description	Range or Active State when closed	P&ID	Signal	Reck Slot	Chan	Instru- ment Alarm Setpoint	Calibrate, config., and Wiring complete	Date	PCSS I/O testing	Date	I/O Testin- g to the HMI	Notes
PLC-SC	UT-4000-1	Secondary Clarifier No. 1 Sludge Level	0-10 ft	8	AI	2	1	0						
PLC-SC	UT-4010-3	Secondary Clarifier No. 3 Sludge Level	0-10 ft	8	AI	2	1	1						
PLC-SC	SI-4100-1	RAS Pump No. 1 Speed Feedback	0-100%	14	AI	2	1	2						
PLC-SC	SI-4100-4	RAS Pump No. 4 Speed Feedback	0-100%	15	AI	2	1	3						
PLC-SC	FI-4102-1	RAS Flow Pumps 1-3	0-1900 GPM	14	AI	2	1	4						
PLC-SC	SI-4110-1	WAS Pump No. 1 Speed Feedback	0-100%	14	AI	2	1	5						
PLC-SC	N/A	Spare Slot	N/A		Spare	2	5	N/A						
PLC-SC	SC-4100-1	RAS Pump No. 1 Speed Setpoint	0-100%	14	AO	2	7	0						
PLC-SC	SC-4100-2	RAS Pump No. 2 Speed Setpoint	0-100%	14	AO	2	7	1						
PLC-SC	SC-4100-3	RAS Pump No. 3 Speed Setpoint	0-100%	14	AO	2	7	2						
PLC-SC	SC-4110-1	WAS Pump No. 1 Speed Setpoint	0-100%	14	AO	2	7	3						
PLC-SC	Spare	Spare	N/A	N/A	AO	2	7	4						
PLC-SC	Spare	Spare	N/A	N/A	AO	2	7	5						
PLC-SC	TSH-4000-1	Secondary Clarifier No. 1 High Temp	Normal	8	DI	3	1	0						
PLC-SC	XA-4000-1	Secondary Clarifier No. 1 Motor Overload	Normal	8	DI	3	1	1						
PLC-SC	WAH-4000-1	Secondary Clarifier No. 1 High Torque	Normal	8	DI	3	1	2						
PLC-SC	YRI-4000-1	Secondary Clarifier No. 1 On/Off	On	8	DI	3	1	4						
PLC-SC	YCI-4000-1	Secondary Clarifier No. 1 In Remote	In Remote	8	DI	3	1	5						
PLC-SC	YFI-4100-1	RAS Pump No. 1 VFD Fault	Normal	14	DI	3	1	6						
PLC-SC	FAL-4100-1	RAS Pump No. 1 Low Flow	Normal	14	DI	3	1	7						
PLC-SC	Spare	Spare	Running	14	DI	3	1	8						
PLC-SC	YRI-4100-1	RAS Pump No. 1 Running	In Remote	14	DI	3	1	9						
PLC-SC	YCI-4100-1	RAS Pump No. 1 In Remote	In Remote	14	DI	3	1	10						
PLC-SC	YFI-4110-1	WAS Pump No. 1 VFD Fault	Normal	14	DI	3	1	11						
PLC-SC	FAL-4110-1	WAS Pump No. 1 Low Flow	Normal	14	DI	3	1	12						
PLC-SC	Spare	Spare	Running	14	DI	3	1	13						
PLC-SC	YRI-4110-1	WAS Pump No. 1 Running	In Remote	14	DI	3	1	14						
PLC-SC	YCI-4110-1	WAS Pump No. 1 In Remote	In Remote	14	DI	3	1	15						
PLC-SC	HSS-4000-2	Secondary Clarifier No. 2 Start Command	Start	8	DO	4	6	0						
PLC-SC	Spare	Spare	N/A	N/A	DO	4	6	1						
PLC-SC	HSS-4100-2	RAS Pump No. 2 Start Command	Start	14	DO	4	6	2						
PLC-SC	HSS-7000-2	Sludge Holding Tank Bagger No. 2 Start Command	Start	17	DO	4	6	3						
PLC-SC	HSS-4100-5	RAS Pump No. 5 Start Command	Start	15	DO	4	6	4						
PLC-SC	Spare	Spare	N/A	N/A	DO	4	6	5						
PLC-SC	HSS-4105-1	Secondary Sludge Pump No. 2 Start/Stop	Start	15	DO	4	6	6						
PLC-SC	HSS-4110-2	WAS Pump No. 2 Start/Stop Command	Start	15	DO	4	6	7						
PLC-SC	7160-FIL-1	Sludge Loadout LCP Pumping Indicator	Pumping	17	DO	4	6	8						
PLC-SC	Spare	Spare	N/A	N/A	DO	4	6	9						
PLC-SC	HSS-7115-2	Sludge Holding Tank Valve No. 2 Start	Start	17	DO	4	6	10						
PLC-SC	Spare	Spare	N/A	N/A	DO	4	6	11						
PLC-SC	HSS-7117-2	Sludge Holding Tank Discharge Valve No. 2 Open CMD	Open	17	DO	4	6	12						
PLC-SC	HSS-7117-2	Sludge Holding Tank Discharge Valve No. 2 Close CMD	Close	17	DO	4	6	13						
PLC-SC	HSS-7120-2	TS Transfer Pump No. 2 Start Command	Start	17	DO	4	6	14						
PLC-SC	Spare	Spare	N/A	N/A	DO	4	6	15						

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**[Project Name] Appendix B - Automatic Control Strategies Sign-Off Form**

All Sections below are required to be filled out by PCSS as part of Testing

Auto. Control Strategies - Loop operational in Automatic as defined in Control Strategies

Control Strategies Loop #	Control Strategy Description	P&ID	Auto. Control Strategy	Date	Notes
LOOP 281 - 284	LOW FLOW PUMPS	8			
LOOP 290	LOW EQ CHANNEL FLOW NO.4	8			
LOOP 300	MICROFILTRATION AIR SUPPLY LOW PRESSURE	10			
LOOP 351, 352	SITE LIFT STATION PUMP NO.1 AND NO. 2	12			
LOOP 355	SITE LIFT STATION HIGH AND LOW LEVEL CONTROL	12			
LOOP 371, 372	SLUDGE HOLDING TANK NO.1 AND NO. 2 LEVEL	14			
LOOP 381, 382	SLUDGE TRANSFER PUMPS	14			
LOOP 385	SLUDGE TRANSFER PUMPS REMOTE START/STOP COMMAND	14			
LOOP 700	EFFLUENT PUMPING STATION LEVEL	14			
LOOP 701, 702, 703	EFFLUENT PUMP NO.1	14			
LOOP 840	POST AERATION CHANNEL AIR FLOW CONTROL	15			
LOOP 900	SLUDGE TRANSFER PUMPS DISCHARGE FLOW	8			
LOOP 971	CENTRIFUGE SLUDGE FEED PUMP NO.1	8			
LOOP 1001	CENTRIFUGE NO.1 SLUDGE FEED FLOW CONTROL	8			
LOOP 1411, 1412	SODIUM HYPOCHLORITE STORAGE TANKS LEVEL	8			
LOOP 1421, 1422	SODIUM HYPOCHLORITE PUMPS	8			
LOOP 1430	SODIUM HYPOCHLORITE STORAGE TANKS				
LOOP 2051, 2052, 2053	CONTAINMENT AREA HIGH LEVEL DETECTION	14			
LOOP 2055	DIESEL ENGINE GENERATOR STATUS	14			
LOOP 2060	TRANSFER SWITCH STATUS	14			
	GENERATOR KILOWATTS MONITORING	14			
APPENDIX ONE	EQUIPMENT RESTART DURING A POWER LOSS WITH THE GENERATOR RUNNING	14			
APPENDIX TWO	EQUIPMENT RESTART WITH POWER RESTORED AFTER A POWER LOSS	14			
N/A	SELF-HEALING CAPABILITIES OF NETWORK	N/A			
N/A	REDUNDANT SCADA SERVER FAILOVER AND RECOVERY	N/A			

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## SECTION 406343 - PROGRAMMABLE LOGIC CONTROLLERS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- 1. Section includes programmable logic controllers and related equipment.
- B. Related Requirements:
  - 1. Section 406100 "Process Control and Enterprise Management Systems General Provisions" for submittal requirements.

#### 1.3 DEFINITIONS

- A. AO – Analog Output
- B. AI – Analog Input
- C. DI - Digital Input
- D. DO - Digital Output
- E. I/O – Input/Output
- F. PLC - Programmable Logic Controller

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Refer to Section 406100 – Process Control and Enterprise Management System General Provisions.
- B. Shop Drawings:
  - 1. Refer to Section 406100 – Process Control and Enterprise Management Systems General Provisions.

## 1.5 CLOSEOUT SUBMITTALS

1. Refer to Section 406100 – Process Control and Enterprise Management System General Provisions.

## 1.6 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. I/O Modules: 10 percent of quantity installed but no fewer than one, of each type.

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Refer to Section 406100 – Process Control and Enterprise Management Systems General Provisions.

## 1.8 FIELD CONDITIONS

- A. Refer to Section 406100 – Process Control and Enterprise Management Systems General Provisions.

# PART 2 - PRODUCTS

## 2.1 SYSTEM DESCRIPTION

- A. Refer to Section 406100 – Process Control and Enterprise Management Systems General Provisions.
- B. Active Spares:
  1. Spare PLC I/O: In new PLC/RIO racks, provide 20 percent points per type AI AO, DI, and DO for future use.
  2. Spare PLC Slots: Provide at least one spare slot for addition of future I/O in each chassis provided.
  3. Provide fuses, relays, and surge suppressors as required for all spare I/O points.
  4. Wire all unused points on all I/O to terminal blocks in the order that they occur on the I/O modules.

## 2.2 PLC EQUIPMENT LIST

- A. Substitutions of the model and part numbers specifically listed herein must be approved by the Engineer. Note that not all parts required to assemble a complete system are listed.
- B. Main PLC / Pump Control Panel

1. S7-400 CPU 414-3 (6ES7414-3EM07-0AB0)
2. Memory card, 2MB (6ES7952-1KL00-0AA0)
3. Communications Module CP 443-1 (6GK7443-1GX30-0XE0)
4. OIT: HMI TP1500 Comfort (6AV2124-0QC02-0AX1)
5. Digital Input module, 32x24VDC (6ES7 421-1BL01-0AA0)
6. Digital Output module, 32x24VAC (6ES7 422-1BL00-0AA0)
7. Analog Input module, 4-20mA, 8x16bit, isolated (6ES7 431-7KF00-0AB0)
8. Analog Output module, 4-20mA, 8x13 bit (6ES7 432-1HF00-0AB0)

C. Remote I/O (RIO) Locations

1. Remote I/O: IM153-4, ET 200M PROFINET interface (6ES7 153-4AA01-0XB0), with memory module (6ES7 953-8LF31-0AA0)
2. Digital Input module, 16x24VDC (6ES7 321-1BH02-0AA0)
3. Digital Output relay module, 8x24VDC (6ES7 322-5HF00-0AB0)
4. Analog Input module, 4-20mA plus HART, 8x16bit, optically isolated (6ES7 331-7NF00-0AB0)
5. Analog Output module, 4x16bit (6ES7 332-7ND02-0AB0)

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Refer to Section 406733 – Panel Wiring.
- B. Comply with NECA 1.
- C. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
- D. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.
- E. To comply with the general philosophy that there be no single point of failure, I/O for related equipment shall terminate on different I/O modules. For example, if there are 4 pumps, terminate digital inputs for two pumps onto one I/O module, and digital inputs for the other two pumps on a separate I/O module.

END OF SECTION 406343

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## SECTION 406613 - SWITCHES AND ROUTERS

### 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

- 1. Section includes switches and routers.
- B. Related Requirements:
  - 1. Section 406100 Process Control and Enterprise Management Systems General Provisions for submittal requirements,.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Refer to Section 406100 – Process Control and Enterprise Management System General Provisions.
- B. Shop Drawings:
  - 1. Refer to Section 406100 – Process Control and Enterprise Management Systems General Provisions.

#### 1.4 DELIVERY, STORAGE, AND HANDLING

- A. Refer to Section 406100 – Process Control and Enterprise Management Systems General Provisions.

#### 1.5 FIELD CONDITIONS

- A. Refer to Section 406100 – Process Control and Enterprise Management Systems General Provisions.

#### 1.6 WARRANTY

- A. Refer to Section 406100 – Process Control and Enterprise Management Systems General Provisions

## PART 2 - PRODUCTS

### 2.1 MANAGED ETHERNET SWITCH

#### A. Manufacturers:

1. Manufacturers and their products are subject to compliance with requirements. Provide the following:
  - a. SCADA Network (PROFINET) in Main Control Panel: Siemens SCALANCE X-200 series or approved equal model.
  - b. Administrative Network (Ethernet TCP/IP) in Main Control Panel: Cisco Catalyst 3850 series or approved equal model.
  - c. Substitutions: Not Permitted.

#### B. General:

1. Furnish a managed Ethernet switch for connection to the network as shown in the Drawings and specified herein.
2. Switches shall support line, star, and ring network topologies.

#### C. Physical Features:

1. DIN rail or 19-inch rack-mountable.
2. Modular construction such that additional copper and fiber ports can be added and removed.
3. SFP slots: 1G/10G SFP slots, and multi-mode fiber SFPs, connectors as required. Quantity as shown on Drawings plus 50 percent spare.
4. Copper ports: 100/1G ports, quantity as shown on Drawings plus 50 percent spare.
5. Operating temperature: 0 to 130 °F.
6. Power: 120VAC redundant power supplies.
7. Enclosure: Metal case.
8. Rating: UL Class 1, Division 2 Groups A, B, C, and D.

#### D. Network Features:

1. Layer 3 routing.
2. Spanning Tree Protocol (STP)
3. Rapid Spanning Tree Protocol (RSTP) (IEEE 802.1w)
4. Full duplex on all port.
5. Auto negotiation and manual configurable speed and duplex.
6. Wire speed switching fabric.
7. IGMP snooping.
8. IGMP filtering.
9. Configuration password protected.
10. Configuration backup capability required.
11. SNMP V3.
12. Lock port function for blocking unauthorized access based on MAC address.



## 2.2 CABLES AND CONNECTORS

### A. Ethernet/PROFINET

1. The unshielded twisted pair cable shall be designed for use with a high speed (10/100/1000 Mbps) Ethernet 10/100/1000 BASE-T/TX communications network. The twisted pair cable shall have a nominal impedance 100 ohms at one MHz, a maximum attenuation of 8 dB per 1000 feet at one MHz. The twisted pair cable must have frequency tested up to 250 MHz or more. The twisted pair cable shall be plenum rated and shall have a minimum of four 23 AWG solid copper conductor pairs. All 10/100/1000 BASE-T/TX (RJ-45) terminations on the twisted pair cable shall be done in a professional and workmanlike manner. Terminations shall provide for proper strain relief on the cable jacket. Strain relief on the wire and/or wire insulation shall not be acceptable. Connectors shall be industrial type, Siemens 6GK1901-1BB10-2AA0 or equal.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Comply with NECA 1.
- B. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

### 3.2 STARTUP SERVICE

- A. Perform startup service as follows.
  1. Complete installation and startup checks according to manufacturer's written instructions.
  2. For Managed Ethernet Switches:
    - a. Enable the lock port function to block unauthorized access based on MAC address for each switch and router. All devices connecting to switch shall have static IP addresses assigned.
    - b. Lock down all spare switch and router ports.

END OF SECTION 406613

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## SECTION 406619 - MEDIA CONVERTERS

### 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

- 1. Section includes media converters.
- B. Related Requirements:
  - 1. Refer to Section 406100 – Process Control and Enterprise Management System General Provisions.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Refer to Section 406100 – Process Control and Enterprise Management System General Provisions.
- B. Shop Drawings:
  - 1. Refer to Section 406100 – Process Control and Enterprise Management Systems General Provisions.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Refer to Section 406100 – Process Control and Enterprise Management System General Provisions.

#### 1.5 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. Provide one spare media converter.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Refer to Section 406100 – Process Control and Enterprise Management Systems General Provisions

1.7 FIELD CONDITIONS

- A. Refer to Section 406100 – Process Control and Enterprise Management Systems General Provisions.

PART 2 - PRODUCTS

2.1 COPPER TO FIBER MEDIA CONVERTER

A. Manufacturers

- 1. Manufacturers and their products are subject to compliance with requirements. Provide the following:
  - a. Siemens SCALANCE X-100
  - b. Substitutions: Not Permitted.

B. General:

- 1. Provide a copper to fiber media converter as shown in the Drawings and specified herein.
- 2. Devices shall support line, star and ring network topologies.

C. Physical Features:

- 1. Industrial Ethernet/PROFINET, RJ45 port.
- 2. Fiber uplink: 10/100MB/1GB (ST connectors).
- 3. Fiber optics: Multi- or single-mode capability as shown in the Drawings.
- 4. Operating temperature: 0 to 130 °F.
- 5. Power: 24 VDC.
- 6. Enclosure: DIN-rail mountable.

2.2 CABLES AND CONNECTORS

- A. Refer to Section 406613.

PART 3 - EXECUTION (NOT USED)

END OF SECTION 406619

## SECTION 406650 - RADIO TELEMETRY 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. Radio Telemetry Equipment, Cables and Accessories.
- 2. Radio Diagnostic Software.
- 3. Radio Path Survey and Study.

- B. Related Requirements:

- 1. Section 406100 "Process Control and Enterprise Management Systems General Provisions" for scope of work and other general requirements.
- 2. Section 406663 "Antennas"
- 3. Section 406666 "Monopoles and Towers"

- C. Meet all applicable federal (FCC, etc.), state, and local codes and regulations.

#### 1.3 ACTION SUBMITTALS

- A. Provide shop drawings and product data, in accordance with Section 013300 "Submittal Procedures", showing materials of construction and details of installation including:

- 1. Data sheets and catalog literature for hardware (radios and accessories).
- 2. Physical dimension drawings.
- 3. Antenna tower details and structural calculations.
- 4. Computer-based radio coverage study.
- 5. Installation and interconnection/wiring diagrams depicting the proposed installation of the equipment, in conformance to the requirements specified on the Plans. Detail these drawings to the extent that they may be modified after installation to serve as the "AS-BUILT" drawings.
  - a. Complete telemetry system block diagram(s) showing in schematic form, the interconnections between major hardware components. Reference all interconnecting cabling requirements for digital components of the system including any data communication links.

- b. Equipment specification sheets fully describing the device, the intended function, how it operates and physical environmental and performance characteristics. As a minimum the specification sheets include the following:
  - 1) Dimension, rigid clearances.
  - 2) Mounting or installation details.
  - 3) Connection.
  - 4) Electrical power requirements.
  - 5) Materials of construction.
  - 6) Environmental characteristics.
  - 7) Performance characteristics.
- c. Submit all planning information, site preparation instructions, grounding and bonding procedures, cabling diagrams, plug identifications, safety precautions or guards, and equipment layouts to enable the Supplier to proceed with the detailed site preparation for the equipment.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions” for any PCSS requirements regarding informational submittals for instruments.
- B. Submit the results of the Radio Path Survey and Study described in paragraph 3.1 of this Section.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Refer to Section 406100 “Process Control and Enterprise Management System General Provision” for O&M documentation .

#### 1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. None Required

#### 1.7 QUALITY ASSURANCE

- A. Provide components compatible with functions required to form complete working system.

#### 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions”.

## 1.9 FIELD CONDITIONS

- A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions”.

## 1.10 WARRANTY

- A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions”.

## PART 2 - PRODUCTS

### 2.1 SPREAD SPECTRUM RADIOS (900 MHZ)

- A. Manufacturers
  - 1. Manufacturers and their products are subject to compliance with requirements. Provide the following:
    - a. GE MDS 9810 or approved equal model.
- B. Type:
  - 1. Frequency Hopping Spread Spectrum (FHSS) radio utilizing 902 – 928 MHz ISM band.
- C. Function/Performance:
  - 1. Modulation: Digital, Continuous Phase Frequency Shift Keying (CPFSK)
  - 2. Throughput: 115.2 kbps capacity. Configurable between 1.2 to 115 kbps asynchronous
  - 3. RF Output Power: 0.1 to 1 Watt
  - 4. Receiver Sensitivity: -105 dBm at 1x10-6 Bit Error Rate
  - 5. Error Detection: 16-bit CRC (resend on error)
  - 6. Communications Interface: RS-232/RS-485
- D. Physical and Environmental:
  - 1. Antenna Connector: TNC Female
  - 2. Operating Temperature: -40 deg F to 158 deg F Power Requirements: 6 to 30 VDC
  - 4. Humidity: < 95% RH (Non-Condensing)
- E. Options/Accessories Required:
  - 1. FCC: Part 15 Approved

## 2.2 TRANSMISSION CABLE AND ACCESSORIES

### A. Manufacturers

1. Manufacturers and their products are subject to compliance with requirements. Provide the following:
  - a. CommScope LDF4-50A
  - b. Substitutions: None permitted.

### B. Type:

1. Low-loss foam dielectric coaxial cable

### C. Function/Performance:

1. Cable Impedance: 50 ohms plus/minus 1 ohm.
2. Capacitance: 23.4 pF/ft
3. Dielectric Constant: 1.32

### D. Physical:

1. Copper-clad aluminum wire
2. Jacket material: polyethylene
3. Dielectric: foam polyethylene
4. Outer conductor: corrugated copper or aluminum tape
5. Nominal diameter: 1/2 inch
6. Operating Temperature: -40 deg F to 185 deg F Connectors: Type N, terminated at both ends of the transmission cable

### E. Options/Accessories Required:

1. Refer to Instrumentation Detail.
2. Provide lightning protectors between transmission cable and coaxial jumper cable. Refer to Section 407856 "Isolators, Intrinsically Safe Barriers, and Surge Suppressors" for lightning protector requirements.

## PART 3 - EXECUTION

### 3.1 RADIO STUDY AND SURVEY

#### A. Perform a Radio Path Survey and Study:

1. Calculate anticipated fade margin. Include the following in the propagation model:
  - a. Longitude, latitude, elevation, and height above ground level of transmitter (Tx) and receiver (Rx) antennas.
  - b. Power (dBm) and antenna gains (dBi) of the system.



- c. Receiver threshold level (dBm).
  - d. System loss (dB) due to Tx/Rx line and connectors losses, and path losses including free-space, diffraction, foliage, and atmospheric absorption.
  - e. Calculated and manufacturer recommended fade margins.
2. Ensure minimum signal strength requirements for each communication link are met. Submit the results of the radio path analysis to the Engineer for review.
- a. Make changes as needed to the radio system to provide a system which can demonstrate an acceptable fade margin ( >20dB above Rx threshold) on all radio paths in both directions. If a suitable radio path is not available, provide repeater radios in the network, with the quantity and location of the repeater sites determined in the field.

### 3.2 INSTALLATION

- A. Install radio telemetry system as shown on the Drawings and in accordance with manufacturer's instructions and approved shop drawings.
- B. Engineer/Owner to approve exact installation locations during construction. Provide all labor and materials necessary to complete the work in an approved manner.
- C. Execute all work in accordance with codes and local rulings. Should any work be performed contrary to said rulings, ordinances and regulations, the system supplier bears full responsibility for such violations and assume all costs arising there from.
- D. Comply with NECA 1.

END OF SECTION 406650

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## SECTION 406663 - ANTENNAS

### 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 antennas for radio telemetry.
- B. Provide identical antennas as much as possible throughout the system to reduce spare parts inventory.
- C. Related Requirements:
  - 1. Section 406100 "Process Control and Enterprise Management Systems General Provisions" for scope of work and other general requirements.
  - 2. Section 406650 "Radio Telemetry Equipment."
  - 3. Section 407856 "Isolators, Intrinsically Safe Barriers, and Surge Suppressors."
- D. Meet all applicable federal (FCC, etc.), state, and local codes and regulations.

#### 1.3 DEFINITIONS

- A. Voltage Standing Wave Ratio (VSWR): The measure of reflected power on a transmission line, expressed as a ratio of reflected voltage ( $V_{\max}$ ) to ideal voltage ( $V_{\min}$ ). An ideal system will have 100% energy transmitted, resulting in a VSWR of 1.0, or 1:1.
- B. Yagi-Uda antenna (YAGI): A directional antenna consisting of parallel arrays of similar elements, typically half-wave dipoles.

#### 1.4 ACTION SUBMITTALS

- A. Provide shop drawings and product data, in accordance with Section 013300 "Submittal Procedures," showing materials of construction and details of installation for:
  - 1. Data sheets and catalog literature for hardware (radios and accessories)
  - 2. Physical dimension drawings
  - 3. Antenna tower details and structural calculations
  - 4. Installation and interconnection/wiring diagrams depicting the proposed installation of the equipment, in conformance to the requirements specified on the Plans. Detail these drawings to the extent that they may be modified after installation to serve as the "AS-BUILT" drawings.

- a. A complete telemetry system block diagram(s) showing in schematic form, the interconnections between major hardware components. Reference all interconnecting cabling requirements for digital components of the system including any data communication links.
- b. Equipment specification sheets that fully describe the device, the intended function, how it operates and its physical environmental and performance characteristics. As a minimum the specification sheets include the following:
  - 1) Dimension, rigid clearances.
  - 2) Mounting or installation details.
  - 3) Connection.
  - 4) Electrical power requirements.
  - 5) Materials of construction.
  - 6) Environmental characteristics.
  - 7) Performance characteristics.
- c. Submit all planning information, site preparation instructions, grounding and bonding procedures, cabling diagrams, plug identifications, safety precautions or guards, and equipment layouts to enable the Supplier to proceed with the detailed site preparation for the equipment.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Refer to Section 406100 "Process Control and Enterprise Management Systems General Provisions" for any PCSS requirements regarding informational submittals for instruments.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Refer to Section 406100 "Process Control and Enterprise Management System General Provisions."

#### 1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. None Required

#### 1.8 QUALITY ASSURANCE

- A. Refer to Section 406100 "Process Control and Enterprise Management System General Provisions."

#### 1.9 DELIVERY, STORAGE, AND HANDLING

- A. Refer to Section 406100 "Process Control and Enterprise Management System General Provisions."

1.10 FIELD CONDITIONS

- A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

1.11 WARRANTY

- A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions”.

PART 2 - PRODUCTS

2.1 OMNIDIRECTIONAL ANTENNAS (900 MHz)

- A. Manufacturers
  - 1. Manufacturers and their products are subject to compliance with requirements. Provide the following:
    - a. Refer to Instrumentation Detail.
- B. Type:
  - 1. 902-928 MHz omnidirectional antenna
- C. Function/Performance:
  - 1. Gain: 6 dBi or greater, as required for acceptable performance.
  - 2. Max power input: 100 W (50 dBm)
  - 3. Impedence: 50 Ohms
  - 4. Polarization: Vertical
  - 5. VSWR: <1.5:1
  - 6. Lightning protection: DC ground
  - 7. Operating Temperature: -40 to 140 degrees F
  - 8. Rated Wind Speed: 130 mph
- D. Physical:
  - 1. Material: High density fiberglass with ultraviolet inhibiting coating.
  - 2. Connector: Female type N
  - 3. Radome Diameter: 1.5-inches
  - 4. Gold anodized or stainless steel mounting sleeve
  - 5. RoHS compliant
- E. Options/Accessories Required:
  - 1. Provide lightning protectors between transmission cable and coaxial jumper cable. Refer to Section 407856 “Isolators, Intrinsically Safe Barriers, and Surge Suppressors” for lightning protector requirements.
  - 2. Provide mounting brackets and hardware suitable for the installation location shown on the drawings and as recommended by the antenna manufacturer.

## 2.2 YAGI DIRECTIONAL ANTENNAS (900 MHz)

### A. Manufacturers

1. Manufacturers and their products are subject to compliance with requirements. Provide the following:
  - a. Refer to Instrumentation Detail.

### B. Type:

1. 902-928 MHz yagi directional antenna
2. Seamless boom with 3 to 6 parallel detector elements

### C. Function/Performance:

1. Gain: 8 dBi or greater, as required for acceptable performance.
2. Max power input: 150 W (51.7 dBm)
3. Impedence: 50 Ohms
4. Horizontal Beamwidth: 52 to 54 degrees
5. Vertical Beamwidth: 45 to 48 degrees
6. VSWR: < 1.5:1
7. Lightning protection: DC ground
8. Operating Temperature: -40 to 185 degrees F
9. Rated Wind Speed: 135 mph

### D. Physical:

1. Construction: Fully welded, black or gold anodized.
2. Connector: Female type N
3. Boom Diameter: 3/4-inch to 1-inch
4. Boom Material: Heat treated 6061-T6 Aluminum
5. Element Diameter: 1/8-inch to 3/8-inch
6. Element Material: Heat treated 6061-T6 Aluminum
7. Gold anodized or stainless steel mounting plate
8. RoHS compliant

### E. Options/Accessories Required:

1. Provide lightning protectors between transmission cable and coaxial jumper cable. Refer to Section 407856 "Isolators, Intrinsically Safe Barriers, and Surge Suppressors" for lightning protector requirements.
2. Provide mounting brackets and hardware suitable for the installation location shown on the drawings and as recommended by the antenna manufacturer.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install radio telemetry system as shown on the Drawings and in accordance with manufacturer's instructions and approved shop drawings.

- B. Engineer/Owner to approve exact installation locations during construction. Provide all labor and materials necessary to complete the work in an approved manner.
- C. Execute all work in accordance with codes and local rulings. Should any work be performed contrary to said rulings, ordinances and regulations, the system supplier bears full responsibility for such violations and assume all costs arising there from.
- D. Comply with NECA 1.
- E. Radio path survey and study, and adjusting antenna for signal strength optimization, will be performed by the Owner.

END OF SECTION 406663

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## SECTION 406666 – MONOPOLES AND TOWERS

### 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 monopoles and towers for radio telemetry.
- B. Related Requirements:
  - 1. Section 406100 “Process Control and Enterprise Management Systems General Provision.”
  - 2. Section 406650 “Radio Telemetry Equipment.”
  - 3. Section 406663 “Antennas.”
- C. Meet all applicable federal (FCC, etc.), state, and local codes and regulations.

#### 1.3 ACTION SUBMITTALS

- A. Provide shop drawings and product data, in accordance with Section 013300 “Submittal Procedures”, showing materials of construction and details of installation for:
  - 1. Data sheets and catalog literature for hardware (radios and accessories)
  - 2. Physical dimension drawings
  - 3. Submit details and structural calculations for the antenna, tower and foundation signed and sealed by a Professional Engineer registered in the State of Florida for approval.
  - 4. Installation and interconnection/wiring diagrams depicting the proposed installation of the equipment, in conformance to the requirements specified on the Plans. Detail these drawings to the extent that they may be modified after installation to serve as the "AS-BUILT" drawings.
    - a. A complete telemetry system block diagram(s) showing in schematic form, the interconnections between major hardware components. Reference all interconnecting cabling requirements for digital components of the system including any data communication links.
    - b. Equipment specification sheets that fully describe the device, the intended function, how it operates and its physical environmental and performance characteristics. As a minimum the specification sheets include the following:
      - 1) Dimension, rigid clearances.
      - 2) Mounting or installation details.
      - 3) Connection.
      - 4) Electrical power requirements.

- 5) Materials of construction.
- 6) Environmental characteristics.
- 7) Performance characteristics.

- c. Submit all planning information, site preparation instructions, grounding and bonding procedures, cabling diagrams, plug identifications, safety precautions or guards, and equipment layouts to enable the Supplier to proceed with the detailed site preparation for the equipment.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions” for any PCSS requirements regarding informational submittals for instruments.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

#### 1.6 QUALITY ASSURANCE

- A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Refer to Section 016000 “Product Requirements” for delivery, storage, and handling requirements.

#### 1.8 FIELD CONDITIONS

- A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

#### 1.9 WARRANTY

- A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions”.

## PART 2 - PRODUCTS

### 2.1 ANTENNA POLES AND TOWERS

- A. Manufacturers:
1. Manufacturers and their products are subject to compliance with requirements. Provide one of the following:
    - a. Radian Communications / Rohn Products
    - b. Universal Towers
    - c. Substitutions: Not Permitted.
- B. Type:
1. Metallic pole or tower
  2. Used for antenna mounting at radio telemetry sites.
- C. Physical:
1. Height shall be as required to achieve a functional system while meeting permitted regulations. Refer to Section 406650 for details of radio path survey and study to be performed by PCSS, as a guide to determining pole and tower heights.
  2. Designed without the need of guy wires. Erect tower to meet all local and TIA/EIA codes.
  3. Grounding connections from the pole/tower to the grounding grid. Ground in accordance with the electrical specifications and drawings.
  4. Tower installation capable of withstanding winds and icing defined in TIA-222 Revision H.
  5. Mast and foundation capable of withstanding wind and debris requirements per Building Code.
  6. Foundation
    - a. Unless shown otherwise, provide a foundation for each tower or pole.
    - b. Concrete foundation and anchor bolts provided under other related Sections.
    - c. Refer to Divisions 02 and 03 for foundation and excavation requirements.
  7. Metallic Poles
    - a. Poles (not on towers) shorter than 20 feet constructed of 2-inch schedule 40 galvanized steel or 2-inch schedule 80 aluminum tubing.
  8. Towers
    - a. Free-standing, rated up to a height of 100 feet. Final height of tower to be determined by the supplier/contractor and to be in conformance with the radio survey.
    - b. Hot-dipped galvanized steel support structure.
    - c. Tower consists of three vertical faces fabricated of high grade steel tubing with steel angle braces.
    - d. Structural components hot-dipped galvanized after fabrication.

- e. Fabricated in 20-foot riser sections, each section being 6-inches smaller on each face than the lower section to which it is connected.
- f. Double bolt holes at each connection joint for each section.
- g. Sections are die-cut equilateral construction with center sections containing steel angle braces between each set of braces.
- h. Top section of the tower provided with 2-in pipe projection (top tube) projecting 30-inches above the tower (total length of top tube to be 52-inches).
- i. Section Fabrication:
  - 1) Top section: 1-1/4-inch, 14 gauge tubing minimum.
  - 2) Center section: 1-1/2-inch, 12 gauge tubing minimum.
  - 3) Bottom section: 2-inch, 10 gauge tubing minimum.
- j. Provide each leg of the bottom support section with thick steel base plate, welded to the bottom of the section.

D. Required Accessories:

- 1. Provide stainless steel mounting hardware and fasteners for each installation, appropriate for the specific location and application. Refer to Instrumentation Detail.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Comply with NECA 1.

#### 3.2 CONNECTIONS

- A. Refer to Section 260526 "Grounding and Bonding for Electrical Systems."

END OF SECTION 406666

## SECTION 406717 – INDUSTRIAL ENCLOSURES

### 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 industrial control enclosures and instrument racks.
- B. Related Requirements:
  - 1. Section 406733 for Panel Wiring.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
  - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

### PART 2 - PRODUCTS

#### 2.1 INDUSTRIAL ENCLOSURES

- A. Manufacturers
  - 1. Manufacturers and their products are subject to compliance with requirements. Provide one of the following:
    - a. nVent: Hoffman.
    - b. Rittal.
    - c. Saginaw.
    - d. Substitutions: Or equal.
  - 2. All panels in indoor, dry, non-corrosive environments shall be NEMA 12 unless otherwise noted and shall be of steel construction. All panels in outdoor, wet, or chemically corrosive environments shall be NEMA 4X and 316 stainless steel construction. All panels located in a hazardous location shall be rated for the type of hazard (e.g., NEMA 7 for Class 1, Division 1).

3. Provide angle stiffeners as required on the back of the panel face to prevent panel deflection under instrument loading or operation. Internally the panels shall be supplied with a structural framework for instrument support purposes and panel bracing. The internal framework shall permit panel lifting without racking or distortion. Provide removable lifting rings designed to facilitate simple, safe rigging, and lifting of the control panels during installation.
4. Each panel shall be provided with full height, fully gasketed access doors. Doors shall be provided with a three-point stainless steel latch and heavy-duty stainless steel locking handle. Panel access doors shall be provided with full length, continuous, piano type stainless steel hinges with stainless steel pins. Front access doors with mounted instruments or control devices shall be of sufficient width to permit door opening without interference from flush mounted instruments. Clamp-type door latches are not permitted.
5. The panels, including component parts, shall be free from sharp edges and welding flaws. Wiring shall be free from kinks and sharp bends and shall be routed for easy access to other components for maintenance and inspection purposes.
6. The panel shall be suitable for top and bottom conduit entry as required by the Electrical Drawings. For top mounted conduit entry, the panel top shall be provided with nominal one-foot square removable access plates, which may be drilled to accommodate conduit and cable penetrations. All conduit and cable penetrations shall be provided with ground bushings, hubs, gasketed locknuts, and other accessories as required to maintain the NEMA rating of the panel and electrical rating of the conduit system.
7. Print storage pockets shall be provided on the inside of each panel. The storage pockets shall be constructed of compatible material with the panel door, welded onto the door, and finished to match the interior panel color. The storage pocket shall be sufficient to hold all of the prints required to service the equipment, and to accommodate 8.5 inch by 11 inch documents without folding.

B. Freestanding and Floor-Mounted Vertical Panels:

1. Furnish freestanding and floor-mounted vertical panels that meet the NEMA classification as shown on the drawings or specified herein. Construct panels of 12 gauge sheet steel, suitably braced internally for structural rigidity and strength. Construct all NEMA 4X rated panels of Type 316 stainless steel. For front panels or panels containing instruments, provide not less than 10 gauge stretcher-leveled sheet steel, reinforced to prevent warping or distortion.

C. Wall and Unistrut Mounted Panels:

1. Furnish wall- and Unistrut- mounted panels that meet the NEMA classification as shown on the Drawings or specified herein. NEMA 4X rated wall mounted panels shall be 316 stainless steel, except for panels in indoor chemical storage and feed areas, which shall be FRP. Steel panels shall be not less than USS 14 gauge steel, suitably braced internally for structural rigidity and strength.

## 2.2 FINISH REQUIREMENTS

- A. All panel sections shall be descaled, degreased, filled and ground, phosphate cleaned, and finished.

- B. Enclosure finish shall be polyester powder-coated. NEMA 12 indoor enclosure exterior shall be ANSI 61 gray. The exterior of outdoor panels and NEMA 4X panels shall be white. All instrument rack panels and sun shield panels shall be white. All enclosure interiors shall be white.

## 2.3 ENVIRONMENTAL CONTROLS

- A. Heat load calculations shall be submitted for all unvented control panels that are not located in air-conditioned areas. The internal temperature of all panels shall be regulated to minimum 5°C; maximum 40°C, or 5°C below the lowest rated component, whichever is greater; under all conditions. Heat calculations shall account for:
  - 1. Loading and dissipation effects on all surfaces of the enclosure. Any surface not available for heat transfer, e.g. against a wall, shall be accounted for. The effects of sun shields shall be accounted for.
  - 2. Internal heat load of components (load and duty cycle).
  - 3. Outside temperature: assume 95°F.
- B. Provide custom fabricated sun shields for all outdoor panels and instrument racks in accordance with the following requirements:
  - 1. Sun shields shall be fabricated from .125 Marine Grade Aluminum, powder-coated white on all surfaces. Units shall be designed, fabricated, installed, and supported to fully cover and shade the top, sides and back of the enclosure, and to partially shade the front panel of the enclosure, from direct exposure to sunlight from sunrise to sunset.
  - 2. Depending on overall size, sun shields may be fabricated in single or multiple segments for attachment to the enclosure support framing or to separate free standing framing around the enclosure, to preserve rigidity.
  - 3. Sun shields shall not be attached directly to the enclosure by drilling holes through, or welding studs to, the enclosure surfaces, and shall be designed and mounted to provide a minimum 3-inch air gap all around the enclosure for air circulation and heat dissipation.
  - 4. The top section of all sun shields shall be sloped at a minimum angle of 5 degrees from horizontal. For wall mounted enclosures, the top section shall slope downward away from the wall and towards the front of the enclosure. For free standing, floor mounted and frame mounted enclosures the top section shall slope downward towards the back side of the enclosure.
  - 5. The front edge of the top section of all sun shields shall incorporate a narrow and more steeply sloped drip shield segment which sheds water away from the front of the enclosure and prevents it from dripping or running directly onto the front panel of the enclosure.
  - 6. All seam welds used in sun shield fabrication shall be continuous and shall be ground smooth.
  - 7. All exposed corners, edges and projections shall be smooth rounded or chamfered to prevent injury.
- C. Under no circumstances shall temperature control methods compromise the NEMA rating of the panel. Air conditioners are not allowed.
- D. Provide an integral heater, fan, and adjustable thermostat for outdoor enclosures and enclosures located in unheated areas indoors or in areas subject to humidity and moisture, to reduce condensation and maintain the minimum internal panel temperature. Mount unit near bottom of

the enclosure with discharge away from heat-sensitive equipment. Heater shall be Hoffman DAH Watts, 120 Volt, 50/60 HZ or equal.

E. Corrosion Control:

1. Protect panels from internal corrosion by the use of corrosion-inhibiting vapor capsules. Size and quantity as necessary per manufacturer recommendations.
2. Manufacturer:
  - a. Zerust VC.
  - b. Hoffman Model AHCI.
  - c. Or equal.

2.4 INSTRUMENT RACKS

- A. Instrument racks shall be sized and configured to support all indicated instruments and accessories, such that they are easily accessible to operators. Mounting elevation requirements provided herein shall apply. Elements to be mounted on an instrument rack may include transmitters and controllers; sensor assemblies; sample and drain pipes, tubes, valves and manifolds; sample pumps or compressors; power supplies, surge suppressors and disconnects.
- B. Instrument rack plates shall be fabricated from .125 Marine Grade Aluminum and .125 316 Alloy Stainless Steel back plate, powder-coated white on all surfaces. Depending on overall size, racks may be fabricated in single or multiple segments for attachment to the support framing, to preserve rigidity. All exposed corners, edges, and other projections shall be smooth rounded or chamfered to prevent injury.
- C. Each instrument rack shall be securely attached by stainless steel hardware to two or more steel support struts. Struts shall be aluminum, 3-inch square with 1/4-inch thick walls, permanently installed in concrete as shown on the Detail drawing. All exposed corners, edges and protruding bolts shall be smooth rounded or capped to prevent injury.
- D. Instrument racks located outdoors shall be fully covered by sun shields as described herein.

2.5 19-INCH EQUIPMENT RACKS

- A. Description: Two post racks with threaded rails designed for mounting telecommunications equipment. Width is compatible with EIA/ECIA 310-E, 19-inch equipment mounting with an opening of 17.72-inches between rails.
- B. General Requirements:
  1. Frames: Modular units designed for telecommunications terminal support and coordinated with dimensions of units to be supported.
  2. Material: Extruded steel.
  3. Finish: Manufacturer's standard, baked-polyester powder coat.
  4. Color: Black.
- C. Wall-Mounted Racks:



1. Depth: 23 inches.
2. Load Rating: 150 lb.
3. Number of Rack Units per Rack: 12.
4. Wall Attachment: Four mounting holes.
5. Equipment Access: Integral swing.

D. Cable Management:

1. Metal, with integral wire retaining fingers.
2. Baked-polyester powder coat finish.
3. Vertical cable management panels shall have front and rear channels, with covers.
4. Provide horizontal crossover cable manager at the top of each relay rack, with a minimum height of two rack units each.

E. Power Strips: Comply with UL 1363.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Rack mounting.
3. Six 15-A, 120-V ac, NEMA WD 6, Configuration 5-15R receptacles.
4. LED indicator lights for power and protection status.
5. LED indicator lights for reverse polarity and open outlet ground.
6. Circuit Breaker and Thermal Fusing: Unit continues to supply power if protection is lost.
7. Close-coupled, direct plug-in line cord.
8. Rocker-type on-off switch, illuminated when in on position.

F. Manufacturer. Kendall Howard "Phantom Class" 12U or 18U, or approved equal.

## 2.6 NAMEPLATES

- A. Equip panels and panel devices with suitable nameplates to identify the panel and individual devices as required. Unless otherwise indicated, include up to three lines with the first line containing the device tag number as shown on the drawings, the second line containing a functional description (e.g., Recirculation Pump No. 1), and the third line containing a functional control description (e.g., Start).
- B. Unless escutcheon plates are specified or unless otherwise noted on the Drawings, furnish nameplates as 3/32-inch thick, black and white, Lamicoid with engraved inscriptions. Use white lettering against a black background unless otherwise noted. Bevel and smooth edges of the. Nameplates with chipped or rough edges are not acceptable.
- C. Mount or fasten cabinet mounted nameplates with epoxy adhesive or stainless steel screws.
- D. For every panel, provide a panel nameplate with a minimum of 1-in high letters. Provide legend plates or 1-in by 3-in engraved nameplates with 1/4-in lettering for identification of door mounted control devices, pilot lights, and meters.
- E. Use single Lamicoid nameplates with multiple legends for grouping of devices such as selector switches and pilot lights that relate to one function.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Comply with NECA 1.
- B. Wiring Method: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters. Conceal raceway and cables except in unfinished spaces.
  - 1. Install plenum cable in environmental air spaces, including plenum ceilings.
  - 2. Comply with requirements for cable trays specified in Section 260536 "Cable Trays for Electrical Systems."
  - 3. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."
- C. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
- D. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

### 3.2 PANEL SCHEDULE

- A. Main Control Panel
  - 1. NEMA 12 indoor, free-standing full-height panel.
  - 2. Maximum dimensions: 72"H x 36"W x 24"D
- B. Well Sites Radio Panel (in High Service Pump Station Building)
  - 1. NEMA 12 indoor, wall-mounted panel.
  - 2. Maximum dimensions: 36"H x 36"W x 18"D
- C. Sodium Hypochlorite RIO Panel
  - 1. NEMA 4X indoor/corrosive, wall-mounted panel, FRP construction.
  - 2. Maximum dimensions: 42"H x 36"W x 18"D
- D. Sodium Hypochlorite Truck Fill Panel
  - 1. NEMA 4X outdoor, wall-mounted panel.
  - 2. Maximum dimensions: 36"H x 36"W x 18"D
- E. GST RIO Panel
  - 1. NEMA 4X outdoor, strut-mounted panel, 316 stainless steel construction.
  - 2. Maximum dimensions: 36"H x 36"W x 18"D

- F. Fiber Optic Interface Panel (adjacent to Generator Control Panel)
  - 1. NEMA 4X outdoor, strut or surface-mounted panel, 316 stainless steel construction.
  - 2. Maximum dimensions: 36"H x 36"W x 18"D
- G. Fiber Optic Patch Panel (in High Service Pump Station Building)
  - 1. 19-inch equipment rack, wall-mounted.

END OF SECTION 406717

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## SECTION 406733 - PANEL WIRING

### 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 requirements for internal wiring of control panels and consoles.

#### 1.3 ACTION SUBMITTALS

- A. Refer to Section 406100 – Process Control and Enterprise Management Systems General Provisions.

### PART 2 - PRODUCTS

#### 2.1 CONTROL PANEL - INTERNAL CONSTRUCTION

- A. Internal Electrical Wiring:
  - 1. Provide stranded, type MTW interconnecting wiring with 600 volt insulation rated for not less than 90 degrees Celsius. Segregate wiring for systems operating at voltages in excess of 120 VAC from other panel wiring either in a separate section of a multi-section panel or behind a removable Plexiglas or similar dielectric barrier. Develop panel layout such that technicians shall have complete access to 120 VAC and lower voltage wiring systems without direct exposure to higher voltages.
  - 2. For power distribution wiring on the line side of fuses or breakers, use 12 AWG minimum. For control wiring on the secondary side of fuses, use 16 AWG minimum. Utilize 18 AWG shielded, twisted pair cable insulated for not less than 600 volts for electronic analog circuits.
  - 3. Cover power distribution blocks with protective guards to meet “finger-safe” requirements of IP20.
  - 4. Route power and low voltage DC wiring systems in separate wireways. Cross different system wires at right angles. Separate different system wires routed parallel to each other by at least 6-inches. Terminate different wiring systems on separate terminal blocks. Do not fill wiring troughs to more than 60 percent visible fill.
  - 5. Terminations:
    - a. Terminate wiring onto single tier terminal blocks, where each terminal is uniquely and sequentially numbered. Direct wiring between field equipment and panel components is not acceptable.

- 1) Multi-level terminal blocks or strips are not acceptable.
  - b. Arrange terminal blocks in vertical rows and separated into groups (power, DI, DO, AI, AO). Provide each group of terminal blocks with a minimum of 20 percent spares.
  - c. Use compression type, fused, unfused, or switched terminal blocks. Use two terminals per point for discrete inputs and outputs (DI and DO) with adjacent terminal assignments. Wire all active and spare PLC and controller points to terminal blocks.
  - d. Use three terminals per point for analog inputs and outputs (AI and AO) per shielded pair connection with adjacent terminal assignments for each point. The third terminal is for shielded ground connection for cable pairs. Ground the shielded signal cable at the PLC cabinet. Wire all active and spare PLC and controller points to terminal blocks.
  - e. Use sleeve-type wire and tube markers with heat impressed letters and numbers.
  - f. Use only one side of a terminal block row for internal wiring. Field wiring side of the terminal shall not be within 6-inches of the side panel or adjacent terminal or within 8-inches of the bottom of free standing panels, or within 3-inches of stanchion mounted panels, or 3-inches of adjacent wireway.
  - g. Isolate circuit power from the SCADA cabinet out to field devices (switches, dry contacts etc.) that are used as discrete inputs to the PLC input cards with an isolating switch terminal block with flip cover that is supplied with a dummy fuse. One isolating switch terminal block per loop numbered piece of equipment and one per spare I/O point is acceptable.
  - h. Isolate all PLC discrete outputs to the field with an isolating fuse switch terminal block with a flip cover and a blown fuse indicator.
  - i. Individual 4-20mA signal loops shall be fused, whether or not they are protected by surge protection devices as per Section 407856.
  - j. Groups of PLC discrete inputs terminated on the same module shall be fused.
6. Clearly identify wiring to hand switches and other devices, which are live circuits independent of the panel's normal circuit breaker protection as such.
  7. Wiring shall be clearly tagged and color coded. Tag numbers and color coding shall correspond to panel wiring diagrams and loop drawings prepared by the PCSS. Power wiring, control wiring, grounding, and DC wiring shall utilize different color insulation for each wiring system used. Color coding scheme shall be in accordance with UL 508a.
  8. Provide surge protectors on all incoming power supply lines at each panel per requirements of Section 407856 – Isolators, Intrinsic Safety Barriers, and Surge Suppressors.
  9. Each field instrument furnished under Division 40 and shown on the Drawings as deriving input power from the control panel(s) shall have a separate power distribution circuit with a circuit breaker or fuse and blown fuse indication. Instruments requiring 120VAC power shall be powered as shown on the drawings.
  10. Wiring trough for supporting internal wiring shall be plastic type with snap-on covers. Side walls shall be open top type to permit wire changing without disconnecting. Trough shall be supported to the subpanel by stainless steel screws. Trough shall not be bonded to the panel with glue or adhesives.
  11. Each panel shall have a single tube, LED light fixture, 20 Watt in size (minimum), mounted internally to the ceiling of the panel. Light fixture shall be switched and shall be complete with the lamp.
  12. Each panel shall have a specification grade duplex convenience receptacle with ground fault interrupter, mounted internally within a stamped steel device box with appropriate

- cover. Convenience receptacle shall not be powered from a UPS and shall be protected by a dedicated fuse or circuit breaker.
13. Each panel shall be provided with an isolated copper grounding bus for all signal and shield ground connections. Shield grounding shall be in accordance with the instrumentation manufacturer's recommendations.
  14. Each panel shall be provided with a separate copper power grounding bus (safety) in accordance with the requirements of the National Electrical Code.
  15. Each panel shall have control, signal, and communication line surge suppression in accordance with Section 407856.
  16. Microprocessor-based electronic devices in the panel that are powered by 120VAC shall be powered by the UPS, refer 406763. UPS receptacles shall be colored orange and labeled as such.
  17. Each panel shall be provided with a circuit breaker to interrupt incoming power.
  18. Additional electrical components including transformers, motor starters, switches, circuit breakers, etc. shall be in compliance with the requirements of Division 26.
- B. Relays not provided under Division 26 and required for properly completing the control function specified in Division 40, Division 26 or shown on the Drawings shall be provided under this Section.
- C. Orientation of devices including PLC and I/O when installed shall be per the manufacturer's recommendations. No vertical orientation of PLC racks shall be allowed unless specifically indicated by the manufacturer as an acceptable mounting alternative and also approved by the Engineer.
- D. Pilot light colors:
1. On or Open – Red
  2. Off or Closed – Green
  3. Alarm – Amber
  4. Auto or Remote – White
  5. Manual or Local – Yellow
  6. Power On – White

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Comply with NECA 1.
- B. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

END OF SECTION 406733

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## SECTION 406763 - CONTROL PANEL MOUNTED UPS

### 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 control panel mounted uninterruptible power supply.
- B. Related Requirements:
  - 1. Section 406100 Process Control and Enterprise Management Systems General Provisions for submittal requirements.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Refer to Section 406100 – Process Control and Enterprise Management System General Provisions.
- B. Shop Drawings:
  - 1. Refer to Section 406100 – Process Control and Enterprise Management Systems General Provisions.

#### 1.4 CLOSEOUT SUBMITTALS

- 1. Refer to Section 406100 – Process Control and Enterprise Management System General Provisions.

#### 1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. None Required

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Refer to Section 406100 – Process Control and Enterprise Management Systems General Provisions.

1.7 FIELD CONDITIONS

- A. Refer to Section 406100 – Process Control and Enterprise Management Systems General Provisions.

PART 2 - PRODUCTS

2.1 24 VDC UNINTERRUPTIBLE POWER SUPPLY

A. Manufacturers

1. Manufacturers and their products are subject to compliance with requirements. Provide the following:
  - a. Siemens SITOP Series with signaling contact module.
  - b. Substitutions: Not Permitted.

B. Type:

1. 24 VDC uninterruptible primary switched mode power supply unit.

C. Operation:

1. To provide uninterrupted 24 VDC power to output upon loss of input power.
2. When 24 V supply voltage is applied, connected battery module is charged.
3. In event of a supply voltage failure, battery module is connected to the output, and stored power ensures that all connected devices continue to operate without interruption. UPS supplies a 24 VDC voltage with a load current up to 10 A.

D. Functional:

1. Input voltage range: 22.5 - 30 VDC.
2. Nominal Output Voltage: 24 VDC.
3. Output Current: 10 A.

E. Controls:

1. Dry contacts shall be provided for remote monitoring of UPS conditions:
  - a. UPS on battery.
  - b. Fault.

F. Physical:

1. Mounting: horizontal DIN rail mounting.
2. Operating temperature range: 0 - 50 degrees C.
3. Degree of protection: IP20.

- G. Performance: UPS shall provide a minimum of 15 minutes of run time for calculated full load. Unit may have either internal or external batteries as necessary to support runtime requirements.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Comply with Section 406733.
- B. Comply with NECA 1.
- C. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
- D. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

END OF SECTION 406763

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## SECTION 407000 - INSTRUMENTATION FOR PROCESS SYSTEMS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Refer to Section 40 61 00 Process Control and Enterprise Management Systems General Provisions.

#### 1.2 SUMMARY

- A. Section includes the general requirements for furnishing, installing, and servicing PCSS provided instruments.
- B. Related Requirements:
  - 1. Refer to individual instrument specifications.

#### 1.3 DEFINITIONS

- A. PCSS – Process Control System Supplier as defined in Section 406100 – Process Control and Enterprise Management System General Provisions

#### 1.4 ACTION SUBMITTALS

- A. Submit complete documentation of all field instruments using ISA-TR20.00.01-2007 data sheet formats. Submit a complete Bill of Materials (BOM) or Index that lists all instrumentation equipment. The list shall be sorted by Loop Number.
- B. Submit separate data sheets for each instrument type including:
  - 1. Plant Equipment Number and ISA tag number per the Drawings.
  - 2. Product (item) name used herein and on the Drawings.
  - 3. Manufacturer's complete model number.
  - 4. Location of the device.
  - 5. Input - output characteristics.
  - 6. Range, size, and graduations in engineering units.
  - 7. Include construction details, material descriptions, dimensions of individual components and profiles.
  - 8. Instrument or control device sizing calculations where applicable.
  - 9. Indicate which instruments will be provided with certified calibration data (i.e., all flow metering devices) as part of O&M manual.

10. Include rated capacities, operating characteristics, electrical characteristics and furnished specialties and accessories Two-wire or four-wire device type as applicable.
11. Indicate which instruments will be provided with manufacturer's maintenance services if specified.

C. Instrument Vendor Shop Drawings:

1. Include plans, elevations, sections, and mounting details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Detail fabrication and assembly of instrument.
4. Include diagrams for power, signal, and control wiring.

D. Submit catalog cuts for all instruments. Submit descriptive literature for each hardware component, which fully describes the units being provided.

E. Submit index and data sheets on 8-1/2" x 11" formats. Electronic format shall be in Microsoft Excel or Word. Submit electronic copy on DVD disk or USB thumb drive.

1.5 INFORMATIONAL SUBMITTALS

- A. Refer to Section 406100 - Process Control and Enterprise Management Systems General Provisions for any PCSS requirements regarding informational submittals for instruments.

1.6 CLOSEOUT SUBMITTALS

- A. Refer to Section 406100 - Process Control and Enterprise Management Systems General Provisions for any PCSS requirements regarding closeout submittals for instruments.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Refer to individual instrument specifications for spare parts requirements.
- B. Refer to Section 406100 - Process Control and Enterprise Management Systems General Provisions for PCSS requirements regarding submission of maintenance materials

1.8 QUALITY ASSURANCE

- A. Refer to individual instrument specifications for quality assurance requirements as well as which specific instruments require manufacturer's start-up and training services.
- B. Refer to Section 406100 - Process Control and Enterprise Management Systems General Provisions for overall quality assurance requirements for PCSS scope of work.

## PART 2 - PRODUCTS

### 2.1 INSTRUMENT TAGS

- A. A permanent stainless steel or other non-corrosive material tag firmly attached and permanently and indelibly marked with the instrument tag number, as indicated in the Drawings, shall be provided on each piece of equipment supplied under this Section and related sections. Equipment shall be tagged before shipping to the site.
- B. Provide 1/8-in by 3/8-in, Type 316 stainless steel button head machine screws.
- C. All supplied instrument transmitters and instrument transmitter elements shall have a stainless steel identification tag attached to each transmitter and element prior to shipment. Tag shall be attached via stainless steel chain or stainless steel wire (24 gauge min) to a non-removable part of the device. The tag size shall be a minimum of 1 inch H x 3 inch W. Tag shall include the ISA alphanumeric instrument number as indicated in the P&ID, loop, and detail drawings. The alphanumeric instrument number shall be stamped into the tag and shall have a minimum of 3/16-in high alphanumeric characters.

## PART 3 - EXECUTION

### 3.1 GENERAL

- A. See execution requirements in Section 406100 – Process Control and Enterprise Management Systems General Provisions.
- B. Unless specifically indicated, direct reading or electrical transmitting instrumentation shall not be mounted on process piping. Instrumentation shall be mounted on instrument racks or stands. All instrumentation connections shall be provided with shutoff and drain valves. For differential pressure transmitters, 5-valve manifolds for calibration, testing and blow down service shall also be provided. For chemical or corrosive fluids, diaphragm seals with flushing connections shall be provided.

### 3.2 INSTALLATION

- A. See installation requirements in individual specification sections.

END OF SECTION 407000

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## SECTION 407113 - MAGNETIC FLOW METERS

### 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 magnetic flow meters.
- B. Related Requirements:
  - 1. Section 406100 – Process Control and Enterprise Management Systems General Provisions.
  - 2. Section 407000 – Instrumentation for Process Systems.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Refer to Section 407000 – Instrumentation for Process Systems.
- B. Shop Drawings:
  - 1. Refer to Section 407000 – Instrumentation for Process Systems.

#### 1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. None Required

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Refer to Section 406100 – Process Control and Enterprise Management System General Provisions.

#### 1.6 FIELD CONDITIONS

- A. Refer to Section 406100 – Process Control and Enterprise Management System General Provisions.

## 1.7 WARRANTY

- A. Refer to Section 406100 – Process Control and Enterprise Management Systems General Provisions

## PART 2 - PRODUCTS

### 2.1 MAGNETIC FLOW METERS

- A. Manufacturers:
  - 1. Manufacturers and their products are subject to compliance with requirements. Provide the following:
    - a. Endress+Hauser ProMag W 500 series
    - b. Substitutions: Not Permitted.
- B. Description: Low-frequency, electromagnetic induction-type flow meter, producing a linear signal directly proportional to flow rate, consisting of flow tube, signal cable, and transmitter.
- C. Performance and Design Criteria:
  - 1. Design: According to AWWA M33.
- D. Flow Tubes:
  - 1. Body Material: Type 304 stainless steel
  - 2. Liner: Polyurethane or composite elastomer .
  - 3. Length: As indicated on Drawings.
  - 4. End Connections: As indicated on Drawings. Environment: For meters with remote mounted transmitters, meters below grade shall be suitable for submergence for up to 48 hours to a depth of 30 ft (9m). Meters above grade shall be NEMA 4X (IP65).
- E. Electrodes:
  - 1. Type 316L stainless steel.
  - 2. Self-cleaning.
- F. Accuracy: Plus or minus 0.5 percent of actual flow rate over a 30:1 range, within velocity limits of 0.1-10.0 ft/sec.
- G. Provide adjustment for zero and span.
- H. Accessories:
  - 1. Furnish cable between transmitter and receiver.
  - 2. Furnish grounding rings, wires, and gaskets as recommended by the manufacturer. All materials must be suitable for the process and surrounding pipe.

## 2.2 TRANSMITTERS

- A. Manufacturer: Same manufacturer as meter.
- B. Transmitter Output:
  - 1. EtherNet/IP connection.
- C. Housing: NEMA 4X (IP65), suitable for surface or pipe stand mounting.
- D. Control Power:
  - 1. Wiring: As specified in Section 260503 - Equipment Wiring Connections.
  - 2. 120-V ac, single phase, 60 Hz.
  - 3. Furnish local transformers as required.
- E. HMI:
  - 1. Touch-screen programming, functioning through enclosure window without opening enclosure.
  - 2. Display:
    - a. Size: Four lines by 16 characters.
    - b. Type: Backlit digital display.
    - c. User-selectable engineering units.
    - d. Readout of diagnostic error messages.
- F. Mounting:
  - 1. Mounting: Remote, as shown on Drawings. Provide mounting hardware as required for the location.
- G. Accessories:
  - 1. A fully configurable totalizer integral to the transmitter. Totalized flow shall be locally viewable.
  - 2. Current signal output simulation.
  - 3. Empty pipe detection.
  - 4. Self-diagnostics.
  - 5. Field validation package that compares current operational status to a factory baseline to verify meter performance. Furnish field verification hardware and software tools as required, and compatible transmitters.
  - 6. Automatic zero adjustment.
  - 7. For outdoor installations, provide a sunshield of sturdy, corrosion- and UV-resistant material.
  - 8. Signal Cable: Provided by flow meter manufacturer.

## 2.3 INSTRUMENT SCHEDULE

### A. FE/FIT-1020: High Service PS Flow

1. Size: 16 inch
2. Flow Range: Minimum 0.43 mgd; maximum 10.6 mgd.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

#### A. Comply with NECA 1.

### 3.2 IDENTIFICATION

#### A. Refer to item in this specification for tagging designation

### 3.3 STARTUP SERVICE

#### A. Perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. The start-up services include calibration, oversight of installations of the sensor, and start-up of the sensor/transmitter in order to provide reliable measurement at the instrument. The factory-authorized service representative or manufacturer shall work with the PCSS to verify the transmitter sends correct information to the control system (i.e., that the scaling and units are the same at the instrument and on the control system's operator interface/PLC). Submit an instrument calibration report in order to document the calibration procedure of the instruments.

END OF SECTION 407113

## SECTION 407276 - LEVEL SWITCHES

### 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 level switches.
- B. Related Requirements:
  - 1. Section 406100 – Process Control and Enterprise Management Systems General Provisions.
  - 2. Section 407000 – Instrumentation for Process Systems.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Refer to Section 407000 – Instrumentation for Process Systems.
- B. Shop Drawings:
  - 1. Refer to Section 407000 – Instrumentation for Process Systems.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Refer to Section 406100 – Process Control and Enterprise Management System General Provisions.

#### 1.5 FIELD CONDITIONS

- A. Refer to Section 406100 – Process Control and Enterprise Management System General Provisions.

## PART 2 - PRODUCTS

### 2.1 ELECTRODE LEVEL SWITCHES

#### A. Manufacturers:

1. Manufacturers and their products are subject to compliance with requirements. Provide one of the following:
  - a. Ametek B/W Controls.
  - b. Gems Sensors Warrick Series 3S.
  - c. Substitutions: Or equal.

#### B. Sensor:

1. Type: Conducting electrodes which actuate an induction relay (level switch) at a given liquid level, wire suspension type.
2. Function/Performance:
  - a. Match level electrode requirements to the liquid being measured.
3. Physical:
  - a. Electrode material: Teflon-coated Type 316 stainless steel.
  - b. Electrode holder: Flanged PVC type with a three- inch minimum flange. Number and type of electrode openings as indicated on drawings and schedule. Weather-proof enclosure attached to the flange for all electrical connections. Match electrode holder to flanges supplied in tank.

#### C. Level Switch (Induction Relay):

1. Type:
  - a. Induction relay.
2. Function/Performance:
  - a. Match the secondary coil voltage to liquid being measured and verify distance to level electrodes is not too large for selected coil voltage.
  - b. Primary coil voltage is 120 volt AC.
  - c. Provide one normally open contact, one normally closed contact per relay with a holding circuit where required.
3. Physical:
  - a. Provide output contacts with a minimum rating of 10 amps at 120 volt AC.
  - b. Provide an outdoor stainless steel, NEMA 4X enclosure for the induction relays and auxiliary controls.
  - c. Provide and mount a fused disconnect switch in each relay control enclosure to disconnect line power to the equipment.

## 2.2 FLOAT SWITCHES

### A. Manufacturers:

1. Manufacturers and their products are subject to compliance with requirements. Provide one of the following:
  - a. Contegra FS 90.
  - b. Evoqua Water Technologies Model 9G-EF.
  - c. Substitutions: Or equal.

### B. Type: Mercury-free ball float switch.

### C. Function/Performance:

1. Differential: Less than 8 inch.
2. Type of Switch: SPDT snap switch
3. Switch Rating: 1 amps at 120 VAC or 100 VA @ 120 VAC.

### D. Physical:

1. Float: Type 316 stainless steel, Teflon or non-stick coating, minimum 5 in diameter.
2. Totally encapsulated switch.
3. Cable shall be heavy-duty, PVC or equivalent jacketed integral to float.

### E. Options/Accessories Required:

1. Provide stainless steel hardware.
2. Lead wire shall be a waterproof cable of sufficient length so that no splice or junction box is required in the vault.
3. Provide cast-aluminum weatherproof junction box outside the sump pit with terminals for all floats and tapped as required for conduit connections.
4. Provide mounting equipment as shown on the drawings.

## 2.3 INSTRUMENT SCHEDULE

### A. LSHH/LSLL-1001: Tank No. 1 Level Switch High-High/Low-Low

1. Type: Electrode Level.
2. LSHH height (elevation): 1 ft below overflow elevation (el 68.1')
3. LSLL height (elevation): 1 foot above LWL, 2 feet above FFE (el 36.0')

### B. LSH-2000: Sodium Hypochlorite Containment Sump Level Switch High

1. Type: Float Switch.
2. Height (elevation): 1 foot above bottom of sump.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1.

3.2 IDENTIFICATION

- A. Refer to this specification for tagging designation.

END OF SECTION 407276



## SECTION 407313 - PRESSURE GAUGES

### 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 pressure and differential pressure gauges.
- B. Related Requirements:
  - 1. Section 406100 – Process Control and Enterprise Management Systems General Provisions.
  - 2. Section 407000 – Instrumentation for Process Systems.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Refer to Section 407000 – Instrumentation for Process Systems.
- B. Shop Drawings:
  - 1. Refer to Section 407000 – Instrumentation for Process Systems.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Refer to Section 406100 – Process Control and Enterprise Management System General Provisions.

#### 1.5 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. Furnish one spare gauge of each type and range installed.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Refer to Section 406100 – Process Control and Enterprise Management System General Provisions.

1.7 FIELD CONDITIONS

- A. Refer to Section 406100 – Process Control and Enterprise Management System General Provisions.

PART 2 - PRODUCTS

2.1 PRESSURE GAGES

- A. Manufacturers:
  - 1. Manufacturers and their products are subject to compliance with requirements. Provide the following:
    - a. Ashcroft, 1259 series.
    - b. Substitutions: Or equal.
- B. Type: Bourdon tube actuated dial face pressure gauge.
- C. Dials:
  - 1. Nominal Diameter: 4-1/2 inches. Minimum 4 inches.
  - 2. Face: White, laminated plastic dials with black graduations.
  - 3. Scale: Extend over arc not less than 200 and not more than 270 degrees.
  - 4. Ranges and Graduation Units: As indicated on Instrument Schedule.
- D. Cases:
  - 1. Material: Phenolic or Type 316 stainless steel.
  - 2. Provide removable rear plate.
  - 3. For gauge pressure, vented case for temperature/atmospheric compensation.
  - 4. Windows:
    - a. Material: Clear acrylic or shatterproof glass.
    - b. Thickness: 1/8 inch.
    - c. Provide gasket.
- E. Connection:
  - 1. Location: Bottom.
  - 2. Socket:
    - a. 1/2-inch NPT male thread.
    - b. Material: Brass forging.

- c. Extend minimum 1-1/4 inches below gage cases.
    - d. Provide wrench flats.
  - 3. Mounting: Stem or surface.
- F. Measuring Element:
  - 1. Bourdon Tubes:
    - a. Material: Stainless steel, to brass socket.
    - b. Provide welded, stress-relieved joints.
  - 2. Movement:
    - a. Material: Stainless steel.
  - 3. Accuracy:
    - a. Comply with ASME B40.100.
    - b. Plus and minus 1.0 percent of full-scale range.
- G. Adjustment:
  - 1. Provide for zero-reading adjustment.
  - 2. Adjusting Screws: Accessible from rear of case without need for disassembly.
- H. Accessories:
  - 1. Special scales: Engineer reserves the right to require special scales and/or calibration if the manufacturer's standard is not suitable for the application.
  - 2. Provide liquid fill or other anti-vibration measures for gauges mounted directly onto pipes where vibration is expected. Provide liquid fill (no substitutes) for all gauges mounted outdoors. Fill liquid shall be glycerin or silicone oil.
  - 3. Refer to Instrumentation Details.

## 2.2 INSTRUMENT SCHEDULE

- A. LG-1001: Tank No. 1 Level
  - 1. Range as level: 0-34 ft (elev. 35.0' – 69.1')
- B. PG-1005: High Service PS Suction Pressure
  - 1. Range: -30 inHg to 30 psig
- C. PG-1011A, 1012A, 1013A, 1014A, 1015A (Qty.5): High Service Pump Suction Pressure
  - 1. Range: -30 inHg to 30 psig
- D. PG-1011B, 1012B, 1013B, 1014B, 1015B (Qty.5): High Service Pump Discharge Pressure

1. Range: 0 to 120 psig
- E. PG-1040: High Service PS Discharge Pressure
  1. Range: 0 to 120 psig
- F. LG-2001, LG-2002 (Qty.2): Sodium Hypochlorite Tank Level
  1. Range as level: 0-11.5 ft (elev. 31.5' – 43.0')

### PART 3 - EXECUTION

#### 3.1 IDENTIFICATION

- A. Refer to drawings for tagging designations.

END OF SECTION 407313

## SECTION 407326 - PRESSURE TRANSMITTERS

### 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 gauge-pressure transmitters.
- B. Related Requirements:
  - 1. Section 406100 – Process Control and Enterprise Management Systems General Provisions.
  - 2. Section 407000 – Instrumentation for Process Systems.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Refer to Section 407000 – Instrumentation for Process Systems.
- B. Shop Drawings:
  - 1. Refer to Section 407000 – Instrumentation for Process Systems.

#### 1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. None Required

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Refer to Section 406100 – Process Control and Enterprise Management System General Provisions.

#### 1.6 FIELD CONDITIONS

- A. Refer to Section 406100 – Process Control and Enterprise Management System General Provisions.

## 1.7 WARRANTY

- A. Refer to Section 406100 – Process Control and Enterprise Management Systems General Provisions.

## PART 2 - PRODUCTS

### 2.1 PRESSURE TRANSMITTERS

#### A. Manufacturers:

- 1. Manufacturers and their products are subject to compliance with requirements. Provide the following:
  - a. Rosemount 3051 series.
  - b. Substitutions: None permitted.

#### B. Performance Requirements

- 1. Capacities and Characteristics:
  - a. Microprocessor based, intelligent type.
  - b. Range: Range of the transmitter shall be the standard range of the manufacturer closest to the pressure range to be metered.
  - c. Accuracy: 0.075 percent of span.
  - d. Temperature Effect: Combined temperature effects shall be less than 0.2 percent of maximum span per 28 degrees C temperature change.
  - e. Stability: 0.05 percent of upper range limit for 1 year.
  - f. Output Signal: 4 to 20 mA DC linear with pressure, with HART protocol.
  - g. Output: Zero adjustable over the range of the instrument provided calibrated span is greater than the minimum calibrated span.
  - h. Operating Temperature Range: -20 to 80 degrees C.
  - i. Response Time: Less than 1 ms.
- 2. Display:
  - a. Digital indicator displaying in the engineering units indicated in the Instrument Device Schedule.
- 3. Diagnostics:
  - a. Self-diagnostics with transmitter failure driving output to above or below out of range limits.
  - b. Simulation capability for inputs and loop outputs.
  - c. Test terminals available to ease connection for test equipment without opening the loop.
  - d. Registers to record minimum and maximum pressure and temperatures transmitter has been exposed to shall be available.

4. Over Range Protection: Provide positive over range protection to 150 percent of the maximum pressure of the system being monitored by the instrument.

C. Materials

1. Enclosure:
  - a. NEMA 4X (IP66), explosion proof
  - b. Approved for Class I, Division 1, Groups C and D.
2. Process Wetted Parts, except for ozone/oxygen service:
  - a. Isolating diaphragm and other wetted metal parts of Type 316L stainless steel, unless otherwise indicated in the device schedule.
  - b. Gaskets and O rings shall be Teflon.
  - c. Connection Type: As indicated in device schedule.

D. Options/Accessories

1. Furnish fittings as necessary for connection to process piping. All fittings shall be stainless steel.
2. Furnish diaphragm seal assemblies where indicated on the Drawings. Refer to Instrumentation Details.

E. Instrument Schedule

1. LIT-1001: Tank No. 1 Level
  - a. Range: 0-34 ft (elev. 35.0' – 69.1')
  - b. Connection Type: 2 inch ANSI 150# flange. Refer to Detail on Mechanical Drawings.
2. PIT-1005: High Service PS Suction Pressure
  - a. Range: -30 inHg to 30 psig
  - b. Connection Type: ¼" or ½" NPT
  - c. Furnish diaphragm seal assembly as shown on Detail Drawing.
3. PIT-1040: High Service PS Discharge Pressure
  - a. Range: 0 to 120 psig
  - b. Connection Type: ¼" or ½" NPT
  - c. Furnish diaphragm seal assembly as shown on Detail Drawing.

## 2.2 PRESSURE SWITCH/TRANSMITTERS

A. Manufacturers:

1. Manufacturers and their products are subject to compliance with requirements. Provide the following:

- a. Dwyer EDA series.
- b. Substitutions: None permitted.

B. Performance Requirements

1. Capacities and Characteristics:

- a. Microprocessor based, intelligent type.
- b. Range: Range of the transmitter shall be the standard range of the manufacturer closest to the pressure range to be metered.
- c. Accuracy: Plus or minus 1 percent of full scale, with stability of plus or minus 2 percent per year.
- d. Temperature Effect: Plus or minus 0.05 percent of full scale per degree F.
- e. Stability: 0.05 percent of upper range limit for 1 year.
- f. Pressure Limits: 1.5x full scale.
- g. Temperature Limits: operating, 20 to 140 F; process, 0 to 176 F.
- h. Power: 24VDC, 2.5 W consumption.
- i. Display: Digital indicator displaying in the engineering units indicated in the Instrument Device Schedule.
- j. Output Signals:
  - 1) 4 to 20 mA DC linear with pressure.
  - 2) 2 SPDT relays, rating 5A @ 120/240VAC or 1A @ 30VDC, adjustable 0-100% FS, with LED indication on the face.

C. Materials

- 1. Enclosure: NEMA 4X (IP65)
- 2. Materials:
  - a. Wetted parts: Type 316L stainless steel.
  - b. Housing: Glass filled plastic.
  - c. Gaskets and O rings shall be Teflon.
- 3. Connections:
  - a. Process: 1/4" MNPT.
  - b. Electrical: 1/2" FNPT conduit openings. Two wires required for power, two wires for analog signal, two wires for each switch output.

D. Options/Accessories

- 1. Furnish fittings as necessary for connection to process piping. All fittings shall be stainless steel.
- 2. Furnish diaphragm seal assemblies where indicated on the Drawings. Refer to Instrumentation Details.

E. Instrument Schedule

- 1. LIT/LSH-2001, LIT/LSH-2002 (Qty.2): Sodium Hypochlorite Tank Level



- a. Range: 0-11.5 ft (elev. 31.5' – 43.0')
- b. Furnish diaphragm seal with all PVC process connection, suitable for sodium hypochlorite service. Assemble with silicone oil fill. Refer to Detail on Mechanical Drawings.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Comply with NECA 1.

#### 3.2 IDENTIFICATION

- A. Refer to item in this specification for tagging designation.

#### 3.3 STARTUP SERVICE

- A. Perform startup service.
  - 1. Complete installation and startup checks according to manufacturer's written instructions.

END OF SECTION 407326

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## SECTION 407521 - CHLORINE ANALYZERS

### 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 chlorine analyzer.
- B. Related Requirements:
  - 1. Section 406100 – Process Control and Enterprise Management Systems General Provisions.
  - 2. Section 407000 – Instrumentation for Process Systems.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Refer to Section 407000 – Instrumentation for Process Systems.
- B. Shop Drawings:
  - 1. Refer to Section 407000 – Instrumentation for Process Systems.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Refer to Section 406100 – Process Control and Enterprise Management System General Provisions.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Refer to Section 406100 – Process Control and Enterprise Management System General Provisions.

#### 1.6 FIELD CONDITIONS

- A. Refer to Section 406100 – Process Control and Enterprise Management System General Provisions.

## 1.7 WARRANTY

- A. Refer to Section 406100 – Process Control and Enterprise Management Systems General Provisions
- B. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace components that fail(s) in materials or workmanship within specified warranty period.
  - 1. Warranty Period: 1 year from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 CHLORINE RESIDUAL ANALYZER - AMPEROMETRIC

- A. Manufacturers:
  - 1. Manufacturers and their products are subject to compliance with requirements. Provide the following:
    - a. Endress+Hauser Liquiline assembly including:
      - 1) Liquiline CM444 4-channel transmitter.
      - 2) CCS51D digital free chlorine sensor.
      - 3) CLS16D digital conductivity sensor.
      - 4) CPS171D digital pH sensor.
    - b. Evoqua DEPOLOX 400M Residual Analyzer assembly, free chlorine with pH.
    - c. Substitutions: Not Permitted.
- B. Type:
  - 1. Microprocessor based electronic transmitter/converter flow-through sample cell.
  - 2. Amperometric chlorine analyzer for continuous measurement of free chlorine in aqueous solutions.
  - 3. Where indicated, additional sensors for conductivity and pH measurement.
- C. Function/Performance:
  - 1. Chlorine Residual
    - a. Accuracy: plus or minus 1 percent of full scale or 0.002 mg/l, whichever is greater, below 20 mg/l;  $\pm 5$  percent of reading between 20 and 50 mg/l.
    - b. Resolution: 0.001 mg/l (<10 mg/l) and 0.01 mg/l (10 to 20 mg/l).
    - c. Range: 0-20 mg/l.
  - 2. Conductivity
    - a. Maximum measured error: 2 % of reading up to 200  $\mu\text{S}/\text{cm}$ ; 3 % of reading from 200 to 500  $\mu\text{S}/\text{cm}$
    - b. Repeatability: 0.2% of reading

- c. Range: 0-500  $\mu\text{S}/\text{cm}$
  - 3. pH
    - a. Range: 1-12
  - 4. Environmental Conditions: The instrument shall operate over an ambient temperature range of 2-50 degrees C.
  - 5. Outputs:
    - a. Isolated 4-20 mA output for each parameter measured, and 1 programmable alarm contact for alarm rated for 0.5A at 115 VAC. Refer to Instrument Schedule.
    - b. Ethernet communication (HTTP or MODBUS TCP protocol) for complete diagnostic capability.
  - 6. Display: Dot matrix or LCD type displaying chlorine residual in ppm.
  - 7. Temperature Compensation: Compensated for sample temperatures over the temperature range of the instrument.
  - 8. Diagnostics: On screen instructions and self-diagnostics.
  - 9. Response: 90 percent of full scale within 1 second for digital inputs and outputs.
  - 10. Physical: Analyzers shall be suitable for surface mounting.
  - 11. Power Requirements: 120 VAC/60 Hz.
  - 12. Electronics enclosure shall be NEMA 4X.
  - 13. Accessories Required:
    - a. Provide manufacturer's flow-through sensor adapter for each sensor installed.
    - b. Provide one year's supply of manufacturer recommended consumables including, but not limited to, electrolytes, calibration reagents, membranes, and annual maintenance kits.
    - c. Provide one spare sensor of each type installed.
    - d. Provide two spare fuses for each transmitter (if not included as part of a maintenance kit).
- D. Manufacturer Start-up and Training services:
- 1. Provide manufacturer's start-up and training services as specified in the start-up and training services article.

## 2.2 INSTRUMENT SCHEDULE

### A. AE/AIT-1030A: Chlorine Residual A

- 1. Manufacturer/Model: Endress+Hauser Liquiline; see above for details.
- 2. Outputs: Free chlorine residual; pH; Conductivity; Fault Alarm.

### B. AE/AIT-1030B: Chlorine Residual B

- 1. Manufacturer/Model: Evoqua DEPOLOX 400M; see above for details.
- 2. Outputs: Free chlorine residual; Conductivity; Fault Alarm.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Comply with installation details on Drawings. Provide all piping and tubing, valves, gauges, and other appurtenances, necessary for sampling and drains.
- B. Comply with NECA 1.
- C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

### 3.2 IDENTIFICATION

- A. Refer to drawings for tagging designations.

### 3.3 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
  - 1. Complete installation and startup checks according to manufacturer's written instructions.
  - 2. The start-up services include calibration, oversight of installations of the sensor, and start-up of the sensor/transmitter in order to provide reliable measurement at the instrument. The factory-authorized service representative or manufacturer shall work with the PCSS to verify the transmitter sends correct information to the control system (i.e., that the scaling and units are the same at the instrument and on the control system's operator interface/PLC). Submit an instrument calibration report in order to document the calibration procedure of the instruments.

### 3.4 MAINTENANCE SERVICE

- A. Vendor Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by manufacturer's authorized service representative. Include annual preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper operation. Parts and supplies shall be manufacture's authorized replacement parts and supplies.

END OF SECTION 407521

## SECTION 407623 - COMBUSTIBLE GAS ANALYZERS

### 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 combustible gas analyzers.
- B. Related Requirements:
  - 1. Section 406100 – Process Control and Enterprise Management Systems General Provisions.
  - 2. Section 407000 – Instrumentation for Process Systems.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Refer to Section 407000 – Instrumentation for Process Systems.
- B. Shop Drawings:
  - 1. Refer to Section 407000 – Instrumentation for Process Systems.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Refer to Section 406100 – Process Control and Enterprise Management System General Provisions.

#### 1.5 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. One (1) complete calibration kit with test gas.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Refer to Section 406100 – Process Control and Enterprise Management System General Provisions.

1.7 FIELD CONDITIONS

- A. Refer to Section 406100 – Process Control and Enterprise Management System General Provisions.

1.8 WARRANTY

- A. Refer to Section 406100 – Process Control and Enterprise Management Systems General Provisions.
- B. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace components that fail(s) in materials or workmanship within specified warranty period.
  - 1. Warranty Period: 1 year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 COMBUSTIBLE GAS/LEL DETECTOR

- A. Manufacturers:
  - 1. Manufacturers and their products are subject to compliance with requirements. Provide one of the following:
    - a. Dräger Polytron 8310 IR Series.
    - b. Industrial Scientific iTrans.
    - c. MSA Ultima XIR Series.
    - d. Substitutions: Or equal.
- B. Sensor:
  - 1. Type:
    - a. Intrinsically safe.
    - b. Continuous infrared sensor.
  - 2. Function/Performance:
    - a. Response Time: T90 in less than 30 seconds.
    - b. Temperature Range: -50 to 90 degrees C.
    - c. Sensor Life: 3 years typical.



3. Physical:
  - a. Infrared sensor technology.
  - b. Suitable for remote wall or ceiling mounting, or directly fitted to transmitter as indicated on the Drawings.
  - c. The sensor shall be mounted approximately 1-3ft. below the ceiling in accordance with manufacturer's recommendation.
4. Accessories Required:
  - a. Pump Sampling Module: A sampling module shall be provided with the assembly when a sample is needed to be drawn from an enclosed area to the sensor. Power: 24 VDC. The module shall be suitable for Class I, Division I, Group D classifications and meet NEMA 4X requirements.
  - b. Filters: The sampling system shall come equipped with the proper filters before the sensor and before the pump assembly as shown on the Instrumentation details.
  - c. Sufficient cable up to 50 ft (15 m) of the type recommended by the manufacturer shall be provided for installation between sensor and transmitter as required by the installation indicated on the Drawings.
  - d. Remote sensor enclosures shall be explosion proof, approved for Class 1, Division 1, Groups C and D areas.

C. Remote Indicating Transmitter/Controller:

1. Type:
  - a. Electronic, microprocessor based single channel transmitter compatible with sensor provided.
2. Function/Performance:
  - a. Accuracy:  $\pm 3$  percent up to 50 percent LEL,  $\pm 5$  percent for greater than 50 percent LEL.
  - b. Range: 0 to 100 percent LEL.
  - c. Environmental Conditions: -20 to 60 degrees C; 10 to 95 percent relative humidity.
  - d. Power: 4-wire 24vdc. Refer to Drawings for power source.
  - e. Output: One 4-20 mA output proportional to calibrated range. Two programmable relay contacts for warning, alarm, and/or fault.
  - f. Display: Digital display indicating the gas level, alarm or fault messages, and diagnostic information.
3. Physical:
  - a. Explosion proof enclosure approved for Class 1, Division 1, Groups B, C, and D.
  - b. Suitable for surface mounting at elevation shown on drawings.
4. Accessories Required:
  - a. Handheld programming unit if required for setup and calibration.

## 2.2 INSTRUMENT SCHEDULE

- A. AE/AIT-3020: Sanitary Grinder Pump Station Combustible Gas Concentration

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Comply with installation details on Drawings. Provide all piping and tubing, valves, gauges, and other appurtenances, necessary for sampling and drains.
- B. Comply with NECA 1.
- C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

### 3.2 IDENTIFICATION

- A. Refer to drawings for tagging designations.

### 3.3 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
  - 1. Complete installation and startup checks according to manufacturer's written instructions.
  - 2. The start-up services include calibration, oversight of installations of the sensor, and start-up of the sensor/transmitter in order to provide reliable measurement at the instrument. The factory-authorized service representative or manufacturer shall work with the PCSS to verify the transmitter sends correct information to the control system (i.e., that the scaling and units are the same at the instrument and on the control system's operator interface/PLC). Submit an instrument calibration report in order to document the calibration procedure of the instruments.

### 3.4 MAINTENANCE SERVICE

- A. Vendor Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by manufacturer's authorized service representative. Include annual preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper operation. Parts and supplies shall be manufacture's authorized replacement parts and supplies.

END OF SECTION 407623

## SECTION 407813 - INDICATORS AND METERS

### 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 indicators and meters.
- B. Related Requirements:
  - 1. Section 406100 "Process Control and Enterprise Management Systems General Provisions" for submittal requirements.
  - 2. Section 406717 "Industrial Enclosures".
  - 3. Section 406733 "Panel Wiring".

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Refer to Section 406100 "Process Control and Enterprise Management Systems General Provisions".
- B. Shop Drawings:
  - 1. Refer to Section 406100 "Process Control and Enterprise Management Systems General Provisions".

#### 1.4 CLOSEOUT SUBMITTALS

- A. Refer to Section 406100 "Process Control and Enterprise Management System General Provisions."

#### 1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. None Required.

## PART 2 - PRODUCTS

### 2.1 PANEL-MOUNTED DIGITAL INDICATORS

#### A. Manufacturers:

1. Manufacturers and their products are subject to compliance with requirements. Provide one of the following:
  - a. Precision Digital ProVu Series.
  - b. Red Lion Controls PAXDP Series.
  - c. Substitutions: Or equal.

#### B. Type:

1. Digital indicator.

#### C. Function/Performance:

1. Accuracy: Plus or minus 0.25 percent of calibrated range.
2. Operating Temperature: -4 to 158 degrees F -20 to 70 degrees C.
3. Input: One (1) 4 to 20 mA.
4. Output: One (1) 4 to 20 mA.
5. Digital Outputs: Two (2) Form C programmable contacts rated for 5A at 120/240 VAC.
6. Display: 0.56-inch-high efficiency, 5-digit LED display.
7. Indicator Failure: Failure of the indicator will not cause failure of the 4-20 mA loop.

#### D. Physical:

1. Suitable for panel mounting.
2. Case size nominal 2.5-inch-high by 5-inch-wide by 6-inch deep.
3. NEMA 4X and explosion-proof approved for Class I, Division 1, Groups C and D areas.
4. Programmable via integrated keypad.
5. Power Requirements: 120 VAC/60 Hz.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- #### A.
1. Refer to Section 406733.

### 3.2 IDENTIFICATION

- #### A.
1. Refer to Section 406717.

END OF SECTION 407813

## SECTION 407816 - INDICATING LIGHTS

### 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 indicating lights.
- B. Related Requirements:
  - 1. Section 406100 "Process Control and Enterprise Management Systems General Provisions" for submittal requirements.
  - 2. Section 406717 "Industrial Enclosures."
  - 3. Section 406733 "Panel Wiring."

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Refer to Section 406100 "Process Control and Enterprise Management Systems General Provisions".
- B. Shop Drawings:
  - 1. Refer to Section 406100 "Process Control and Enterprise Management Systems General Provisions".

#### 1.4 CLOSEOUT SUBMITTALS

- A. Refer to Section 406100 "Process Control and Enterprise Management System General Provisions."

#### 1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. None Required.

## PART 2 - PRODUCTS

### 2.1 PILOT TYPE INDICATING LIGHTS

#### A. Manufacturers:

1. Manufacturers and their products are subject to compliance with requirements. Provide one of the following:
  - a. Cutler-Hammer.
  - b. Allen Bradley.
  - c. General Electric.
  - d. Square D.
  - e. Crouse Hinds (NEMA 7).
  - f. Substitutions: Or equal

#### B. Type:

1. Energy efficient, Solid-State LED Lamps.

#### C. Function/Performance:

1. Low voltage LED lamps suitable for the voltage supplied.
2. Integral reduced voltage transformers for 120VAC powered lights.
3. Replaceable lamps from the front of the unit.

#### D. Physical:

1. NEMA 4X.
2. Lens caps: 1.18-inch diameter.
3. Colors:
  - a. On or Open – Red
  - b. Off or Closed – Green
  - c. Alarm – Amber
  - d. Auto or Remote – White
  - e. Manual or Local – Yellow
  - f. Power On – White
4. Provide legend faceplates engraved to indicate the required function of each device. Refer to Section 406717.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- #### A.
- Refer to Section 406733.

3.2 IDENTIFICATION

A. Refer to Section 406717.

END OF SECTION 407816

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## SECTION 407819 - SWITCHES AND PUSH BUTTONS

### 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 switches and push buttons.
- B. Related Requirements:
  - 1. Section 406100 "Process Control and Enterprise Management Systems General Provisions" for submittal requirements.
  - 2. Section 406717 "Industrial Enclosures".
  - 3. Section 406733 "Panel Wiring".

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Refer to Section 406100 "Process Control and Enterprise Management Systems General Provisions".
- B. Shop Drawings:
  - 1. Refer to Section 406100 "Process Control and Enterprise Management Systems General Provisions".

#### 1.4 CLOSEOUT SUBMITTALS

- A. Refer to Section 406100 "Process Control and Enterprise Management System General Provisions."

#### 1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. None Required.

## PART 2 - PRODUCTS

### 2.1 SELECTOR SWITCHES AND PUSHBUTTONS

#### A. Manufacturers:

1. Manufacturers and their products are subject to compliance with requirements. Provide one of the following:
  - a. Allen Bradley.
  - b. Crouse Hinds (NEMA 7).
  - c. Cutler-Hammer.
  - d. General Electric.
  - e. Square D.
  - f. Substitutions: Or approved equal.

#### B. Type:

1. Heavy-duty oil tight type with stackable contact blocks.

#### C. Function/Performance:

1. Contact arrangement and switching action as required for the control system specified.
2. For 120VAC service, provide contacts rated 10A at 120VAC. For 24VDC service, provide silver sliding contacts rated 5A at 125VDC. For electronic (millivolt/milliamp) switching, provide contacts rated 1A at 28VDC.

#### D. Physical:

1. NEMA 4X.
2. Size: 1.18-inch diameter.
3. Pushbuttons: Flush type operators.
4. Selector switches: Knob or wing lever operators.
5. Provide legend plates denoting switch/pushbutton position and/or function. Refer to Section 406717.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- #### A.
- Refer to Section 406733.

### 3.2 IDENTIFICATION

- #### A.
- Refer to Section 406717.

END OF SECTION 407819

## SECTION 407853 - RELAYS

### 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 relays.
- B. Related Requirements:
  - 1. Section 406100 Process Control and Enterprise Management Systems General Provisions for submittal requirements.
  - 2. Section 4067XX, Control Panel specifications.

#### 1.3 ALLOWANCES

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Refer to Section 406100 – Process Control and Enterprise Management System General Provisions.
- B. Shop Drawings:
  - 1. Refer to Section 406100 – Process Control and Enterprise Management Systems General Provisions.

#### 1.5 CLOSEOUT SUBMITTALS

- 1. Refer to Section 406100 – Process Control and Enterprise Management Systems General Provisions.

#### 1.6 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. Furnish 10 percent, minimum one (1), of the quantity of each type installed.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Refer to Section 406100 – Process Control and Enterprise Management Systems General Provisions

1.8 FIELD CONDITIONS

- A. Refer to Section 406100 – Process Control and Enterprise Management Systems General Provisions.

PART 2 - PRODUCTS

2.1 GENERAL PURPOSE RELAYS AND TIME DELAYS

- A. Manufacturers:
1. Manufacturers and their products are subject to compliance with requirements. Provide one of the following:
    - a. Allen Bradley.
    - b. IDEC
    - c. Weidmuller.
    - d. Substitutions: Or equal.
- B. Type:
1. General purpose plug-in type.
- C. Functional:
1. Contact arrangement/function shall be as required to meet the specified control function; Mechanical life expectancy shall be in excess of 10 million.
  2. Duty cycle shall be rated for continuous operation; Units shall be provided with integral indicating light to indicate if relay is energized.
  3. Solid state time delays shall be provided with polarity protection (DC units) and transient protection.
  4. Time delay units shall be adjustable and available in ranges from .1 second to 4.5 hours.
- D. Physical:
1. For 120 VAC service provide contacts rated 10 amps at 120 VAC, for 24 VDC service provide contacts rated 5 amps at 28 VDC, for electronic (milliamp/millivolt) switching applicator provide gold plated contacts rated for electronic service; relays shall be provided with dust and moisture resistant covers.
  2. All relays shall be provided with number of poles required to meet the design intent.

E. Options/Accessories Required:

1. Provide blade terminal din rail mounting sockets with pressure type terminal blocks rated 300 volt and 10 amps.
2. Provide mounting rails/holders as required.
3. Provide LED/neon lamp indicator.

2.2 SIGNAL RELAY SWITCHES (CURRENT TRIPS)

A. Manufacturers:

1. Manufacturers and their products are subject to compliance with requirements. Provide one of the following:
  - a. Acromag.
  - b. Action Instruments Slim Pak.
  - c. Substitutions: Or equal.

B. Type:

1. Solid state, ASIC technology, electronic type.

C. Functional:

1. Input: 4-20 mA.
2. Output: Isolated contact output, double pole double throw, rated 5 amps at 120 VAC.
3. Accuracy: 0.1 percent.
4. Protection: Provide RFI protection.
5. Deadband: Adjustable between 0.1 and 5.0 percent of span.
6. Set point Adjustment: Single Point alarms shall be adjustable to trip on rising or falling input signal, dual point alarms shall be adjustable to trip on rising and falling input signals.
7. Repeatability: Trip point repeatability shall be at least 0.1 percent of span.

D. Physical:

1. Mounting: DIN rail.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1.

B. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

3.2 IDENTIFICATION

- A. Refer to drawings for tagging designations.

END OF SECTION 407853

## SECTION 407856 - ISOLATORS, INTRINSICALLY SAFE BARRIERS, AND SURGE SUPPRESSORS

### 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 isolators, intrinsically safe barriers, and surge suppressors.
- B. Related Requirements:
  - 1. Section 406100 Process Control and Enterprise Management Systems General Provisions for submittal requirements.
  - 2. Section 4067XX, Control Panel sections.
  - 3. Section 407XXX, Instrument sections.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Refer to Section 406100 – Process Control and Enterprise Management System General Provisions.
- B. Shop Drawings:
  - 1. Refer to Section 406100 – Process Control and Enterprise Management Systems General Provisions.

#### 1.4 CLOSEOUT SUBMITTALS

- 1. Refer to Section 406100 – Process Control and Enterprise Management Systems General Provisions.

#### 1.5 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. Furnish 10 percent, minimum one (1), of each type of unit installed.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Refer to Section 406100 – Process Control and Enterprise Management Systems General Provisions

## 1.7 FIELD CONDITIONS

- A. Refer to Section 406100 – Process Control and Enterprise Management Systems General Provisions.

## PART 2 - PRODUCTS

### 2.1 SIGNAL ISOLATORS/BOOSTERS/CONVERTERS

- A. Manufacturers:
  - 1. Manufacturers and their products are subject to compliance with requirements. Provide one of the following:
    - a. Acromag.
    - b. Action Instruments Slim Pak.
    - c. Substitutions: Or equal.
- B. Type:
  - 1. Solid state, ASIC technology; electronic type.
- C. Functional:
  - 1. Accuracy: 0.15 percent.
  - 2. Inputs: Current, voltage, frequency, temperature, or resistance as required.
  - 3. Outputs: Current or voltage as required.
  - 4. Isolation: There shall be complete isolation between input circuitry, output circuitry, and the power supply.
  - 5. Adjustments: Zero and span adjustment shall be provided.
  - 6. Protection: Provide RFI protection.
- D. Physical:
  - 1. Mounting: DIN Rail.

### 2.2 INTRINSIC SAFETY BARRIERS

- A. Manufacturers:
  - 1. Manufacturers and their products are subject to compliance with requirements. Provide one of the following:



- a. Gems – 54800 (4-20mA) and 65800 (dry contacts).
- b. R. Stahl - Intrinspak
- c. Siemens Water Technologies – IS1 (4-20mA) and IS6 (dry contacts).
- d. Substitutions: Or equal.

B. Type:

1. Barriers shall be of the solid state electronic type in which the energy level of the sensing or actuation circuit is low enough to allow safe usage in hazardous areas.
2. Provide a barrier for instrumentation and equipment transmitting analog or digital signals that originate in a hazardous area as indicated in the design documents.

C. Options Required:

1. Barriers shall match power supply provided.
2. Barriers shall be located in non-hazardous areas.

## 2.3 INTRINSIC SAFETY BARRIERS (FOR 2-WIRE TRANSMITTER SYSTEMS)

A. Manufacturers:

1. Manufacturers and their products are subject to compliance with requirements. Provide one of the following:
  - a. Gems.
  - b. P&F.
  - c. Unitech.
  - d. Substitutions: Or equal.

B. Intrinsic safety barriers shall be passive devices requiring no external voltage supply and supplied with series resistors, series fuse and shunt zener diodes to limit the transfer of energy to levels required by intrinsically safe protection between safe and hazardous locations.

C. Unit shall be Factory Mutual approved and certified for use in accordance with National Fire Protection Association (NFPA 493).

## 2.4 SURGE PROTECTION FOR CONTROL SYSTEMS

A. Manufacturers:

1. Manufacturers and their products are subject to compliance with requirements. Provide the following:
  - a. 120vac power: Citel DS41S-120
  - b. 24vdc power: Citel DS220S-24DC
  - c. 24vdc analog signal: Citel DLAW-24D3
  - d. Ethernet/PROFINET: Phoenix Contact DT-LAN-CAT.6+ (p/n 2881007)
  - e. Substitutions: Not Permitted.
  - f. Other applications: See below.

- B. General - Surge protection shall be provided to protect the electronic instrumentation system from induced surges propagating along the signal and power supply lines from lightning, utility, or the plant electrical system. The protection systems shall be such that the protective level shall not interfere with normal operation but shall be lower than the instrument surge withstand level. Protection shall be maintenance free and self-restoring. Devices shall have a response time of less than 50 nanoseconds and be capable of handling a discharge surge current (at an 8x20 $\mu$ s impulse waveform) of at least 8 kA. Ground wires for all instrumentation device surge protectors shall be connected to a low resistance ground .
- C. Provide protection of all analog signal (4-20 mA) circuits where any part of the circuit is outside of the building envelope. Circuits shall be protected at both the transmitter and the control system end of the circuit. Protection devices located near the transmitter shall be mounted in a separate NEMA 4X enclosure. Substitution of a single device to protect both 120 VAC and 4-20 mA wires to an instrument is acceptable.
- D. Provide protection of all 120 VAC power feeds into control panels, instruments, and control room equipment.
- E. Non-Fiber Based Data Highway or Communications Circuits: Provide protection on all communication and data highway circuits that leave a building or are routed external to a building. Provide circuit protection at both ends of the line.
- F. RF Coaxial Cable: Provide protection on communication cables between radios and antennas, mounted either inside the panel, or in the wall of the enclosure in accordance with NEMA and UL 497E standards. Surge protection devices shall be Citel P8AX series, Polyphaser, or equal.
- G. Inductive Loads: Provide coil surge suppression devices, such as varistors or interposing relays, on all process controller outputs or switches rated 120 VA or less that drive solenoid, coil, or motor loads.
- H. Telephone Circuits: At a minimum, provide Telephone Company approved line protection units for all telephone lines used for telemetry or SCADA system use under this Contract. Surge protective device: Citel DLA-170, or equal.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Comply with NECA 1.
- B. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

#### 3.2 IDENTIFICATION

- A. Refer to drawings for tagging designations.

END OF SECTION 407856

## SECTION 407859 - POWER SUPPLIES

### 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 power supplies for use in control panels..
- B. Related Requirements:
  - 1. Section 406100, Process Control and Enterprise Management Systems General Provisions, for submittal requirements.
  - 2. Section 4067XX, Control Panel sections.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Refer to Section 406100 – Process Control and Enterprise Management System General Provisions.
- B. Shop Drawings:
  - 1. Refer to Section 406100 – Process Control and Enterprise Management Systems General Provisions.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Refer to Section 406100 – Process Control and Enterprise Management System General Provisions.

#### 1.5 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. Power supplies: 10 percent, but no fewer than one (1), of each type installed.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Refer to Section 406100 – Process Control and Enterprise Management Systems General Provisions

1.7 FIELD CONDITIONS

- A. Refer to Section 406100 – Process Control and Enterprise Management Systems General Provisions.

PART 2 - PRODUCTS

2.1 24 VDC POWER SUPPLIES

- A. Manufacturers:
  - 1. Manufacturers and their products are subject to compliance with requirements. Provide the following:
    - a. PULS.
    - b. Substitutions: Not Permitted.
- B. Provide a 24 VDC power supply in the control panel to power field instruments, panel devices, etc., as required. Equip the power supply with a power on/off circuit breaker.
- C. The 24 VDC power supply shall meet the following requirements:
  - 1. Input power: 115 VAC, plus or minus 10 percent, 60 Hz.
  - 2. Output voltage: 24 VDC.
  - 3. Output voltage adjustment: 5 percent.
  - 4. Line regulation: 0.05 percent for 10 volt line change.
  - 5. Load regulation: 0.15 percent no load to full load.
  - 6. Ripple: 3 mV RMS.
  - 7. Operating temperature: 32 to 140 degrees Fahrenheit.
- D. Size the 24 VDC power supply to accommodate the design load plus a minimum 25 percent spare capacity.
- E. Provide output overvoltage and overcurrent protective devices with the power supply to protect instruments from damage due to power supply failure and to protect the power supply from damage due to external failure.
- F. Mount the 24 VDC power supply such that dissipated heat does not adversely affect other panel components.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1.
- B. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

END OF SECTION 407859

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## SECTION 407963 - INSTRUMENT TUBING

### 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 instrument tubing.
- B. Related Requirements:
  - 1. Section 406100 – Process Control and Enterprise Management Systems General Provisions.
  - 2. Section 407000 – Instrumentation for Process Systems.

#### 1.3 FIELD CONDITIONS

- A. Refer to Section 406100 – Process Control and Enterprise Management System General Provisions.

### PART 2 - PRODUCTS

#### 2.1 TUBING AND FITTINGS

- A. Manufacturers:
  - 1. Manufacturers and their products are subject to compliance with requirements. Available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Swagelok.
    - b. Substitutions: Or equal.
- B. All instrument air header takeoffs and branch connections less than 2 inches shall be Type 316 stainless steel.
- C. All instrument shut-off valves and associated fittings shall be supplied in accordance with the piping specifications and all instrument installation details. The materials for fittings and valves shall be compatible with process fluids. Where metallic fittings and valves are compatible, wetted materials shall be Type 316 stainless steel.

- D. The materials for instrument tubing shall be compatible with process fluids. Where metallic tubing is compatible, tubing shall be fully annealed ASTM A 269/A 269M Seamless Type 316 grade free of OD scratches having the following dimensional characteristics as required to fit the specific installation:
1. 1/4 to 1/2 inch O.D.by 0.035 inch wall thickness.
  2. 5/8 to 1 inch O.D.by 0.049 inch wall thickness.
  3. 1 inch O.D.by 0.065 inch wall thickness.
  4. 1-1/4 inch O.D.by 0.065 inch wall thickness.
  5. 1-1/2 inch O.D.by 0.083 inch wall thickness.
  6. 2 inch O.D.by 0.095 inch wall thickness.
- E. All process connections to instruments shall be annealed 1/2 inch O.D. stainless steel tubing, Type 316.
- F. All tube tracks shall be supported by stainless steel and installed as per manufacturer's installation instructions.

PART 3 - EXECUTION (NOT USED)

END OF SECTION 407963



## SECTION 412213.13 - BRIDGE CRANES

### 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: Bridge crane systems.
- B. Related Requirements:
  - 1. Section 055000 – Metal Fabrications
  - 2. Section 099010 – Shop Priming
  - 3. Section 099100 - Painting
  - 4. Section 400593 - Common Motor Requirements for Process Equipment: Electric motors and accessories normally supplied as part of equipment assemblies.

#### 1.3 DEFINITIONS

- A. Runway: Structural supporting system attached to or part of building/structure to support bridge wheels.
- B. Bridge: Part of traveling crane consisting of supporting girders, end trucks/trolleys, wheels, and drive mechanism, carrying trolley-mounted hoist; of single- or double-girder construction. Bridge mobility by electric motor drive or hand chain drive.
  - 1. Top-Running Crane: Traveling crane bridge running on top of support girders.
- C. Hoist: Electric motor or manually powered hoist with load hook to raise and lower a freely suspended load. Hook supported by one or more wire rope strands that reel from a drum mounted on hoist, or by one or more strands of metal chain. Standard headroom or close headroom construction.
- D. Pendant: Hand-operated controller for bridge, trolley, and hoist that hangs from the crane by a cable or portable.
- E. Trolley-Mounted Hoist: Assembly consisting of a wheeled trolley with electric or manual drive that moves along bridge girder(s), supporting hoist.
  - 1. Top-Running Hoist: Hoist trolley running on top of bridge girders

#### 1.4 PREINSTALLATION MEETINGS

- A. Section 013100 – Project Management and Coordination: Requirements for preinstallation conference.

#### 1.5 ACTION SUBMITTALS

- A. Section 013300 - Submittal Procedures: Requirements for submittals.
- B. Product Data:
  - 1. Manufacturer catalog information for rail, trolley, hoist, motors, controls, description of operation, crane capacity, equipment layout, and dimensions including hoist coverage limits.
  - 2. Equipment data sheets for hoist selection indicating capacity, lift distance, lift speed, motor data, weight, dimensions, and materials of construction.
  - 3. Equipment data sheets for hoist trolley selection indicating capacity, speed, motor data, dimensions, weight, and materials of construction.
  - 4. Equipment data sheets for bridge trolley selection indicating capacity, speed, motor data, dimensions, weight, and materials of construction.
  - 5. List of manufacturer's recommended spare parts.
- C. Shop Drawings:
  - 1. Dimensional drawings and details crane and runway, including clearances, principal dimensions, details of structural connections, and component details.
  - 2. Erection drawings.
  - 3. Support details and loads at each support.
  - 4. Control panel layout, location, control schematics, and wiring diagrams.
  - 5. Bill of materials of crane components.

#### 1.6 DELEGATED DESIGN SUBMITTALS:

- 1. Submit signed and sealed design calculations and assumptions for:
  - a. Sizing of bridge girders and supports.
  - b. Selection and sizing of hoist brakes.
  - c. Sizing of bridge and trolley brakes.
  - d. Tabulation of crane rail stop load reaction on the structure.
- 2. Notify Engineer if submittal requirements cannot be met for any reason.

#### 1.7 INFORMATIONAL SUBMITTALS

- A. Manufacturer's Certificate:
  - 1. Certify that products meet or exceed standards referenced herein.
  - 2. Certify that final installation meets or exceeds standards referenced herein and standards of each manufacturer providing components for the system.

- B. Test and Evaluation Reports:
  - 1. Mill Test Reports: Indicate for bridge.
  - 2. Inspection and Rated-Load Test Reports: Indicate according to ASME B30.2.
  - 3. Crane certification documentation.
- C. Manufacturer Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures.
- D. Source Quality-Control Submittals: Indicate results of factory tests and inspections.
- E. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.
- F. Qualifications Statements.
  - 1. Submit qualifications for manufacturer, installer, and licensed professional.
  - 2. Submit manufacturer's approval of installer.
  - 3. Welder certificates: Submit certifications of welders and welding procedures employed on Work verifying AWS qualification within previous 12 months.
- G. Notify Engineer if submittal requirements cannot be met for any reason.
- H. Provide written documentation that related components referenced in Section 055000 have been coordinated.

#### 1.8 CLOSEOUT SUBMITTALS

- A. Section 017700 - Execution and Closeout Requirements
- B. Project Record Documents:
  - 1. Record schematic, wiring, and layout information for crane and radio controls.

#### 1.9 MAINTENANCE MATERIAL SUBMITTALS

- A. Section 017823 – Operation and Maintenance Data
- B. Spare Parts:
  - 1. Furnish manufacturers recommended spare parts for bridge crane.

#### 1.10 QUALITY ASSURANCE

- A. Design and Fabrication: Comply with the following:
  - 1. AISC 325, Steel Construction Manual
  - 2. ASME B30.10 Hooks
  - 3. ASME B30.11 Monorails and Underhung Cranes
  - 4. ASME B30.16 Overhead Underhung and Stationary Hoists

5. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.
6. NEMA ISC 2 Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts
7. NEMA ISC 8 Application Guide for Industrial Control and Systems Crane and Hoist Controllers
8. OSHA 1910.179 Overhead and Gantry Cranes
9. OSHA 29 CFR 1926, Subpart N
10. ASME HST-4, Performance Standard for Overhead Electric Wire Rope Hoists]
11. ASME B30.17 Cranes and Monorails (with Underhung Trolley or Bridge) ]
12. CMAA 74
13. ASME B30.2
14. CMAA 70

B. Installation and Start-Up: Comply with:

1. OSHA 1919.71 Unit Proof Test and Examination of Cranes
2. ASME B30.16

C. All components to be UL listed where UL listed components are available.

D. Maintain one copy of each standard affecting Work of this Section on Site.

#### 1.11 QUALIFICATIONS

A. Manufacturer:

1. Company specializing in manufacturing products specified in this Section with minimum three years' experience.

B. Installer: Company specializing in performing Work of this Section with minimum three years' experience.

C. Licensed Professional: Professional engineer experienced in design of specified Work and licensed in State of Florida.

D. Welders: AWS qualified within previous 12 months for employed weld types.

#### 1.12 DELIVERY, STORAGE, AND HANDLING

A. Section 016000 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.

C. Store materials according to manufacturer instructions.

D. Protection:

1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
2. Provide additional protection according to manufacturer instructions.

#### 1.13 WARRANTY

- A. Section 017700 - Execution: Requirements for warranties.
- B. Provide an equipment warranty for the hoist with three-years of coverage on all mechanical components and one-year on all electrical components.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. All bridge crane systems including bridge beam, end trucks, carriers and trolleys, electrification, accessories: Whiting Corp., American Monorail, Inc., ACCO, Louden Systems, J. Herbert Corporation, Konecranes, or equal.
- B. Hoist equipment: Konecranes, Yale Hoists, Coffing Hoists, Wright, Shaw Box, or equal.

#### 2.2 PERFORMANCE AND DESIGN CRITERIA CRANE BRIDGE CRANE

- A. Location: Rivertown HSPS
- B. Service Class: C.
- C. Environment:
  1. Indoor,
  2. Unclassified.
- D. System Capacity: 2 tons.
- E. System Electric Power Supply: 480 Volt, 60 Hz, 3 Phase
- F. Runway and columns: Provided under Section 055000 "Metal Fabrications".
- G. Girders: Provided under Section 055000 "Metal Fabrications".
- H. Bridge:
  1. Type: Top-running
  2. Construction: Single-girder.
  3. Bridge Capacity: 2 tons.
  4. Bridge Drive: Electric
  5. Drive Type: Dual on each end truck
  6. Bridge Speed: 40-60 fpm.

7. Bridge Drive Power: 0.5 hp
8. Bridge Motor: Variable frequency drive
9. Electrification: Festoon

I. Main Hoist:

1. Configuration: Top Running
2. Headroom: Standard
3. Hoist Type: Electric wire rope
4. Hoist Service Class: H3
5. Reeving: Single
6. Hoist Wire Rope Material: Galvanized steel
7. Hoist Suspension: Trolley
8. Hoist Capacity: 2 tons
9. Hoist Lift Distance: 11' minimum
10. Hoist Lifting Speed: Two-speed, 20/3.3 fpm.
11. Hoist Motor: TEFC
12. Hoist Motor Power: 0.5 hp
13. Trolley Type: Low head room
14. Trolley Drive: Electric
15. Trolley Speed: 40-60 fpm achievable by 2 speed or VFD
16. Trolley Motor: TEFC
17. Trolley Drive Power: 0.5 hp
18. Electrification: Festoon

J. Limits of hook travel shall not exceed 5-ft from any wall, as shown on the drawings.

K. Control Panel:

1. Construction:
  - a. NEMA 250 Type 4X Stainless steel
  - b. Single-point power connection and grounding lug.
  - c. Location: Factory mounted on crane bridge.
2. Limit Switches:
  - a. Description:
    - 1) Automatically stop hoist motion when block reaches its highest position.
    - 2) Prevent application of forces greater than rated capacity of the hoist including allowance for accelerating load.
  - b. Comply with NEMA ICS 2.
  - c. Enclosures: Comply with NEMA 250 Type 4X

L. Controls:

1. Description: Push-button pendant station.
2. Enclosure: NEMA 4X

3. Comply with NEMA ICS 8 and CMAA 70/74.
4. Push-Button Pendant:
  - a. Location: Suspended from fixed location on bridge with festoon control connection to hoist/trolley.
  - b. Elevation: Fixed suspension 4 feet above operating floor.
  - c. Controls:
    - 1) POWER ON-OFF switch
    - 2) POWER ON light
    - 3) RAISE /LOWER hoist control
    - 4) HIGH SPEED/LOW SPEED hoist control
    - 5) LEFT/RIGHT trolley control
    - 6) FORWARD/REVERSE bridge control

## 2.3 COMPONENTS

### A. Electric Motors:

1. As specified in Section 400593.23 - Common Motor Requirements for Process Equipment.
2. Comply with CMAA 74 and MH27.1

### B. Runway track: As specified in Section 055000 "Metal Fabrications".

### C. Electric Hoist

1. Comply with ASME HST- 4
2. Service Class: H3
3. Motor: Direct-coupled
4. Hoist/Trolley Limit Controls:
  - a. Adjustable upper and lower overtravel limit stops
  - b. Adjustable overload limit control
  - c. Trolley stop limit switch control upper and lower limits of hook travel
  - d. Physical upper paddle style limit switch as an ultimate limit
5. Sheaves:
  - a. Material: Forged steel.
  - b. Bearings: Permanently lubricated roller type; ABMA 11.
  - c. Minimum Diameter: 20 times rope diameter.
6. Hook:
  - a. Material: Forged steel.
  - b. Swivel: Anti-friction type, allowing 360-degree rotation of load.
  - c. Furnish spring-loaded safety latch.
  - d. Furnish nuts keyed to hook shanks by setscrew.

D. Electric Trolley:

1. Wheels: Comply with CMAA 74 and MH27.1
2. Wheel material: Forged or cast steel
3. Brakes:
  - a. Magnetic-release disc type.
  - b. Integrally mounted to motor.

E. Electrification:

1. Provide junction box to connect power feeder from disconnect switch (by Div. 26).
2. Conductor Bar System
  - a. Description: Conductor bar system used to power runway
  - b. Single conductor bars enclosed in molded high dielectric plastic cover
  - c. Copper conductors
  - d. Attach to crane runway
  - e. Bridge mounted adjustable spring-loaded sliding shoe collectors
  - f. Conductor sizing/rating: Comply with CMAA 74 and MH27.1
  - g. No exposed current-carrying surfaces
  - h. Manufacturers: Insul-8-Bar, Safe-T-Bar, Duct-O-Bar or equal.
3. Festoon System:
  - a. Description:
    - 1) Multi-Conductor power supply cables suspended from trolleys mounted on heavy-duty C-track parallel to hoist monorail.
    - 2) Used to power trolley and hoist
    - 3) Construction: Non-sparking.
  - b. Cables:
    - 1) UL-listed neoprene-jacketed, stranded multi-conductor flat cables.
    - 2) Conductor sizing/rating: Comply with CMAA 74 and MH27.1
    - 3) Length: 110 percent of required length.
  - c. Trolleys:
    - 1) Furnish towing and manufacturer's standard trolleys.

F. Mounting Hardware: Galvanized Steel.

G. Labeling

1. Safety Signs: Comply with NEMA 535.
2. Clearly label capacity of bridge and hoist(s) on each piece of equipment.

H. Factory Coatings:

1. Apply factory finish paint or coatings to all exposed component surfaces.
2. Apply rust inhibitive coatings to all ferrous surfaces not designated to be painted.



3. Factory surface preparation, priming, and painting to be manufacturer's standard and as specified in Division 9.
4. Finish coat colors to conform to industry standard. Submit color selections as offered.

## 2.4 SOURCE QUALITY CONTROL

- A. Section 014000 - Quality Requirements: Requirements for testing, inspection, and analysis.
- B. Factory-assemble individual crane components and perform shop inspection and testing of completed assemblies.
- C. Testing:
  1. Perform "no-load" running test of controls and drive machinery to ensure proper operation.
  2. Proof-test load chains. Comply with applicable ASME HST Standard
  3. Comply with OSHA 1919.71
  4. Electrical:
    - a. Test hoist, trolley, and bridge controls.
    - b. Verify independent operation of pendant and radio controls.
    - c. Verify operation of limit switches and bypass controls.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Section 017700 - Execution and Closeout Requirements: Requirements for installation examination.
- B. Verify that systems are ready to receive Work.
- C. Verify that field dimensions are as indicated on Drawings.

### 3.2 INSTALLATION

- A. According to manufacturer instructions and as indicated on Drawings.
- B. Construction: Comply with referenced standards and OSHA 1920.179.

### 3.3 FIELD QUALITY CONTROL

- A. Section 017000 - Execution and Closeout Requirements: Requirements for testing, adjusting, and balancing.
- B. Inspection: Check hoist and motor for excessive vibration and noise.

C. Testing:

1. Notify Engineer and perform all testing in the presence of Engineer.
2. Perform initial “no-load” running test of controls and drive machinery to ensure proper operation.
  - a. Operate crane through complete lift and lowering cycle and through complete travel of bridge and trolley under full-load and no-load conditions.
  - b. Verify that equipment performs smoothly and safely.
  - c. Verify independent operation of pendant.
  - d. Verify that pendant cable length is sufficient to permit operation from desired floor levels.
  - e. Verify that hoist and bridge motions operate as required.
  - f. Verify that limit switches operate as required.
3. Perform load tests on bridge, hoist, and trolley through-out full range of access of the bridge crane.
  - a. Load Test Certification: Comply with OSHA Part 1910.179.
  - b. Unit Proof Test: Comply with OSHA Part 1919.71, and ASME B30.16.
  - c. Verify that temperature within enclosures is within tolerance after full-load tests.

D. Manufacturer Services: Provide the services of a factory trained service engineer, specifically trained on type of equipment specified. Submit qualifications of service engineer for approval. Man day requirements listed exclusive of travel time, and do not relieve Contractor of obligation to provide sufficient service to place equipment in satisfactory operation.

1. Two 8-hour man-days to assist with:
  - a. Installation: to assist in location of anchor bolts; setting, leveling, field erection, etc, coordination of piping, electrical, miscellaneous utility connections,
  - b. Start up, testing, calibration, and certification,
  - c. Operation and maintenance instruction.

E. Equipment Acceptance:

1. Adjust, repair, modify, or replace components failing to perform as specified and rerun tests.
2. Make final adjustments to equipment under direction of manufacturer's representative.

F. Repair damaged coatings with material equal to the original coating and as specified in Section 099100 - Painting .

3.4 ADJUSTING

- A. Section 017000 - Execution and Closeout Requirements: Requirements for starting and adjusting.
- B. Field-calibrate local controls and indicators.

3.5 DEMONSTRATION

- A. Section 017000 - Execution and Closeout Requirements: Requirements for demonstration and training.
- B. Demonstrate crane operation, routine maintenance, and emergency repair procedures to Owner's personnel.

3.6 PROTECTION

- A. Section 017000 - Execution and Closeout Requirements: Requirements for protecting finished Work.
- B. Construct temporary protection for equipment and installations, consisting of canvas, heavy plastic, plywood, or other suitable materials, closed tightly and dustproof.

END OF SECTION 412213.13

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## SECTION 432321.14 - AXIALLY SPLIT CASE PUMPS – HIGH SERVICE PUMPS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Horizontally Mounted axially split case pumps, including their respective motors and variable frequency drives.
  - 2. Supervisory services during installation and field testing of each unit and instructing the regular operating personnel in the proper care, operation and maintenance of the equipment.
  - 3. Pump manufacturer shall have unit responsibility for the pumping system, including, but not limited to, pumps, motors, and variable frequency drives.

#### 1.3 COORDINATION

- A. Section 013100 “Project Management and Coordination”.
- B. Coordinate installation and startup of Work of this Section with Owner’s operations.

#### 1.4 ACTION SUBMITTALS

- A. Section 013300 “Submittal Procedures”: Requirements for submittals.
- B. If manufacturing techniques differ, completely describe all aspects that do not conform to specifications.
- C. Product Data: Submit literature, which may include drawings, describing the equipment in detail, including materials of construction, to indicate full conformance with the specifications.
  - 1. Prior to Manufacture: Submit dynamic vibration analysis report describing the analysis process, assumptions utilized in the analysis, and analysis conclusions as described in Paragraph 2.4. Report to identify the specified limitations will be met with the pump installed per the Specification. For the dynamic vibration analysis described, minimum and maximum operating speeds will be in accordance with conditions of operation specified in Table 432321.14-1 for each pump station.
  - 2. The total weight of the equipment including the weight of the single largest item.
  - 3. A complete materials table for all equipment establishing compliance with these specifications.

4. A list of the Manufacturer's recommended spare parts with the Manufacturer's current price for each item. Include gaskets, packing, etc. on the list. List all bearings by the bearing manufacturer's numbers only.

D. Shop Drawings:

1. Descriptive literature, bulletins, and/or catalogs of the equipment.
2. Include statement indicating location of manufacturer and distance to Project for each regionally manufactured material.
3. Certified shop and erection drawing showing parts arrangement, details, including pick points for rigging, and materials of construction and dimensions.
4. Equipment baseplate drawing indicating size and location of bolt holes for anchorage plus details of anchorage of equipment to foundation including anchor bolt type, size, materials, embedment depth, and minimum edge distance.
5. Complete Bill of Materials (may be submitted as a part of O&M manual).
6. Data on the characteristics and performance of each pump.
  - a. Catalog sheets showing a family of curves covering full range selection of impeller diameter (not sufficient without the addition of the following, to establish detailed compliance with project requirements).
  - b. Performance Curve Requirements:
    - 1) Guaranteed performance curves, based on actual shop tests on similar units, showing the specified requirements for head, capacity, efficiency, guaranteed maximum net positive suction head required (NPSH3), and brake horsepower.
    - 2) Guaranteed performance curves to ANSI/HI 14.6 acceptance grade 1U for specified (intermediate) design point and acceptance grade 1E for the other specified points,
    - 3) Curves to be plotted on 8 ½-in by 11-in sheets at as large a scale as practical specifically for the pump proposed from no flow at shut off head to pump capacity at minimum specified TDH. The POR and AOR (refer to ANSI/HI 9.6.3) shall be clearly shown on the curves.
    - 4) For variable speed pumps, submit variable speed curves with five evenly spaced speeds plotted from maximum to minimum recommended speeds.
7. Prior to Manufacture: Submit required vibration analyses detailing requirements have been met. For the dynamic vibration analysis, minimum and maximum operating speeds will be in accordance with the conditions of operation specified in PART 2.
8. Description of painting and protective coatings.
9. Complete master wiring diagrams, elementary or control schematics, including coordination with electrical equipment and control devices, and suitable outline drawings showing such details as are necessary to locate conduit stub-ups and field wiring.
10. Data for electric motors in accordance with Section 400593.
11. Data for variable frequency drives in accordance with Section 262419.

E. Manufacturer's Certificates

1. A statement and supporting data indicating motor bearing life meets or exceeds specified value.

2. Manufacturer's certification of installation meeting Manufacturer's installation, operation and maintenance manuals and as specified in PART 3.
3. Welder certifications.

F. Test and Evaluation Reports

1. Certified motor test data as described in Section 400593.
2. Tabulated data for the drive motors including rated horsepower, full load rpm, power factor and efficiency curves at 1/2, 3/4 and full load, service factor and kW input, including when the pump is at its design point. Submit a certified statement from the motor manufacturer that the motors are capable of continuous operation on the power supply from the variable frequency drives to be furnished without affecting the design life of bearings or windings.
3. Description of proposed pump factory test procedures and equipment.
4. Factory and field performance test data as specified in PART 2 and PART 3.
5. A schedule of the date of factory testing and delivery of the equipment to the job site.
6. Inspection report of pumps prior to shipment
7. Six-month follow up vibration testing report as specified in PART 3.

G. Manufacturers' Installation Instructions

H. Source Quality-Control Submittals:

1. Indicate results of factory tests and inspections.

I. Field Quality-Control Submittals: Indicate results of Contractor furnished tests and inspections.

1. Identify the entity and experienced individual who will inspect the installation.
2. Manufacturer's field report as specified in PART 3.

J. Compliance with noise levels as specified in Section 400593.

K. Complete description of surface preparation and shop painting for pumps and motors.

L. Critical speed analyses report submittal including backup documentation and a statement of guarantee that the critical speed analyses as required in Paragraph 2.4 of this Section have been completed and that the specified limitations will be met.

1.5 INFORMATIONAL SUBMITTALS

- A. Critical speed analyses report submittal including backup documentation and a statement of guarantee that the critical speed analyses as required in Paragraph 2.4 of this Section have been completed and that the specified limitations will be met.

1.6 CLOSEOUT SUBMITTALS

- A. See Section 017000 "Execution and Closeout Requirements" for closeout requirements.
- B. Operation and Maintenance Data.

- C. Warranty Documentation: submit warranty complying with requirements herein and Section 017700 "Closeout Procedures."
- D. Project Record Documents

#### 1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish all special tools and test equipment required for the proper servicing of all equipment as specified in Section 011310. All such tools and test equipment shall be furnished in a suitable steel tool chest complete with lock and duplicate keys.
- B. All spare parts shall be properly protected for long periods of storage and packed in containers that are clearly identified with indelible markings as to contents.
- C. Furnish the following spare parts for each size pump:
  - 1. Two mechanical seals.
- D. Provide to the Owner a list of all spare and replacement parts with individual prices and location where they are available. Prices shall remain in effect for a period of not less than one year after start-up and final acceptance.
- E. Special tools and spare parts shall be furnished in accordance with Section 011310.
- F. Section 017000 - Execution and Closeout Requirements specifies requirements for maintenance materials.

#### 1.8 QUALITY ASSURANCE

- A. Provide units furnished by a single manufacturer. To assure unity of responsibility, the motors, variable frequency drives and supporting base plate shall be furnished and coordinated by the Manufacturer.
- B. Manufacture pumps in accordance with the Hydraulic Institute Standards, except where otherwise specified.
- C. Manufacturer: Equipment furnished under this Specification shall be new and unused, shall be the standard product of manufacturers having a successful record of manufacturing and servicing similar equipment and systems for a minimum of five years.
- D. Manufacturer or its representative shall have an authorized warranty center within a 300 mile radius of the job site, fully staffed with factory trained mechanics, and equipped with a stock of strategic spare parts for each model of pump furnished under this contract. The service facility and strategic spare parts shall be established prior to delivery of equipment for this project.
- E. The Manufacturer shall be certified to the ISO 9001 standard for design and manufacture of this type of pump.



## 1.9 DELIVERY, STORAGE, AND HANDLING

- A. Section 016000 “Product Requirements”: Requirements for transporting, handling, storing, and protecting products.
- B. Ship pumping units with motor space heaters connected to a terminal board ready to be energized. Promptly energize motor space heaters during storage. House pumping units in weatherproof enclosures at all times during storage.
- C. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage. As necessary, provide inspection report to Manufacturer identifying any damage and rework necessary prior to installation.
- D. Store pumps and all appurtenances according to Manufacturer’s instructions.
- E. Do not disassemble factory assembled parts and components for shipment unless written permission received from Engineer.
- F. Long Term Storage:
  - 1. Follow Manufacturer's detailed recommendations for long term storage.
  - 2. Properly protect all parts so that no damage or deterioration occurs.
- G. Protection:
  - 1. Protect materials from moisture and dust by storing in clean, dry location remote for construction operations areas.
  - 2. Provide additional protection according to manufacturer’s instructions.
  - 3. Protect unpainted finished iron and steel surfaces to prevent rust and corrosion.
  - 4. Protect finished surfaces of exposed flanges with wood or equivalent blank flanges.
  - 5. Protect bearings against formation of rust in accordance with bearing manufacturer’s recommendations. For bearings that are not pre-lubricated, apply corrosion inhibiting treatment for protection during transportation, storage, handling, installation, and lapse of time prior to start-up.
  - 6. Intermittently manually rotate equipment prior to start-up to ensure distribution of lubricant/protection.

## 1.10 SITE CONDITIONS

- A. Ambient Conditions
- B. Field Measurements: Verify field measurements prior to fabrication. Indicate field measurements on Shop Drawings.

## 1.11 WARRANTY

- A. Section 017700 “Closeout Procedures” specifies closeout requirements for warranties.

- B. Pump Manufacturer shall warranty all equipment supplied under this Section for a period of one year. Warranty period shall commence on the date of Substantial Completion, as outlined in Divisions 00 and 01.
- C. The Manufacturer's warranty period shall run concurrently with the Contractor's warranty period. No exception to this provision shall be allowed.
- D. The equipment shall be warranted to be free from defects in workmanship, design and materials. If any part of the equipment should fail during the warranty period, it shall be replaced in the machine(s) and the unit(s) restored to service at no expense to the Owner.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Flowserve; (Primary pump model: 6LR18B, jockey pump model: D8144x3x9f)
- B. Peerless; (Primary pump model: 8AE15G, jockey pump model: 4AE10)
- C. Aurora; (Primary pump model: 410-5x6x17, jockey pump model: 410-4x5x10B)

### 2.2 SYSTEM DESCRIPTION

- A. The pumps will pump water from the above-grade water storage reservoir to the distribution system. The on/off pump operation will be controlled by pressure in the distribution system.
- B. Equipment to include 3 primary and 2 jockey horizontal mounted axially split case finished water pumps. Motors, variable frequency drives, and accessories for each pump shall be included, as specified herein and as shown on the Drawings.
- C. For control descriptions and control sequences, refer to Section 406196 Process Control Descriptions. Coordinate for proper operation and compatibility.
- D. Pumping Units:
  - 1. Supply by one Manufacturer.
  - 2. Complete system including pumps, motors, variable frequency drives, and appurtenances such as, but not limited to, couplings, guards and gauges.
  - 3. Materials, including the coatings in the pumps, conform to AWWA E-103, Horizontal and Vertical Line-Shaft Pumps Standard and ANSI/NSF 61 and ANSI/NSF 372.
  - 4. Provide ample room for inspection, repairs and adjustments.
- E. Pump(s): Capable of temporary operation at and near shut off head for 30 seconds maximum, during opening and closing of the pump discharge check valve as the pump is ramped by the VFD during starts and stops.
- F. Design and build pumps, motors, variable frequency drives, for 24-hour continuous service at any and all points within the required range of operation, without overheating, excessive vibration or strain.

## 2.3 PERFORMANCE AND DESIGN CRITERIA

- A. Pumps of same service type shall be identical in every respect with all parts interchangeable.
- B. Design each pump for design conditions listed herein and for operation within the system head curve envelope as appended.
- C. Head – Capacity Performance Curve: continuously rising from runout to shutoff with no points of inflection at any operational speed for stable operation within the AOR.
- D. Operate throughout the specified range within the vibration limitations specified herein.
- E. Maximum sound pressure level from one pump/motor when operating on utility power measured 3-feet from the equipment and 5-feet above the floor shall be 90 dBA.
- F. When the pump is operating at any point on its performance curve within the specified operating range at maximum speed, nameplate ratings of the motor shall not be exceeded, nor shall the design service factor be reduced.

**TABLE 432321.14-1**  
**PUMPING UNIT DESIGN REQUIREMENTS – PRIMARY PUMP**

<b>Item Description</b>	<b>Design Conditions – Primary Pump</b>
Service	Finished Water
Number of Pumps (operating/standby)	3 (2/1)
Maximum Motor Full Load Speed (FLS) (rpm)	1765
Maximum Allowable Motor Horsepower (non-overloading throughout operating range) (HP)	150
Motor Design Voltage/Phase/Frequency	460 V/3 ph/60 Hz
Minimum Pump Discharge Nozzle Size (inches)	6
Minimum Pump Suction Nozzle Size (inches)	10
Pump Shut-Off Head at Motor FLS Acceptable Range (minimum/maximum) (feet)	210/225
Flow Rate at Secondary Operation Point (gpm)	1200
Minimum TH at Secondary Operation Point (feet)	205
Minimum Pump Efficiency at Secondary Operation Point (%)	60
Maximum allowable NPSH3 at Secondary Operation Point (feet)	20
Intermediate (Design) Point Flow Rate (gpm)	1800
TH at Intermediate (Design) Point (feet)	195
Minimum Pump Efficiency at Intermediate (Design) Point (%)	72
Maximum NPSH3 at Intermediate (Design) Point (feet)	20
Best Efficiency Point (BEP) Flow Rate Acceptable Range (minimum/maximum) (gpm)	2000/3000
Minimum Pump Efficiency at BEP (%)	75
Primary Operating Point TH (feet)	110
Minimum Flow Rate at Primary Operating Point (gpm)	2700
Minimum Pump Efficiency at Primary Operating Point (%)	60
Maximum NPSH3 at Primary Operating Point (feet)	28
Pump Model Used for Design	Peerless Model 8AE15G

**PUMPING UNIT DESIGN REQUIREMENTS – JOCKEY PUMP**

<b>Item Description</b>	<b>Design Conditions – Jockey Pump</b>
Service	Finished Water
Number of Pumps (operating/standby)	2 (2/0)
Maximum Motor Full Load Speed (FLS) (rpm)	3550
Maximum Allowable Motor Horsepower (non-overloading throughout operating range) (HP)	60
Motor Design Voltage/Phase/Frequency	460 V/3 ph/60 Hz
Minimum Pump Discharge Nozzle Size (inches)	4
Minimum Pump Suction Nozzle Size (inches)	5
Pump Shut-Off Head at Motor FLS Acceptable Range (minimum/maximum) (feet)	195/210
Flow Rate at Secondary Operation Point (gpm)	350
Minimum TH at Secondary Operation Point (feet)	190
Minimum Efficiency at Secondary Operation Point (%)	50
Maximum NPSH3 at Secondary Operation Point (feet)	20
Intermediate (Design) Point Flow Rate (gpm)	500
Minimum TH at Intermediate (Design) Point (feet)	195
Minimum Pump Efficiency at Intermediate (Design) Point (%)	60
Maximum NPSH3 at Intermediate (Design) Point (feet)	20
Best Efficiency Point (BEP) Flow Rate Acceptable Range (minimum/maximum) (gpm)	800/1000
Minimum Efficiency at BEP (%)	70
Primary Operating Point TH (feet)	120
Minimum Flow Rate at Primary Operating Point (gpm)	1000
Minimum Pump Efficiency at Primary Operating Point (%)	60
Maximum NPSH3 at Primary Operating Point (feet)	25
Pump Model used for Design	Peerless model 4AE10

See attached pump and system curve envelope in Figure 432321.

## 2.4 SOURCE QUALITY CONTROL

- A. Dynamic vibration analysis shall be performed by
  1. Mechanical Solutions Inc. (MSI) of Whippany, NJ,
  2. DynaTech Engineering, Inc. of Auburn, CA,
  3. Engineering Dynamics Inc. (EDI) of San Antonio, TX.
  4. Approved equal.
- B. Provide lateral rotordynamic vibration analysis of the pump rotating system, including pump and motor rotor, coupling, and installed bearing stiffness.
  1. Identify and predict that the first lateral critical speed shall have a separation margin of at least 20 percent above the maximum pump speed or 20 percent below the minimum pump speed.

2. If a design modification (i.e., such as changing the shaft diameter or different coupling arrangement) cannot resolve a separation margin deficiency or is not practical, a forced damped response analysis shall be performed to demonstrate that deflections at the bearings or at the impeller wear rings, if applicable, will not exceed 35% of the available clearances.
- C. Provide torsional rotordynamic vibration analysis of the complete rotating system (pump, motor, shafting, and coupling).
1. Identify and predict that no torsional natural frequencies occur within a separation margin extending from 20 percent below to 20 percent above the specified pump operating speed range.
  2. Additionally, no natural frequencies shall be +/- 10% of 2x times running speed, line frequency, 2x line frequency, vane pass frequency, and VFD control frequencies (if applicable) within the specified multiple of the pump operating speed range.
  3. If a design modification (i.e., such as a shaft diameter change or different coupling arrangement) cannot resolve a separation margin deficiency or is not practical, a forced damped response analysis shall be performed to show that infinite life will be achieved with a safety factor of at least two.
- D. Submit Campbell diagrams documenting lateral rotordynamics, and torsional rotordynamic analysis results and graphically demonstrating the separation margins specified above.
- E. Maximum Vibration Velocity: Per ANSI/HI 9.6.4 as measured in the field for all specified operating conditions.
- F. Maximum Vibration Displacement: Field vibration displacement peak-to-peak shall conform to the requirements of ANSI/HI 9.6.4 for specified operating conditions at or below 600 rpm. This only applies if full or reduced speeds will be below 600 rpm.

## 2.5 PUMP CONSTRUCTION - GENERAL

- A. Mount the pump and driving motor on a fabricated steel drip-rim baseplate with provision to collect leakage and shall be of sufficient size and rigidity to support the unit and prevent harmful or damaging vibration. A minimum 1/2-in drain tap and copper pipe nipple shall be provided. The steel base shall be attached to a concrete support base with grout holes.
- B. All necessary anchor bolts, nuts, and washers will be furnished and be of Type 316 stainless steel to attach the steel base to the concrete support base. Anchor bolts shall be supplied by the contractor.
- C. Design and construct the pump and motor to successfully withstand a maximum reverse runaway speed equal to 150 percent of synchronous speed or the runaway speed that would occur at an applied head equal to the head at the best efficiency point, whichever is higher, resulting from backflow through the pump.
- D. Casing:
1. Type: Axially split; removable top portion.
  2. Material: Cast iron conforming to ASTM A48, Class 25 or Class 30

3. Sufficient thickness and suitably ribbed to withstand all stresses and strains of service at full operating pressure.
4. Suction and discharge nozzle cast integrally with the lower half.
5. Removal of the upper half of the casing must allow the rotating element to be removed without disconnecting the suction and discharge flanges.
6. Lifting eyes shall be cast into the upper casing.
7. Design pressure: 150 psi.
8. Connections:
  - a. Air vent for air vacuum valve connection on the top of the casing: not less than 2-inch
  - b. Suction and discharge pressure gauge connections: ¼ inch
9. End Connections:
  - a. Flanged.
  - b. Comply with ASME B16.1, Class 125

E. Impellers:

1. Impeller Design Type: double suction.
2. Cast ASTM A743 CF8M cast stainless steel or nickel aluminum bronze.
3. Provide certified analysis of the impeller pour metal.
4. Two-plane dynamic balance in accordance with 1940-1 quality grade G2.5.

F. Wearing Rings:

1. Casing wear ring material: nickel aluminum bronze ASTM B148, alloy 95800 or Stainless Steel, A487 Grade CA15.
2. The wearing surfaces parallel to the axis of rotation.
3. Securely fasten wearing rings to prevent any relative motion and designed for easy replacement.

G. Shafting:

1. Pump shafting shall be equal to SAE designation 1045 or better.
2. The shafting shall be true and parallel over its entire length.
3. Shafting and couplings shall be dynamically balanced.

H. Pump Bearings:

1. Heavy duty single row inboard and double row outboard anti-friction type.
2. Arranged for grease or oil lubrication.
3. Minimum L-10 life per ABMA Standards: 50,000 hours.
4. No external cooling allowed.
5. Removable bearing housings shall be bolted and doweled to bearing brackets that are cast integral with the pump lower half casing.

## 2.6 SEALS AND ACCESSORIES

### A. Stuffing box/seal box sealed with cartridge mechanical seal:

1. Discharge head shall be fitted with a mechanically sealed type stuffing box arranged for fresh water flush of stuffing box flushing water supply from pump volute (API Plan 11).
2. Shaft Sleeve:
  - a. Section of line-shaft that extends through or into the stuffing box shall be fitted with a replaceable 316 stainless steel sleeve that extends beyond the face of the stuffing box far enough to accommodate the total length of the mechanical seal.
  - b. Sleeve shall be held to the shaft with threaded section or set screws to prevent rotation and shall be sealed to prevent leakage between the shaft and the sleeve.
  - c. Minimum shaft sleeve thickness: 1/4 inch
3. Seal: Hydraulically balanced, self-aligning faces and threaded port for flushing/venting.
  - a. Stationary design.
  - b. Capable of handling full vacuum to 150 psi.
  - c. All components shall be split.
4. Seal materials of construction: 316 stainless steel for all wetted parts and Hastelloy C springs.
5. Seal faces shall be of carbon rotating face and silicon carbide.
6. Isolate springs from the pumpage.
7. Ensure that shaft movement and seal chamber pressures at all specified operating conditions are fully compatible with the mechanical seal system provided.
8. Dynamic o-rings shall be on the shaft sleeve O.D. and seal to a micro polished surface to eliminate hang up and hysteresis.
  - a. O-rings shall be Viton® or compatible with the fluid being pumped.
  - b. The gland shall be of a universal design to fit varied bolt sizes and circles.
  - c. The gland shall have a minimum of one tapped flush/by-pass port that can be rotated 360 degrees to accommodate flush piping.
  - d. Stuffing box/seal box sealed with single-piece mechanical seal.
9. Throat Bushing:
  - a. Install a nickel aluminum bronze throat bushing in the bottom of stuffing box to throttle flow out of seal area.
  - b. System shall be configured in accordance with flushing system, API Plan 11.
10. Provide mechanical seal manufactured by:
  - a. A.W. Chesterton,
  - b. Equal by John Crane,
  - c. Equal by Flowserve,
  - d. or equal.

## 2.7 OPERATION

### A. Motors:

#### 1. Pump Drive:

- a. Horizontal inverter duty rated squirrel cage induction electric motor with a maximum horsepower and speed as specified in 2.3 above.
  - b. Provide winding temperature detectors for each motor. Winding temperature detectors shall be a factory installed, embedded, bi metallic switch type with leads terminating in the main conduit box. This device shall protect the motor against damage from overheating caused by single phasing, overload, high ambient temperature, abnormal voltage, locked rotor, frequent starts or ventilation failure. The switch shall have normally open contacts. Not less than three detectors shall be furnished with each motor.
  - c. Enclosure: Totally Enclosed Fan-Cooled TEFC
  - d. Provide 120 V motor space heaters
  - e. Meet requirements of Section 400593
  - f. Provide thrust bearing capable of handling both mechanical and hydraulic thrust of the pump.
  - g. Bearings will be anti-friction, grease lubricated type.
  - h. Minimum L-10 life per ABMA Standards: 50,000 hours
2. Pump Motors: Suitable for driving the pumps continuously over the entire pumping range. Furnished by the Manufacturer. Constructed and guaranteed to withstand pump reverse runaway speed equal to 150 percent of synchronous speed or the runaway speed that would occur at an applied head equal to the head at the best efficiency point, whichever is higher.
  3. All lubrication fittings shall be brought to the outside of all equipment so that they are readily accessible from the outside without the necessity of removing covers, plates, housings, or guards, or without creating falling hazards. Fittings shall be buttonhead type. Lubrication fittings shall be mounted together wherever possible. Pressure grease-lubricated fittings shall be the "Zerk Hydraulic" type or the "Alemite" type. Housings of grease-lubricated bearings shall be automatically exhausted to the atmosphere to prevent excessive greasing.
  4. Motors shall be mounted to the Baseplate with Heavy Hex Grade 8 bolts, nuts and washers torqued to the Manufacturer's recommended value.

### B. Motor to Pump Coupling:

1. Pump drive shaft shall be directly connected to the motor by means of a Falk or equal all metal flexible coupling, suitably sized to transmit the required driving torque and axial unbalanced thrust.

### C. Variable Frequency Drives:

1. Speed control for variable speed pumps will be Variable Frequency Drives, as specified in Section 262419, suitable for installation as shown on the Drawings.
2. Provide by the Manufacturer.
3. Coordinate with pumps and pump driving motors.
4. Include all internal auxiliaries required to meet the functional specifications.



5. Design for a speed range of 70% to 100% of full load motor speed.
6. Incorporate components to receive temperature data from the pump motor.

## 2.8 SHOP PAINTING

- A. Prepare, shop-prime and finish-coat each piece of equipment in accordance with the Manufacturer's standard practice prior to shipment.
- B. Colors shall be Manufacturer's standard. Coating for Variable Frequency Drives shall be as specified in Section 262419. Furnish adequate supply of touch-up paint from the Manufacturer.
- C. Clean all interior and exterior surfaces of pump of all rust, mill scale, grease, dirt, other foreign matter and provide Manufacturer's standard epoxy coatings.
- D. All coatings on wetted surfaces shall be epoxy type and shall comply with AWWA E-103 and ANSI/NSF 61 and ANSI/NSF 372 for use with drinking water systems. Surface preparation shall conform to the coating manufacturer's recommendations.
- E. Protect all nameplates during painting.

## 2.9 ACCESSORIES

- A. Nameplates:
  1. Each major piece of equipment shall be furnished with a stainless-steel nameplate (with embossed data or equivalent) securely mounted to the body of the equipment.
  2. At a minimum, the nameplate for the pumps shall include the Manufacturer's name and model number, serial number, rated flow rate, head, and speed.
  3. At a minimum, nameplates for motors shall include the manufacturer's name and model number, serial number, horsepower, speed, input voltage, amps, number of cycles and power and service factors.
  4. Nameplate information for the variable frequency drives shall include the manufacturer's name and serial number, input speed, voltage, current and frequency and horsepower at full load.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Take all necessary measurements in the field to determine the exact dimensions for all work and the required sizes of all equipment under this Contract. All pertinent data and dimensions shall be verified.

### 3.2 INSTALLATION

- A. Install in strict accordance with the Manufacturer's instructions and recommendations in the locations shown on the Contract Documents and pump shop drawings. Provide required oil and grease for initial operation in accordance with the Manufacturer's recommendations.
  - 1. If the Contractor does not provide qualified installation staff on the job during the pump installation, the Engineer may direct the Contractor to provide the services of a Manufacturer's factory representative to give the necessary instructions to ensure a proper installation.
  - 2. Connection of piping to pumps shall be done in the presence of the Engineer. All piping connections to the pump shall be done without bending and/or twisting the piping to mate with the pump flange connections.
  - 3. A certificate from the Manufacturer shall be submitted stating that the installation of their equipment is satisfactory, that the equipment is ready for operation, and that the Owner's operating personnel have been suitably instructed in the operation, lubrication and care of each unit.
- B. Mechanical equipment, including electric motors shall be supplied and installed in accordance with applicable OSHA regulations including requirement for guards on all rotating assemblies.

### 3.3 ATTACHMENT

- A. Rigidly and accurately anchor pump base plate, precisely leveled and aligned, so that the completed installation is free from stress or distortion.
- B. Proportion baseplate to support each entire pump/motor assembly and the loads (including the results of the dynamic vibration analysis) to which it may be subjected during operation.
- C. Provide anchor bolts, plates, nuts and washers and conform to the recommendations and instructions of the Manufacturer.
- D. Pump Manufacturer shall validate base plate installation by on-site inspection during installation.
- E. Bolt pump base plate to the concrete foundation:
  - 1. Bolts and Washers: Type 316 stainless steel epoxy type
  - 2. Nuts on Stainless Steel Anchor Bolts: Monel.
  - 3. Anti-Seize Compound: Molybdenum disulfide base Molycoat G or approved.
  - 4. Anchor bolt configuration and installation in accordance with API RP 686 and ACI 318-08.
- F. Pump Support/Anchors and Associated Accessories:
  - 1. Support pump on anchor bolts and located as shown on the Drawings.
  - 2. Provide special slings, strongbacks, or other devices necessary to handle the pump during loading, unloading, erection, installation, and subsequent disassembly.
  - 3. Install, level and grout base plate in accordance with API RP 686, Chapter 5 – Mounting Plate Grouting.

4. Provide jacking bolts and Five Star non-shrink epoxy grout for leveling pump base plate assembly. Back leveling jacking bolts off after grouting so that they do not support any of the load.
5. Provide anchor bolt layout to aid in placement of anchor bolts.
6. Use of shims or leveling nuts on anchor bolts is specifically prohibited.
7. Grout for use under the base plate: Five Star DP Epoxy Grout, an expansive, non-shrink, low exothermic epoxy system, or approved equal, mixed and applied according to the Manufacturer's directions to a thickness as specified under Grout Placement. Manufacturer's representative required to be present during the pouring of the epoxy grout.
8. Use of rigid non-absorbing formwork and a head box are mandatory.
9. Cover surface of formwork in contact with epoxy grout with a layer of paste wax.
10. Clearance between the concrete surface and bottom surfaces of the base plate shall be per Manufacturer's recommendation.
11. Grout Placement:
  - a. Chip concrete in contact with epoxy grout to present a slightly rough surface and remove the laitance.
  - b. Clean surface of all dust, moisture and oil.
  - c. Place 1-inch minimum diameter by 0.25-inch thick stainless-steel disk, with full radiused edges under each jack bolt.
  - d. Place thin layer of leveling grout under metal.
  - e. Radius metal edges in contact with the epoxy grout to a minimum 0.5-inch radius to prevent stress risers in the epoxy grout.
  - f. Place plastic vent tubes under the base plate, sized and spaced per Manufacturer's recommendation, to vent air during grouting and prevent voids in the epoxy grout.
  - g. Fill annular space between the anchor bolts and the anchor bolt sleeve with expanding urethane foam.
  - h. Cover threads of both anchor bolts and jack bolts in contact with the grout with paste wax and a layer of duct tape.
  - i. After all alignment tolerances are met, tighten anchor bolts to prevent movement during the pour.
  - j. Epoxy grout shall not be allowed to extend above the top edge of the base plate (or drip rim).
  - k. Remove the jack bolts after the epoxy grout has fully cured, within 24 to 48 hours after pouring, and tighten anchor bolts to torque levels recommended by the Manufacturer.
  - l. Coat threaded jack bolt holes with grease and remove paste wax and duct tape then reinsert and secure in position with a lock nut to within 0.25 inch of the bottom of the hole.
  - m. After grouting, patch chipped edges to present a smooth finish.

### 3.4 INSPECTION AND TESTING

#### A. General:

1. The Engineer shall have the right to inspect any equipment to be furnished under this Section prior to their shipment from place of manufacture.
2. Engineer shall be notified in writing no fewer than ten working days prior to the factory performance test, so that arrangements can be made for inspection by the Engineer.

3. Field tests shall not be conducted until such time that the pumping system, including controls, is complete and ready for testing.

B. Factory Pump Testing:

1. Factory test each pump as described in ANSI/HI 14.6, American National Standard for Rotodynamic Pumps for Hydraulic Performance Acceptance Tests.
2. Manufacturer shall perform hydrostatic test on the pressure-containing parts in accordance with ANSI/HI 14.6. Test shall be conducted on each pump prior to shipment.
3. Visually inspect cast surfaces of all components per MSS SP-55.
4. Factory pump tests shall be the basis of acceptance of the hydraulic performance of the pumps. Manufacturer shall factory test all pumps prior to shipment in accordance with the Hydraulic Institute standards. Flow rate, total head, efficiency and input KW shall be tested and recorded for at least five points on the pump performance curve. Test shall be performed to demonstrate that the pumps meet ANSI/HI 14.6, acceptance grade 1U for specified (intermediate) design point and acceptance grade 1E for the other specified points. The five points shall include the points specified in Article 2.3. If any pump tested fails to meet any specification requirement it will be modified until it meets all specification requirements. If any pump tested fails to meet the flow rate, head or efficiency requirements for any of the conditions listed in Article 2.3 of this specification and all reasonable attempts to correct the inefficiency are unsuccessful, the pump(s) shall be replaced with a unit(s) that meets the specified requirements.
5. Submit certified pump performance curves, including total head, flow rate, pump efficiency and total brake horsepower for each pump supplied. Test data shall be submitted for approval by the Engineer prior to shipment.
6. If the Manufacturer does not have historical test records for NPSH3 at the specified design pump speed, one pump shall be tested to demonstrate NPSH3 versus flow rate.
7. All meters, gauges, and other test instruments shall be calibrated within the manufacturer's established time period prior to the scheduled test and certified calibration data shall be provided. If the Manufacturer has no ISO standard calibration period, Hydraulic Institute Standards shall govern.
8. The pumps shall be tested at 100 percent of the design speed. Reduced speed curves will be determined using affinity laws.
9. Each pump shall be tested through the specified range of flow, and head/flow rate/efficiency curves plotted at maximum output speed. During each test, the pump shall be run at each head condition for sufficient time to accurately determine flow rate, head, power input, and efficiency. In addition, during the tests, the overall efficiency shall be determined at each test point. The pump under test shall be modified until the specified conditions are met or replaced with a pump that will meet the specified conditions.
10. All pumps shall receive a non-witness factory test.

C. Field Testing:

1. In the presence of the Engineer, necessary tests shall be performed to indicate that the pumps, variable frequency drives and motors generally conform to the operating conditions specified (flow rate, total head,). The factory testing specified above will be the basis of performance acceptance. A 30 day operating period of the pumps will be required before acceptance. If pump performance does not generally agree with the factory test results, corrective measures shall be taken, or the pump shall be removed and replaced with a pump that satisfies the conditions specified. Provide, calibrate and install all temporary gauges and meters, make necessary tapped holes in the pipes, and install all

temporary piping and wiring required for the field acceptance tests. Written test procedures shall be submitted to the Engineer for approval no fewer than 30 days prior to testing.

2. When full speed operation can be accomplished, and in the presence of the Engineer, perform vibration tests in accordance with ANSI/HI 9.6.4 on each unit by a minimum level III qualified vibration technician as defined by Vibration Institute or equivalent to (a) demonstrate compliance with specified limitations, and (b) demonstrate that there are no field installed resonant conditions due to misalignment, the foundation, or the connecting piping and its supports, when operating at any speed within the specified operating range.
3. Motor tests:
  - a. Prior to any pump mechanical test, the Contractor shall megger each motor winding before energizing the motor, and, if insulation resistance is found to be low, shall notify the Engineer and shall not energize the motor.
  - b. Prior to any pump mechanical test, the Contractor shall check all motors for correct clearances and alignment and for correct lubrication in accordance with the motor manufacturer's instructions. The Contractor shall check direction of rotation of all motors prior to any pump mechanical test and reverse connections, if necessary.
  - c. The Contractor shall meet all the testing requirements of Section 400593.
4. If required, take corrective action and have the units retested to ensure full compliance with the specified requirements. All costs associated with the field tests or any required corrective action shall be borne by the Contractor.

### 3.5 MANUFACTURER SERVICES INCLUDING OPERATING INSTRUCTIONS

#### A. Operating and Maintenance Manual:

1. Operating and maintenance manual shall be furnished by the Manufacturer to the Engineer as provided for in Section 017823. The manuals shall be prepared specifically for this installation and shall include all required cuts, drawings, equipment lists, description, etc. that are required to instruct operating and maintenance personnel unfamiliar with such equipment. The maintenance instructions shall include trouble shooting data, full preventative maintenance schedules, and complete spare parts lists with ordering information.

#### B. Installation Inspection and Startup:

1. The Contractor shall include in his bid price the services of a Manufacturer's factory representative who has complete knowledge of proper operation and maintenance shall be provided to instruct representatives of the Owner and the Engineer on proper operation and maintenance. This work may be conducted in conjunction with the inspection of the installation and start-up. If there are difficulties in operation of the equipment because of the Manufacturer's design or fabrication, additional service shall be provided at no additional cost to the Owner. The listed service requirements are exclusive of travel time and shall not limit or relieve the Contractor of the obligation to provide sufficient service necessary to place the equipment in satisfactory and functioning condition. VFD training shall be as specified in Division 017900. Also refer to additional requirements in PART 3 of this Section.

2. Installation inspection: Complete review of installation in accordance with Section 014000. Provide written certification that the installation is complete and operable in all respects, and that no conditions exist which may affect the warranty. The Manufacturer shall supply the installation inspection services of an experienced Manufacturer's factory representative to verify the proper pump installation.
  3. Qualified supervisory services, including Manufacturers' Factory representatives, shall be provided to ensure that the installation is done in a manner fully approved by the Manufacturer. The Manufacturer's factory representative shall specifically approve the installation and alignment of the pump with the motor, the grouting, and the alignment of the connecting piping and the installation of the field installed packing or mechanical seal. If there are difficulties in the start-up or operation of the equipment due to the Manufacturer's design or fabrication, additional service shall be provided at no additional cost to the Owner. Services of the Manufacturer's factory representative and training shall be provided when the first pump is started, with follow-up visits upon start-up of each subsequent pump.
    - a. Minimum time on-site shall be one 8-hour day per pump station.
  4. Start-Up: Provide written report, summarizing test procedures, tested and measured variables (flow rates, total heads, shaft-speed, vibration measurements, alignment check, etc.):
    - a. Minimum time on-site shall be one 8-hour day per pump station.
- C. Training:
1. Field and classroom instruction on operation and maintenance of the equipment, including start-up, shut-down troubleshooting, lubrication, maintenance and safety.
  2. The Manufacturer shall provide detailed manuals to supplement the training courses. The manuals shall include specific details of equipment supplied and operations specific to the project.
  3. The Manufacturer shall make use of teaching aids, manuals, slide/video presentations, etc. After the training services, such materials shall be delivered to Owner.
    - a. Minimum time on-site shall be one 8-hour day per group of identical pumps.
- D. The Contractor alone shall be responsible for requesting these services and shall coordinate these requests with all other relevant trades, to ensure the effectiveness of the Manufacturers' service. In the event that the lack of coordination by the Contractor results in the need to recall the Manufacturer's factory representative, the lost time shall not be counted against the above days.
- E. The manufacturer's authorized service person shall provide precision laser alignment of the motor to the driven pump using equipment that provides a computer generated alignment report showing the angular and parallel offset data for each pump prior to start-up. Reports shall demonstrate the absence of pipe stress on the pump and no "soft foot" for the motor.

END OF SECTION 432321.14

## SECTION 434143 - HIGH DENSITY POLYETHYLENE TANKS

### 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. JEA Water and Wastewater Standards Manual, latest edition
- C. JEA Water Treatment Plant Standards, latest edition

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Rotationally molded, vertical, high density polyethylene tanks.
  - 2. Tank accessories.
  - 3. Tank anchoring hardware.
- B. Chemicals stored: Sodium hypochlorite
- C. Related Requirements:
  - 1. Section 033000 "Cast in Place Concrete" Support pads.
  - 2. Division 40 "Process Interconnections" for associated pipes, tubes, fittings, and valves.

#### 1.3 DEFINITIONS

- A. ARM: Association of Rotational Molders
- B. ASTM: American Society for Testing and Materials
- C. HDPE: High Density Polyethylene.
- D. XLHDPE: Crosslinked High-Density Polyethylene.
- E. LPE: Linear (Low Density) Polyethylene
- F. UV: Ultraviolet

#### 1.4 COORDINATION

- A. See Section 013000 "Administrative Requirements" for coordination requirements.

## 1.5 PREINSTALLATION MEETINGS

- A. See Section 013000 “Administrative Requirements” for preinstallation meeting requirements.
- B. Convene minimum one week prior to commencing installation work of this Section.

## 1.6 SCHEDULING

- A. Section 013100 “Project Management and Coordination” for scheduling requirements.
- B. Schedule Work of this Section after concrete Work for support pad and prior to connecting utility and piping Work.

## 1.7 ACTION SUBMITTALS

- A. See Section 013300 “Submittal Procedures” for submittals requirements.
- B. Product Data: Include rated capacities, accessories, appurtenances, and furnished specialties for each storage tank indicated.
  - 1. Ladder and ladder safety devices.
  - 2. Information concerning materials of construction and fabrication.
  - 3. Personnel access manways and covers and associated hardware dimensions, materials and assembly details.
  - 4. Nozzle and nozzle hardware dimensions, materials and assembly details.
  - 5. Resin used and certification of chemical resistance.
  - 6. Anchoring systems.
  - 7. Tank base padding material.
- C. Shop Drawings: Show fabrication and installation details for each storage tank, including the following:
  - 1. Complete plan, elevation, and sectional drawings showing critical dimensions.
  - 2. Tank wall and floor thickness.
  - 3. Tank weight.
  - 4. Locations, elevations, dimensions and sizes of manways, access openings, nozzles, nozzle flats, anchoring points.
  - 5. Access openings (manways), covers, pipe connections, and accessories.
  - 6. Ladder and ladder safety device details.
  - 7. Tank labeling text, size, layout and locations.
  - 8. Heating and insulating details including wiring diagrams and power requirements (if specified).
  - 9. Anchoring system details including anchor bolt embedment length.
  - 10. Manufacturer supplied tank pad dimensions and details.



## 1.8 DELEGATED DESIGN SUBMITTALS

- A. Wall thicknesses calculations per ASTM D1998.
- B. Anchorage and/or hold down device calculations stamped by a professional civil or structural engineer registered in the State of Florida demonstrating that each tank will adequately transfer seismic, wind or hydraulic forces from the vessels to the anchor bolts at the foundation. Submit with the calculations a tabulation of all loads imparted on the foundation by the tank.

## 1.9 INFORMATIONAL SUBMITTALS

- A. Manufacturer's Certificate:
  - 1. Ten years prior experience in construction of rotationally molded HDPE and XLHDPE tanks.
  - 2. Certification of material compatibility for chemical stored including tank, nozzles, hardware and elastomers.
- B. Manufacturers' Instructions: Detailed instructions on installation requirements, including tank transport handling, storage and anchoring procedures and anchoring layout.
- C. Source Quality-Control Submittals: Results of shop tests and inspections:
  - 1. Impact Test per ASTM D1998, Section 11.3 at – 20 degrees F. Sample passes if it does not shatter or crack at:
    - a. 120 ft/lbs for a 1/2-inch wall thickness
    - b. 100 ft/lbs for a wall thickness less than 1/2-inch.
  - 2. Degree of Crosslinking Test per ASTM D1998, Section 11.4. Sample passes if gel percent is 60 to 70 percent
  - 3. Hydrostatic Test. Fill the tank with water to the top of the side wall. Tank passes if there are no leaks after one hour and no significant bulging or shape deformation.
  - 4. Wall thickness. Measure actual wall thickness measurement at one-foot elevation intervals up to three feet from the bottom of the tank.
  - 5. Prepare and submit complete inspection reports for each tank. Provide, on Owner's request, a copy of inspection records for review.
- D. Field Quality-Control Submittals:
  - 1. Results of Contractor furnished tests and inspections.
  - 2. Owner Installation Certificate: Signed and dated certificate from manufacturer's representative that tank has been properly installed and is ready for filling.

## 1.10 CLOSEOUT SUBMITTALS

- A. See Section 017700 "Closeout Procedures" for submittals requirements.
- B. Field Quality-Control Submittals: Results of Contractor-furnished tests and inspections.

- C. Manufacturer Reports: Certify that tank has been installed according to manufacturer instructions.
- D. Project Record Documents: Record actual locations of tank and accessories.
- E. Operation and Maintenance Data: For tanks, accessories, and appurtenances to include in emergency, operation, and maintenance manuals.

#### 1.11 QUALITY ASSURANCE

- A. Fabricate like items of the same materials at one shop to standardize quality and appearance in accordance with ASTM D1998.
- B. Perform Work according to JEA Standards

#### 1.12 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum ten years' documented experience.
- B. Licensed Professional: Professional engineer at least five years of experience in design of specified Work and licensed in State of Florida.

#### 1.13 DELIVERY, STORAGE, AND HANDLING

- A. See Section 016000 "Product Requirements" for transporting, handling, storing, and protecting products requirements.
- B. Deliver materials in manufacturer's packaging including application instructions. Do not ship tanks with ladders, handrails or external piping assembled.
- C. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- D. Store materials according to manufacturer's instructions.
- E. Protection:
  - 1. The Manufacturer is responsible for packaging to prevent damage to the tanks during transit and handling.
  - 2. Provide additional protection according to manufacturer instructions.
  - 3. Protect flange faces and other openings with a minimum 1/2-in thick wooden blind flange secured in place with temporary nuts and bolts in each bolt hole. Alternatively, plastic caps can be used to prevent entrance of dirt, water and debris.
  - 4. Protect threaded and socket nozzles with plugs securely taped in place.
  - 5. Shrink-wrap tank for added protection during shipping
  - 6. Provide instructions for unloading and installation of the tanks, using lifting and tailing lugs as needed for handling by for crane, fork truck or similar device. Do not use nozzles, manways, or other fittings for lifting.

7. Wrap ladders, railings, sight gages and other components removed for shipment to prevent damage during shipment.
8. Do not ship loose components inside the tanks.

#### 1.14 EXISTING CONDITIONS

##### A. Field Measurements:

1. Verify field measurements prior to fabrication.
2. Indicate field measurements on Shop Drawings.

#### 1.15 WARRANTY

- A. Section 017700 "Closeout Procedures" specifies requirements for warranties.
- B. Furnish five-year manufacturer's warranty that equipment is free of defects in design, fabrication, material and workmanship.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE AND DESIGN CRITERIA:

1. Refer to Tank Table appended to this Specification Section.

#### 2.2 STORAGE TANKS

##### A. Manufacturers

1. PolyProcessing Inc.
2. Assmann Corporation of America

##### B. Description: Rotationally molded, HDXLPE construction

1. Cylindrical, flat-bottomed and vertical
2. Dimensions, details and accessories as shown in the Tank Tables and Tank Figures.
3. Hoop Stress Value:
  - a. No greater than 600 psi at 100 °F.
  - b. Decrease to 300 psi at 150 °F.
  - c. Safety Factor: No less than 2 using Barlow formula for calculating wall thickness.
  - d. The minimum wall thickness shall be sufficient to support its own weight in an upright position without external support but shall not be less than 0.187 inch thick.
4. Knuckle Radius: Bottom to wall - Minimum 1-inch.
5. Design specific gravity: See Tank Table.

6. Finish: Smooth surfaces free from visual defects, such as foreign inclusions, air bubbles, pin holes and craters.
7. Tolerance Outside Diameter Including Out-of-Roundness: Plus/minus 1 percent.
8. Trim cut outs to have smooth edges.

## 2.3 RESIN

- A. Interior of tanks will be coated with a NSF 61 approved medium density polyethylene resin.
- B. Delamination or separation of the resin from the tank interior will not be acceptable.
- C. Color: Natural
- D. Manufacturers:
  1. Exxon/Mobile Chemical Paxon 7000 series
  2. Chevron Phillips Marlex HMN TR-942
  3. Exxon 8461
  4. SchuLink XL350
  5. Or approved equal

### E. Properties:

Molded Properties	Test Based On	Typical Values HDXLPE	Typical Values HDPE	Unit
Tensile Strength at Yield	ASTM D 638	2,800	2,950	PSI
Tensile Elongation at Yield	ASTM D 638	20	10	%
Tensile Elongation at Break	ASTM D 638	700	>1000	%
Flexural Modulus 1% Secant	ASTM D 790 PROCEDURE B	87,000 to 100,000	110,000 to 129,000	PSI
Impact Strength @ -40°C 1/8" thickness 1/4" thickness	ARM	74 190	64 170	ft-lbs. ft-lbs.
Notched IZOD Strength @ -40°F	ASTM D 256	4.3	4.3	ft-lb/in
Gel Content	ASTM D2765	60 to 70%	NA	%
Vicat Softening Temperature	ASTM D1525	250	235	°F
Environmental Stress Crack Resistance	ASTM D 1693 Condition A 100% Igepal 10% Igepal	F <sub>0</sub> > 1,000 F <sub>0</sub> > 1,000	F <sub>0</sub> > 700 F <sub>0</sub> > 250	hr hr
Deflection temperature @ 66 psi @ 264 psi	ASTM D 648	142 110	136 99	°F °F

### F. Additives

1. Long term U.V. stabilizer.

2. White or black pigment, if specified in Tank Tables, not to exceed 0.5 percent of dry blended or 2 percent if melt compounded of the total weight of the tanks.
3. Anti-oxidant: Increase the concentration of anti-oxidant by a factor of four in non-crosslinked resin (entire tank or melt-bonded liner) for applications with sodium hypochlorite and sulfuric acid, and other oxidizing chemicals.

## 2.4 NOZZLES

- A. Bolted flanged fittings with the bolt heads on the inside of the tank for tank overflow and top mounted nozzles.
- B. Install tank top nozzles on the flat sections of the top except as shown on the Tank Figures.
- C. For nozzles on non-flat sections of the tank top, use bolted flanged nozzles with universal balls to facilitate alignment.
- D. For flanges greater than 3-inch diameter on the side wall, machine the flange faces to contour to the tank.
- E. Flange bolting per ANSI 16.5, 150-pound design, with:
  1. Gaskets between the washer on the inside of the tank and the tank.
  2. A gasket between the outside flange and the tank.
  3. Bolting material per the Tank Tables.
- F. Cover bolt heads and washers inside the tank with polyethylene caps.
- G. Pump Suction:
  1. For each tank, provide either:
    - a. An integrally molded flanged outlet constructed of the same material as the tank and formed with the tank molding and a split-ring backer flange, or
    - b. A bushing of chemically resistant metal per the Tank Tables and molded into the tank as the tank is formed, O-rings as needed to seal the bushing, and threaded fitting to adapt the outlet to a flange.

## 2.5 SIDEWALL CONNECTIONS TO THE TANK

- A. All sidewall connections to the tank shall have a flexible pipe connection with the exception of the liquid level gauge.
- B. Flexible connections shall have titanium or Hastelloy C-276 hardware and Viton gaskets.
- C. Flexible pipe connections will meet the tank manufacturer's recommended flexural requirements.
- D. pipe supports will be placed after the flexible pipe connection to allow the sufficient tank movement outward when filled.

## 2.6 MANWAYS AND COVERS

### A. Tank Top Manways

1. 24-inch diameter with bolted cover for tanks 2000 gallons and larger.
2. Gasketed and guaranteed fume tight.

## 2.7 LADDERS, RAILINGS AND PLATFORMS

### A. Ladder for Tank-Top Manway Access

1. OSHA compliant design.
2. Floor supported for vertical load, braced to molded-into-the-tank fittings at the top of the tank for lateral support.
3. Ladder accessories
  - a. Anchor brackets for floor mounting
  - b. Stand-off brackets at the tank top
  - c. Fasteners
4. Each tank will include a minimum 5,000 pound vertical track fall arrest system on top of the tank. The fall arrest system shall be OSHA compliant.

## 2.8 ACCESSORIES

- A. Refer to Tank Tables for fastener, insert and gasket materials requirements.
- B. Lifting lugs. designed and fabricated with a 5-times load safety factor
- C. Hold-down cables and associated hardware and floor mounted anchor brackets for wind and seismic restraints.
- D. 6-inch chemical tank vents shall be piped outside the building as indicated in the Drawings. Each vent shall terminate outside with a 90 degree bend facing down and bug screen
- E. Tank Labels
  1. Chemical specific label, with 6-inch high lettering
    - a. NFPA 704 four-diamond hazard identification label
    - b. Stickers shall be high tack laminated polyethylene
    - c. Chemical Name
    - d. Tank number
    - e. DOT-required hazardous labels
  2. Manufacturer's label, 316 SST, 1-inch high lettering
    - a. Manufacturer's name
    - b. Month and year of manufacture
    - c. Serial number

- d. Tank number (assigned by JEA)
- e. Tank capacity in gallons (straight side)
- f. Tank height
- g. Tank weight
- h. Tank diameter
- i. Maximum specific gravity
- j. Design pressure and temperature
- k. Maximum pressure
- l. Materials of construction

F. Support Pad:

- a. Contractor shall construct concrete tank pad per the design drawings with a 3/8-inch neoprene buffer pad to absorb irregularities and scuff damage.

G. Tank Outlet

- 1. Provide a full drain connection capable of providing complete drainage through the tank sidewall.
- 2. Tanks will be installed on an equipment pad or stand to sufficiently accommodate the outlet flange, without impeding or requiring modification to the concrete slab or grating below.
- 3. Integrally Molded Outlet
  - a. PTFE bellows-lined with fiber reinforced composite exterior stainless-steel limit link cables.
  - b. ANSI 150-pound flange connections
  - c. Movement capacity:
    - 1) Axial compression  $\geq 0.67''$
    - 2) Axial extension  $\geq 0.67''$
    - 3) Lateral deflection  $\geq 0.51''$
    - 4) Angular deflection  $\geq 14^\circ$
    - 5) Torsional rotation  $\geq 4^\circ$ .
  - d. Model:
    - 1) Andronaco Industries Company,
    - 2) Ethylene brand,
    - 3) Durcor Flexijoint
    - 4) Proco
    - 5) approved equal.
  - e. Install expansion joint after the tank shut-off valve, prior to the first pipe support, as close to the tank as possible.

H. Liquid Level Gauge

- 1. Clear PVC Sch 80 liquid level gauge with 1/2-inch increment labeled
  - a. Reverse float level gauge will not be acceptable.

2. Ball valves will be installed above and below the level gauge to allow isolation.
3. If level gauge is connected to the tank outlet, the ball valve configuration will allow level gauge isolation, regardless of tank operation.
4. A support will be provided for every 6-feet of tank sidewall height to maintain level gauge alignment.

## 2.9 SOURCE QUALITY CONTROL

- A. See Section 014000 “Quality Requirements” for testing, inspection, and analysis requirements.
- B. Fabricate like items of the same materials at one shop to standardize quality and appearance in accordance with ASTM D1998.
- C. Perform the tests described below on samples from the manway cut out areas or where fittings are inserted in each tank.
  1. Testing:
    - a. Impact Test per ASTM D1998, Section 11.3 at – 20 degrees F. Sample passes if it does not shatter or crack at:
      - 1) 120 ft/lbs for a 1/2-inch wall thickness
      - 2) 100 ft/lbs for a wall thickness less than 1/2-inch.
    - b. Degree of Crosslinking Test per ASTM D1998, Section 11.4. Sample passes if gel percent is 60 to 70 percent.
    - c. Hydrostatic Test. Fill the tank with water to the top of the side wall. Tank passes if there are no leaks after one hour and no significant bulging or shape deformation.
    - d. Wall thickness. Measure actual wall thickness measurement at one-foot elevation intervals up to three feet from the bottom of the tank.
    - e. Prepare and submit complete inspection reports for each tank. Provide, on Owner’s request, a copy of inspection records for review.
  - D. Owner Inspection:
    1. Make completed product tank available for inspection at manufacturer's factory prior to packaging for shipment.
    2. Notify Owner at least seven days before inspection is allowed.
  - E. Owner Witnessing: The Owner reserves the right to inspect tank fabrication and/or to hire an Inspector to provide inspection services at Owner’s cost during tank fabrication and installation.
    1. Allow witnessing of factory inspections and test at manufacturer's test facility.
    2. Notify Owner at least seven days before inspections and tests are scheduled.
  - F. Certificate of Compliance:
    1. When fabricator is approved by authorities having jurisdiction, submit certificate of compliance indicating Work performed at fabricator's facility conforms to Contract Documents.



2. Specified shop tests are not required for Work performed by approved fabricator.
- G. Submit Factory Test Report, approved and signed by the Fabricator's Quality Control Supervisor which includes for each tank:
  1. Inspection records.
  2. Results of hydrostatic testing.
  3. Test reports of physical properties of standard laminates.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. See Section 017300 "Execution" for installation examination requirements.
- B. Verify that designated areas, clearances, structural requirements, piping, utility connections, and electronic signals are ready to receive equipment.

#### 3.2 PREPARATION

- A. See Section 017300 "Execution" for installation preparation requirements.
- B. Adjacent Surfaces: Protect adjacent surfaces
- C. Seal cracks.
- D. Cleaning: Clean surfaces.
- E. Apply sealer.

#### 3.3 INSTALLATION

- A. Install equipment and perform Work according to manufacturer instructions.
- B. Support Pad: Using templates furnished with tank, install anchor bolts and accessories for mounting and anchoring tank.
- C. Install tanks as indicated on Drawings on an even bearing on the concrete pad and/or an HDPE disc provided by the manufacturer and according to manufacturer instructions.
- D. Make all pipe connections to tanks as shown on the Drawings, with reducers and flexible connectors as necessary.
- E. Install tank accessories not factory mounted to complete installation.
- F. Engage the Fabricator to inspect the foundation prior to tank setting and to advise on tank off-loading from the delivery truck.

- G. Install anchor bolts, accessories shipped loose, pipe connections, instruments, etc.
- H. Support pipes independently of the tank, except where pipe supports are specifically built into the tank.
- I. Following the field test and repair of leaks, anchor tanks in their final position according to the Manufacturer's recommendations.

### 3.4 FIELD QUALITY CONTROL

- A. Field Testing:
  - 1. Hydrostatically test each tank by filling with water to the overflow pipe level.
  - 2. Conduct test minimum 2 hours.
  - 3. No leakage permitted.
- B. Equipment Acceptance: Adjust, repair, modify, or replace components failing to perform as specified and rerun tests.
- C. Furnish installation certificate from equipment manufacturer's representative attesting that equipment has been properly installed and is ready for startup and testing.

### 3.5 FINAL CLEANING

- A. After hydrostatic testing, clean the tank with a mild detergent. Do not use abrasives.
- B. Rinse with potable water spray and remove all standing water.

### 3.6 ATTACHMENTS

A. Tables:

**TANK TABLE 1**

Revisions	By	Date
0	Anna Ness	June 6, 2020
1	Anna Ness	July 21, 2020
2		
<b>GENERAL</b>	Client	JEA
	Project Name	Rivertown WTP
	Location	Jacksonville, Florida
	Project Number #	6103-237938
	Tank Tag #	T-2001, T-2002
	Tank Name	Sodium Hypochlorite
	Tank location (project area or room)	Chemical Building
	Installation indoor or outdoor	Indoor
	Specification Section Reference	434143
	P & ID Reference	I-5
	Schedule buyer's inspection during fabrication	Upon JEA request
<b>CONTENTS</b>	Chemical/Fluid Name	Sodium Hypochlorite
	Concentration	10% - 15%
	pH	8.0
	Specific Gravity	1.21
	Temperature, Normal Operating, °F	73
	Temperature, Maximum Operating, °F	85
	Temperature, Minimum, °F	35
	Vapor Pressure, mmHg at 77 °F (25 °C)	14 mm Hg
<b>TANK GEOMETRY</b>	Volume (To Overflow on side wall) gal	Minimum 6,000
	External Diameter	Less than 11 feet
	Straight Side (Including Freeboard), Inches	
	Top. Include flat areas for fittings.	Domed, up to 12'
	Bottom	Flat
<b>DESIGN</b>	Integrally molded outlet at bottom side wall, size, inches	4"
	Design pressure	
	Atmospheric	
	<10" w.g. (to vent or scrubber)	
	Other (consult with factory before specifying)	
	Design specific gravity (always greater than fluid s.g.)	

	Single or double wall	Single
	Materials	
	HDPE	
	XLHDPE	X
	XLHDPE with Linear HDPE liner	
	Pigmented Black or White	White
<b>LOADS</b>	Snow loads	
	Ground snow load (Pg), psf	X
	Exposure Category	X
	Wind loads	
	Basic Wind Speed, mph	X
	Exposure Category	X
	Seismic loads	
	Site Class	X
	Mapped Spectral Response Accelerations	Ss=0. X, S1=0. X
	Design Spectral Response Accelerations	Sds=0. X, SD1=0. X
	Design Category	X
	Uplift load	
	Water depth in secondary containment, ft	X
<b>ACCESSORIES AND HARDWARE</b>	Live load on top head	
	Pounds	250
	Insulation and jacket required (Yes or No)	No
	Thickness, inches	
	Self-Limiting Heating (Yes or No)	No
	Ladders	
	Pultruded FRP, isophthalic polyester resin, yellow safety color	X
	304SS steel	
	Painted steel, yellow-safety-color paint	
	Bolting hardware (pick galvanized or 304SS)	304 SS
	Lifting lugs	Poly
	Flange bolting hardware	
	316SS	
	Titanium (for sodium hypochlorite)	X
	Blind flange gaskets	
	EPDM	
	PVDF	X
	Vent	
	Diameter	6 inches
	Gooseneck with insect screen or flange for extension	X
	NFPA label (X (health)/ Y (flammability)/ Z (reactivity))	X/Y/Z

END OF SECTION 434143

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## SECTION 434163 - WIRE AND STRAND WRAPPED PRESTRESSED CONCRETE TANK

### 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. Coordinate the design and construction of the tank bottom slab, foundation, sump and equipment supports with the equipment supplier including all associated pipe connections.
- C. Geotechnical information to be used in the design of the prestressed tank can be found in the Geotechnical Exploration and Evaluation, Phase 2 Report for Rivertown Water Treatment Plant performed by CSI Geo dated July 2020. The geotechnical report is provided for information only as an appendix to this document.. The Contractor is responsible for any conclusions to be drawing from the geotechnical information including the character of materials to be encountered and the degree of difficulty to be expected in the performance of the work.
- D. Components specified here-in shall meet requirements of the 2020 JEA Water and Wastewater Standards Manual, or latest edition.
- E. Disinfecting of Water Supply Systems shall comply with the latest requirements listed in Section 350 and 351 JEA Water and Wastewater Standards (January 2019 or latest).

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Furnish all labor, materials, and incidentals required to design, construct, test, and disinfect 2-million gallon circular wire wrapped prestressed concrete tank, complete, as shown on the Drawings and as specified herein.
  - 2. Furnish and install all piping and fittings to the limits as shown on the Drawings and as specified herein and in other Sections.
- B. Related Requirements:
  - 1. Excavation, dewatering, and backfill are included in Division 31.
  - 2. Concrete is included in Division 03.
  - 3. Waterproofing, dampproofing and caulking are included in Division 07.
  - 4. Level transmitters and appurtenances are included in Division 40.
  - 5. Pipe, valves, and fittings are included in Division 40.

#### 1.3 COORDINATION

- A. Section 013100 – Project Management and Coordination specifies requirements for coordination.

#### 1.4 PREINSTALLATION MEETINGS

- A. Section 013100 - Project Management and Coordination specifies requirements for preinstallation meeting.
- B. Convene minimum one week prior to commencing Work of this Section.

#### 1.5 ACTION SUBMITTALS

- A. Section 013300 – Submittal Procedures: Requirements for submittal.
- B. Product Data: Manufacturer's information, specifications, and installation instructions for the tank appurtenances. This submittal will be reviewed for operational requirements only. Appurtenances include the following:
  - 1. Inlet, outlet, overflow, pipe to future GST, and drain pipe
  - 2. Ladders, hatches, and railings
  - 3. Wrap-around staircase with platform
  - 4. Roof ventilator fans
  - 5. Natural draft cascade tray aerator
  - 6. Perimeter concrete overflows
  - 7. Wall manways
  - 8. Liquid level indicators
  - 9. Interior and exterior coatings
- C. Ground Storage Tank Construction Safety Precautions: During the stress tensioning of the tank, establish zoned-off areas around tank and install appropriate barriers as needed to protect surrounding structures and personnel in the event of a wire break. Tank manufacturer shall address the complete safety requirements in their project safety plan.

#### 1.6 DELEGATED DESIGN SUBMITTALS

- A. Design Data
  - 1. Upon the completion of the construction of the tank, submit the design calculations of the "as-built tank" stamped by a professional engineer licensed in the State of Florida for the project records only. The calculations will not be reviewed by the Engineer. Calculations submitted prior to tank construction will not be reviewed and will be returned for re-submittal upon completion of construction.
- B. Shop Drawings:
  - 1. Detailed erection shop drawings and construction procedures stamped by a professional engineer licensed in the State of Florida.
  - 2. Provide complete details for the foundation, floor slab, walls, roof construction, piping, aerator, staircase, and all other details and accessories necessary to build the tanks.
  - 3. Provide complete details for the ventilation fans and intake hoods.
  - 4. The submittal will be reviewed for operational requirements only and will be used in the field by the Owner's representative during construction.



C. Certification

1. The tank manufacturer is responsible for the design and construction of the prestressed concrete tank. Submit written certification prepared, sealed, and signed by a professional engineer licensed in the State of Florida that the design, details, and construction conform to the requirements of AWWA D110, this Section, and applicable city and state building codes.
2. Submit certification on Form 434163-A included at the end of this Section.

1.7 INFORMATIONAL SUBMITTALS

- A. Section 013300 - Submittal Procedures specifies requirements for submittals.
- B. Statement of Qualification
  1. Submit experience record in the design and construction of wire wrapped prestressed concrete tanks as specified herein.
  2. Submit experience record in shotcrete work of each nozzleman and foreman to be employed on the project as specified herein.
- C. Manufacturer's Certificate: Certify that the tank meets or exceeds specified requirements.
- D. Test and Evaluation Reports.
- E. Manufacturers' Instructions.
- F. Source Quality-Control Submittals: Indicate results of factory tests and inspections.
- G. Field Quality-Control Submittals: Indicate results of Contractor furnished tests and inspections.
- H. Manufacturer Reports.
- I. Qualifications Statements:
  1. Submit qualifications for manufacturer, applicator, installer, erector,
  2. Submit manufacturer's approval of applicator, fabricator and installer.

1.8 CLOSEOUT SUBMITTALS

- A. Section 017700 - Closeout Procedures for submittals.
- B. Project Record Documents.
- C. Operation and Maintenance Data.

1.9 MAINTENANCE MATERIAL SUBMITTALS

- A. Section 017700 - Closeout Procedures specifies requirements for maintenance materials.

#### 1.10 QUALITY ASSURANCE

- A. Perform Work according to AWWA D110 standards except where otherwise specified herein.
- B. Maintain one copy of each standard affecting the Work of this Section on Site.

#### 1.11 QUALIFICATIONS

- A. Manufacturer: Company specializing in tank design and construction specified in this Section with minimum ten years' experience in the design and construction of wire wrapped circular prestressed concrete tanks as specified in this section.
- B. The design and construction of all aspects of the floor slab, walls, prestressing, shotcrete and roof and of the wire wound circular prestressed concrete tank shall be performed by the tank manufacturer and shall not be subcontracted or otherwise assigned.
- C. All excavation, backfill, and grading work shall be under the supervision and responsibility of the Geotechnical Engineer. Concrete tank work shall be under the supervision and responsibility of the tank manufacturer, including the base slab and foundation. The manufacturer shall have designed and constructed at least 5 wire wrapped prestressed concrete tanks with domed roofs conforming to AWWA D110 with Type II core wall(s) that have been put into service within the last 10 years. The tanks shall have a diameter and capacity of not less than 75 percent nor more than 150 percent of the diameter and capacity of the proposed tank.
- D. Foreman supervising the placing of the shotcrete shall have a minimum of 3 years' experience as a nozzleman. Each shotcrete nozzleman shall have a minimum of 2 years' experience on similar applications and shall be able to demonstrate by tests, if required, their ability to satisfactorily gun shotcrete of the required quality.
- E. Licensed Professional: Professional engineer experienced in design of specified Work and licensed in State of Florida.

#### 1.12 DELIVERY, STORAGE, AND HANDLING

- A. Section 016000 - Product Requirements specifies requirements for transporting, handling, storing, and protecting products.
- B. Specific requirements, if any, shall be as specified in this Section.
- C. Deliver materials in manufacturer's packaging including application instructions.
- D. Inspect all materials and equipment.
- E. Store all materials according to manufacturer's instructions.

#### 1.13 AMBIENT CONDITIONS

- A. Section 015000 - Temporary Facilities and Controls specifies ambient condition control facilities for product storage and installation.

- B. Minimum Conditions: Do not install when under 35°F for the daily minimum temperature.

#### 1.14 WARRANTY

- A. Section 017700 - Closeout Procedures specifies requirements for warranties.
- B. The tank Manufacturer shall warranty the tank structure against any defective materials or workmanship for a period of 5 years from the date of tank(s) acceptance. If any materials or workmanship prove to be defective within that period, they shall be replaced or repaired by the tank Manufacturer.
- C. The ventilation fan and intake hood manufacturer/supplier shall warrant that the products sold shall be free from defects in workmanship and material upon delivery under normal use and service for a period of 1 year from the date of original installation or 18 months from the date of shipment, whichever occurs first. Costs of dismantling, reinstallation, time and materials, and freight are not covered under this warranty unless agreed upon and accepted in writing with the manufacturer/supplier.

### PART 2 - PRODUCTS

#### 2.1 SYSTEMS

- A. Tank, Aerator, Staircase, Ventilation:
  - 1. Wire wrapped prestressed concrete tank with a Type II core wall.
  - 2. Any surface in contact with potable water including equipment (if any) and coatings shall be suitable for use with potable water and shall be NSF 61 approved.
- B. Manufacturers:
  - 1. CROM LLC Gainesville, FL
  - 2. Precon Corp. Newberry, FL
  - 3. Aerovent/Markair for Ventilation Fans and Intake Hoods, Jacksonville, FL

#### 2.2 COMPONENTS

- A. Materials: New, of domestic manufacture, and conforming to AWWA D110 and the following material standards.
- B. Concrete and reinforcing steel for the tank core wall and roof dome:
  - 1. Conform to the requirements of AWWA D110.
  - 2. Concrete and reinforcing steel for all other structural elements, conform to the requirements of DIV 03.
  - 3. Admixtures causing accelerated or retarded set of the concrete, not allowed unless approved in writing by the Engineer.
  - 4. Concrete Strength: Minimum concrete strength at 28 days.

- |    |                     |                  |
|----|---------------------|------------------|
| a. | Pipe Encasement,    | $f_c = 3000$ psi |
| b. | Footing and floors  | $f_c = 4000$ psi |
| c. | Dome roof           | $f_c = 4000$ psi |
| d. | Cast-in-place walls | $f_c = 4000$ psi |

C. Prestressed Wire

1. Conform to ASTM A821, suitable for redrawing and having a minimum ultimate strength of 231,000 psi, unless otherwise approved in writing by the Engineer.

D. Shotcrete

1. In accordance with AWWA D110. Shotcrete shall have a minimum  $f_c = 4000$  psi at 28 days.
2. Steel Diaphragm
  - a. The galvanized steel diaphragm used in the construction of the core wall shall be 26-gauge with a minimum thickness of 0.017-inches, vertically ribbed with reentrant angles spaced not more than 3-inches apart with a depth of 3/8-inch and conforming to the requirements of ASTM A653/A653M. Weight of zinc coating shall be not less than G 90 of Table 1 of ASTM A653/A653M.
  - b. All vertical joints in the diaphragm shall be rolled seamed, crimped and sealed watertight using epoxy injection.
  - c. In all tanks designed to use a waterstop at the floor/wall joint, the steel shell diaphragm shall be epoxy bonded to the waterstop.

E. Elastomeric Materials:

1. Waterstops
  - a. Extruded from elastomeric plastic compound with virgin polyvinyl chloride as the basic resins.
  - b. Meet the performance criteria in the Corps of Engineers Specifications CRD-C572.
2. Elastomeric Bearing Pad
  - a. Neoprene or Natural Rubber Pad conforming to ASTM D2000, line call-outs 2BC415A14B14 and 4AA420AB respectively.

F. Moisture Barrier

1. Polyethylene Class A conforming to ASTM D-4397. The thickness shall not be less than 6 mil.

G. Seismic Cables Assembly

1. Seismic Cables: Epoxy-coated seven-wire stress-relieved wire meeting the requirements of ASTM A882.
2. Seismic Cable Sleeves: Medium grade closed cell neoprene conforming to 2A3 of ASTM D1056.

H. Lightning Protection and Grounding

1. The tanks shall be provided with lightning protection and grounding in accordance with JEA Electrical Standards

I. Identification

1. A Type 316 stainless steel nameplate mounted on the outside of the tank at eye level.
2. Information of the on the nameplate shall include: tank manufacturer, usable volume in million gallons (MG), inner diameter in feet, date of tank substantial completion, warranty expiration date (at a minimum the date approved by shop drawing) and interior coating system.

J. Wrap-Around Stairs

1. Stair stringers shall be aluminum mounted to cantilevered concrete intermediate landings.
2. Stairs shall be fabricated from 6061-T6 and 6063-T6 aluminum and shall conform to all applicable OSHA standards.
3. Aluminum accessories shall be shop fabricated and fully welded. All welding shall be in accordance with American Welding Society (AWS) D1.2 to fuse materials without distortion of the material. Mechanical splices shall only be used at field splice locations.
4. Aluminum shall have a "mill" finish.
5. Aluminum surfaces in contact with concrete shall be protected with a coat of bituminous paint.

K. Baffle Curtains

1. Each baffle shall be to withstand chlorine, extreme temperatures, abrasion and hydraulic shock, and shall have a prudent safety factor for all stresses that may occur during fabrication, erection, intermittent, or continuous 24-hour per day operation.
2. Baffles shall be provided by the ground storage tank manufacturer.
3. Materials
  - a. Baffle/curtain shall be NSF 61 certified.
  - b. Baffle/curtain material shall be 30 mil minimum polyester liner. Liner material shall be 8130 XR-3 PW as manufactured by Seaman Corporation, or approved equal.
  - c. Baffle/curtain shall have 3/8-inch, polypro rope in the top, bottom and sides for supporting ballast. The top edge shall have double 2 x 2 1/4 inch stainless steel angles bolted on each side of the reinforced hem with lifted points adequate to permanently suspend the curtain, spaced 6 feet on center. The fiberglass angle needs to be anchored every 3 feet on bottom and sides.
  - d. The baffle/curtain shall be supported by 5/8-inch 316 stainless steel weg-it eyebolts or 316 stainless steel embedded anchor cast into the roof, side and bottom slab at 6 feet on center, supplied and installed by the Contractor.
  - e. The baffle/curtain shall be attached to the sides and bottom anchorage with a 2 x 2 x 1/4-inch fiberglass angle at 3'-0" centers or a 2 x 2 x 3/16-inch stainless steel angle bolted to the side and bottom at 6'-0" centers. Curtain hem shall be doubled at both sides and bottom connections; bottom hem shall have an additional layer of material.

4. Baffles shall be installed in accordance with the manufacturer's recommendations as approved by the Engineer.

L. Ventilation fans:

1. General

- a. Quantity: 3 to be installed on the Ground Storage Tank No. 1 as shown on the Contract Drawings.
- b. Rating point: 9,000 cfm at 1.0" static pressure in water column
- c. Model: 28 D6 VP or engineer-approved equal
- d. Drive type: direct-drive
- e. Tank manufacturer shall be responsible for coordination with the fan supplier, including but not limited to: dimensions and connection, additional weight, air flow, and potential pressure impacts.
- f. Equipment shall be designed for corrosive environment, specifically exposure to hydrogen sulfide and reduced sulfur components.

2. Fans shall be tested and certified in accordance with ANSI/ASHRAE 51 and ANSI/AMCA 210 test codes and guaranteed by manufacturer to deliver at rated published performance levels.

3. Fan sound level shall be less than 73 dBA at 5 feet'. Fan sound data shall be included in submittal to Engineer.

4. Test each unit prior to shipment. Test certification(s) shall be provided to Engineer for approval prior to installation.

5. Fan shall be designed to meet wind load requirements or provided with tie downs to meet wind load requirements.

6. Fan Housing:

- a. Fan housing shall be arranged for vertical upblast exhaust construction.
- b. Fan housing shall be minimum 0.125-inch aluminum continuous welded seam construction.
- c. Fan shall have a welded aluminum stack cap with 316 SS hardware and Owner approved mechanically fastened insect gasketing.
- d. Fan shall be designed with a self-supported swing-out maintenance accessibility of motor & propeller utilizing triple post aluminum pipe supports, stainless steel De-Sta-Co door hardware, gasketed door, 316 SS door shaft with pillow block style flanged bearings, and aluminum sloped roller entry ramp with SS wheel.
- e. Fan curb cap shall be welded 0.125-inch aluminum with support gussets and 4-inch overlap on curb.

7. Fan Propeller:

- a. Propeller shall be vane axial style with heavy blade construction.
- b. The propeller shall be of sand cast A319 aluminum alloy, solid one-piece construction and dynamically and statically balanced.
- c. The propeller shall be secured to motor shaft with taper-lock bushing.
- d. Fabricated aluminum shield shall be installed behind propeller hub to direct airflow around motor.
- e. The propeller assembly shall be statically and dynamically balanced in accordance with ISO 1940-1973, "Balance Quality Grade Of G2.5". In addition, the fan

assembly shall be balanced after final assembly, in the fan casing, in accordance with ISO 1972.

8. Finish:

- a. The units, after fabrication, shall be cleaned and aluminum welds shall be brushed with non-ferrous wire cleaning brush.
- b. Fans shall be mill finished.

9. Fan Accessories:

- a. Provide NEMA 4X Non-Fused Disconnect, Mounted and Wired To Motor Junction Box When Specified On Scheduled
- b. Provide 316 SST Extended Lube Lines
- c. Provide 316 SST Nameplates and Assembly Hardware

10. Motors and Drives:

- a. Fan motors shall be UL listed suitable for severe mill and chemical duty, TEFC, premium efficient with IEEE-841 rating. Each motor shall be sized per the following:
- b. Motor Horsepower: Less than or equal to 3 hp
- c. Motor Speed: 1200 rpm
- d. Motor Design Voltage/Phase/Frequency: 460/3/60
- e. Duplicate motor junction box shall be mounted on exterior of each fan housing for electrical connection.
- f. Duplicate motor nameplate shall be mounted on each fan exterior.

M. Ventilation Fan Intake Hoods

1. Quantity: 3 to be installed on the Ground Storage Tank No. 1 as shown on the Contract Drawings.
2. Dimensions: 60" square intake hood with 28" square throat. Hoods shall be designed to fit concrete curbs. Hood manufacturer or representative shall field measure and verify existing concrete curb dimensions.
3. Hood roof shall have a cross break to create pitch for drainage.
4. Tank manufacturer shall be responsible for coordination with the supplier, including but not limited to: dimensions and connection, additional weight, air flow, and potential pressure impacts.
5. Equipment shall be designed for corrosive environment, specifically exposure to hydrogen sulfide and reduced sulfur components.
6. Provide 316 SST 24 mesh insect screen over openings.

N. Natural Draft Aerator

1. Material: fiberglass
2. Capacity: 10,000-gpm
3. Type: perforated 7-tray natural draft aerator suitable for contact with potable water
4. Fasteners shall be of 316 stainless steel.
5. A watertight circular fiberglass catch basin and roof, roof support columns, and polyester screen shall be provided for the aerator housing.

6. A minimum of six, 20-inch diameter downcomers shall be provided.
7. Downcomers shall be located at the low point next to the aerator housing to ensure complete drainage inside aerator housing. Ponding of water shall not be acceptable.
8. Downcomer piping shall extend within the tank dome by 3-inches such that water does not run down the inner sides of the dome which would result in short-circuiting.
9. Tray aerator shall be provided by the tank manufacturer.
10. A drain shall be provided for ease of cleaning the catch basin.
11. The anchoring of the aerator assembly shall be designed to match the wind loads of the ground storage tank with the exception of the screen panels which will be designed to detach.
12. Operator access to the aerator shall be provided with a hinged door. Hinges shall be Type 316 stainless steel. The access door shall also include provisions for a padlock for security.
13. A hose rack and bib to be provided at the top of the dome near the entrance of the tray aerator for periodic cleaning.

O. Coatings:

1. All interior and exterior surfaces of ground storage tanks shall be painted. The coatings of the tank shall be coated by the tank supplier and the tank supplier shall have system responsibility for all interior coatings. Subcontracting of this work is not allowed. Coatings shall be applied by coating manufacturer approved applicator.
2. Interior Coatings Requirements
  - a. All interior coatings shall be approved for contact with potable water and conforming to NSF 61.
  - b. Underside of dome and interior walls (full height)
  - c. Surface preparation: Sweep blast to CSP5.
  - d. Surfacer across the interior wall and dome surface to fill all bug holes and coat all peaks: Sherwin-Williams Dura-Plate 2300 or Tnemec 218 MortarClad at 1/16-inch to 1/8-inch above all peaks.
  - e. Conduct a detailed inspection of the surfacer application paying attention to bug holes that have not been properly covered.
  - f. Apply a second application of surfacer (Sherwin-Williams Dura-Plate 2300 or Tnemec 218 MortarClad) to areas where bug holes are discovered. Assume 1,000 square feet of surfacer is required per tank.
  - g. Prime Coat: Sherwin-Williams 5500 Macropoxy or Tnemec Series 20HS Pota-Pox at 5.0 to 8.0 mils DFT.
  - h. Apply a third application of surfacer (Sherwin-Williams Steel Seam FT910 or Tnemec Series 217 Mortarcrete) to areas where bug holes are discovered. Assume 500 square feet of surfacer is required per tank.
  - i. Stripe Coat: All concrete edges and sharp points shall be coated with a brush or roller to within 3-inches of the edge with Sherwin-Williams 5500 Macropoxy or Tnemec Series 20HS Pota-Pox .
  - j. Top Coat: Sherwin-Williams Duraplate UHS White or Tnemec Series 22 Pota-Pox 100 at 18-22 mils DFT.
  - k. "Holiday" test the entire surface.
  - l. Repair any pinholes with Duraplate UHS or Tnemec Series 22 Pota-Pox 100.



3. Interior floor
  - a. Surface preparation: Sweep blast to ICRI CSP3.
  - b. Prime Coat: Sherwin-Williams 5500 Macropoxy or Tnemec Series 20HS Pota-Pox at 5.0 to 8.0 mils DFT.
  - c. Apply surfacer (Sherwin-Williams Steel Seam FT910 or Tnemec Series 217 Mortarcrete) to areas where bug holes are discovered. Assume 200 square feet of surface is required per tank.
  - d. Stripe Coat: All concrete edges and sharp points shall be coated with a brush or roller to within 3-inches of the edge with Sherwin-Williams 5500 Macropoxy or Tnemec Series 20HS Pota-Pox at 5.0 to 8.0 mils DFT .
4. Top Coat: Sherwin-Williams Dura-Plate UHS White or Tnemec Series 22 Pota-Pox 100 at 18-22 mils DFT.
5. All interior metal surfaces included pipes and pipe supports
  - a. Surface preparation: Pressure wash at 4,000 psi and abrade primer with sandpaper to develop a surface profile.
  - b. Prime Coat: Sherwin-Williams Dura-Plate UHS OAP Blue primer at 4.0 to 6.0 mils DFT
  - c. Stripe Coat: All edges and sharp points shall be coated with a brush roller to within 3 inches of the edge with Sherwin-Williams Dura-Plate UHS Primer Gold 4.0 to 6.0 mils DFT.
  - d. Spot Prime: Dura-Plate UHS Primer Gold at 4.0 to 6.0 mils DFT.
  - e. Top Coat: Sherwin-Williams Duraplate UHS White or Tnemec Series 22 Pota-Pox 100 at 18-22 mils DFT.
6. Exterior Coatings Requirements
  - a. Provide an elastomeric breathable coating for the exterior of the tank (walls and dome). Exterior coating shall be a modified waterborne acrylate applied to two coats.
  - b. Surface preparation: Remove all contaminants by powerwashing per SSPC-SP1.
  - c. First Coat
    - 1) Tnemec 156 Enviro-crete – 5 mils DFT; or
    - 2) Sherwin-Williams, Loxon XP (smooth) – 6 mils DFT.
  - d. Second Coat
    - 1) Tnemec Series 156 Enviro-crete – 5 mils DFT; or
    - 2) Sherwin-Williams, Loxon XP (smooth) – 6 mils DFT.
  - e. Acceptable colors for exterior coatings:

Location	Tank Type	Color Code
Dome	Potable	Federal Standard 33617
Walls	Potable	Federal Standard 33617
Top of Wall Ring	Potable	Federal Standard 25230

7. Manufacturers' recommendation for surface preparation, primer, and coatings shall be strictly adhered to.

P. Epoxy

1. Epoxy Sealants:

- a. Epoxy shall conform to the requirements of ASTM C881/C881M.
- b. Epoxy used for sealing the diaphragm shall be Type III, Grade 1, and shall be 100% solids, moisture insensitive, low modulus epoxy.
- c. Epoxy used for placing the waterstop shall be Type II, Grade 2, and shall be 100% solids, moisture insensitive, low exotherm epoxy.
- d. When pumped, maximum viscosity of the epoxy shall be 10 poises at 77°F.
- e. The epoxy sealants used in the tank construction shall be suitable for bonding to concrete, shotcrete, PVC and steel.

2. Bonding Epoxy:

- a. Epoxy resins used for enhancing the bond between fresh concrete and hardened concrete shall conform to the requirements of ASTM C881/C881M.
- b. Epoxy resins shall be a two-component, 100% solids, moisture-insensitive epoxy and shall be Type II, Grade 2.

Q. Appurtenances:

1. Ladders

- a. Material: fiberglass interior tank ladder
- b. Hardware: Type 316 stainless steel safety post and Type 316 stainless steel safety climb device, belt and rail extension. The side rails shall be punched to receive rungs and rungs shall be mechanically secured to the side rails.
- c. The ladder shall conform to all OSHA requirements.
- d. A locking aluminum box adjacent to the roof hatch to store the safety climb device rail extension and safety climb belt.

2. Anti-Vortex Plate

- a. Material: Fiberglass
- b. Diameter: 8-feet
- c. Reference standard: Hydraulic Institute Standards Section 9.8, Figure A.13.

3. Roof Hatch:

- a. Material: Fiberglass
- b. Main clear opening of 6-feet square and an internal, hinged, 3-foot square clear opening hatch.
- c. Design Live Load: 40 psf
- d. Hatch:
  - 1) Provide hold open device that shall automatically lock when the door is in the fully opened position.

- 2) Springs: Stainless steel.
  - 3) Provide spring latch and padlock hasp.
  - 4) Provide stainless steel hardware throughout.
  - 5) Provide stainless steel anchor system for attachment to concrete curb on roof.
  - 6) Provide continuous 1/4-inch thick, 60 durometer neoprene sheet gasket under hatch flange. Fasten flange through gasket.
  - 7) Make watertight.
4. Handrail and Non-Slip Walkway:
  - a. Handrail Material: 6061 T6 aluminum
  - b. Railing: Extend a minimum of six feet on either side of the exterior bridge platform.
  - c. Handrail: Provide vertical posts, kick plate, mid rail and a top rail 42-in in height that extends from the bridge platform landing to the aerator housing. Provide perimeter handrails at dome edge and aerator platform as well as grab rails at the hatch
  - d. Provide non-slip walkway that extends from the bridge platform landing to the aerator housing.
5. Wall Manways:
  - a. Watertight rectangular shape made of Type 316 stainless steel.
  - b. Clear Opening: 3-ft vertical by 5-ft horizontal minimum.
  - c. Cover plate with a stainless-steel hinge shall be mounted on the inside.
  - d. Provide gasket between manway cover and wall sleeve and attached to the manway cover.
  - e. Manway's to be located for ease of access to the tank drains.
  - f. Maximum height from the bottom of the manway opening to the interior footer shall be 2 foot-0 inches.
  - g. Maximum height from the bottom of the manway opening to exterior grade shall be 1 foot-0 inches.
6. Liquid Level Indicator:
  - a. Half travel gauge with an interior float.
  - b. Glass: Fiberglass with 4-in black numbers on a white board.
  - c. Level Indicator: Red fiberglass target.
  - d. Zero Mark: Set even with the top of the tank wall.
  - e. Interior Float: Fiberglass or PVC guided vertically true.
7. Pipe support brackets in tank shall be stainless steel. See Drawings for pipe required and provide supports to rigidly hold the pipe.
8. Through-wall pipe sleeves shall be Type 316 stainless steel sleeves with neoprene modular seal units.
9. Concrete dome overflow/vents with 316 SST mesh 24 insect screens
10. Sample Piping and Valves
  - a. Quantity: 3 sample pipes and sample taps configured and constructed at the location indicated on drawings (one in each baffle area of the tank)

- b. Sample piping inside of the tank shall be Sch 80 PVC
- c. Sample piping through the wall and outside of the tank shall be Sch 80, Type 316 stainless steel and provided with appropriate insulation to prevent freezing.
- d. Threading is not permitted at the sample piping outlet. Ensure ball valve handle does not conflict with spigot.

11. Instrument Probe Curbs

- a. Include a concrete curb or precast cylinder in the dome for mounting a 4-inch flanged by plain end Type 316 stainless steel roof pipe.
- b. The roof pipe shall have a blind flange on the exposed end above the roof.
- c. Instruments shall include high and low level float switches inside of the ground storage tank.
- d. Include 8" concrete curb in the dome for mounting future equipment.

12. Settlement Monument

- a. Provide settlement monuments mounted on top of the footer (four) at 90-deg increments to survey and monitor total, differential, and angular settlement for compliance with ACI 372R and settlement estimates. The Contractor shall be responsible to perform a Pre-loading program as described on sheet M-2.

2.3 PERFORMANCE AND DESIGN CRITERIA:

A. Tank Construction

- 1. Floor: Non-prestressed cast-in-place reinforced concrete
- 2. Minimum thickness of the floor slab is 4-in.
- 3. Provide thickened edge for the exterior wall footing. Footings for interior walls shall be thickened areas in the slab.
- 4. Floor Slabs less than 6-inches: Provide single layer of reinforcement in each direction.
- 5. Floor Slabs greater than 6-inches: Provide top and bottom reinforcement in each direction.
- 6. Provide a minimum percentage of 0.60% reinforcing steel in the floor. The minimum percentage shall apply to all thickened sections and shall extend a minimum of two feet into the adjacent floor.
- 7. The transition from the bottom of the footings and pipe encasements to the underside of the floor slab shall not be steeper than 2 horizontal to 1 vertical. The pipe encasements shall not be less than the OD of the pipe plus 24-in. The clearance in all directions shall not be less than 12-in. Pipe encasements shall be as shown on the on the Drawings.
- 8. Floor/Wall Joint -Translation and rotation allowed
- 9. Wall: Type II Shotcrete core wall with metal diaphragm
- 10. Horizontal prestressing shall be continuous. Discontinuous prestressing tendons or strands will not be allowed.
- 11. Wall/Roof Joint - Fixed
- 12. Dome:
  - a. Cast-in-place concrete dome with a minimum thickness of 3-inches. Dome shall have one-tenth rise and be free-span. Provide a minimum percentage of 0.25% reinforcing steel in the dome.

- b. All surfaces at the joint between the wall and the dome shall be coated with bonding epoxy which complies with requirements in Section 2.2.
- c. The exterior surface of the dome shall receive a light broom finish.
- d. The dome roof design shall take into consideration a minimum of six 20-inch diameter downcomers. The downcomers shall be located at the low point next to the aerator housing to ensure complete drainage inside aerator housing.

B. Design Loads:

- 1. Minimum loading in the design of the tank(s) and tank appurtenances:
- 2. Unit Weights:
  - a. Concrete and Shotcrete - 150 pcf
  - b. Soil - 120 pcf
  - c. Water - 62.5 pcf
  - d. Steel - 490 pcf
- 3. Snow Load – Determined in accordance with ASCE 7-10 using the following minimum parameters:
  - a. Risk Category: III
  - b. Ground Snow Load (Pg): 15psf
  - c. Exposure Category: C
  - d. Exposure Factor: 1.0
  - e. Thermal Factor: 1.2
  - f. Importance Factor: 1.1
- 4. Live Load:
  - a. Floor - 62.4 psf times the height of water to overflow plus 6-in
  - b. Roof - 20 psf - horizontal projection to tank roof
- 5. Wind Load:
  - a. Ultimate Design Wind Speed - 120 mph
  - b. Normal Design Wind Speed: 93 mph
  - c. Exposure Category - C
- 6. Earth Pressure:
  - a. Equivalent fluid pressure above groundwater level - 1 ft above bearing elevation of clearwell floor
  - b. Live Load surcharge equivalent to 2-ft earth
- 7. Allowable Bearing Pressure: 2,400 psf

C. Seismic Criteria:

- 1. Risk Category: III
- 2. Importance Factor: 1.25
- 3. Structure Coefficient:

- a. Mapped Spectral Response Coefficients:  $S_S = 0.136$ ,  $S_I = 0.067$
- 4. Site Class: C
- 5. Seismic Forces
  - a. Calculate forces and moments resulting from water sloshing and seismic accelerations of roof, wall and water loads in accordance with AWWA D110.
  - b. If sufficient freeboard height is not provided to prevent uplift forces due to sloshing, the tank roof and its connections shall be designed for the uplift forces in accordance with AWWA D110.
- 6. Ventilator(s) Capacity Requirements
  - a. Normal Operation:
    - 1) Maximum fill rate – 2,050 cfm
    - 2) Maximum draw down rate – 2,050 cfm
  - b. Emergency Condition:
    - 1) Rapid draw down rate – 3,070 cfm
    - 2) Maximum pressure differential on tank components for the design of vents shall be plus or minus 6-in of water
- D. Section 014000 - Quality Requirements specifies testing, inspection, and analysis requirements.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Overexcavation and Replacement
  - 1. Refer to the Drawings for the limits of overexcavation and replacement for the structure foundation.
- B. Reinforcing Steel
  - 1. Reinforcing steel: Install in accordance with the CRSI, Code of Standard Practice.
- C. Placing Concrete
  - 1. General Placement
    - a. Cast-in-place concrete floor and interior wall(s): Install in accordance with ACI 318 and ACI 350R except as specified herein.
    - b. No concrete shall be mixed or placed during freezing weather without explicit permission. When placing concrete when air temperature is below 40 degrees F, the water, sand and gravel shall be heated so that the temperature of the concrete will be at least 50 degrees F. This temperature shall be maintained for 72 hours after placing. No concrete shall be placed on frozen ground.

- c. In hot weather, concrete, when deposited, shall have a placing temperature that will not cause difficulty from loss of slump, flash set, or formation of cold joints. In no case shall the temperature of concrete being placed exceed 90 degrees F.

2. Floor Slab

- a. Prior to placement of the floor slab, a 6 mil polyethylene moisture barrier shall be placed over the subbase. Joints in the polyethylene shall be overlapped a minimum of 6-in.
- b. The floor slab including the thickened portion for the wall footing shall be placed in one continuous concrete placement. Construction joints between the floor slab and footings shall not be allowed. Where a construction joint is approved in writing by the Engineer, the joint shall have 6-in wide, 3/8-in thick PVC waterstop conforming to the same requirements as the wall - base slab waterstop.
- c. The tank floor shall be wood/bull float finished first. Floor shall receive a soft broom finish. No water shall be added to the slab during finishing. Curing of the tank floor shall be accomplished by ponding the entire area within the waterstops with 2-in minimum of water within 24 hours after concrete placement. The floor shall be kept ponded for a minimum of 7 days.

3. Roof Slab

- a. The cast-in-place dome roof shall be wood float finished and then receive a light broomed surface finish. No water shall be added during the finishing of the dome roof.

D. Core Walls

1. Prestressed Core wall(s)

- a. Exterior wall, inner tank wall and exterior dome tension ring details including the steel diaphragm, PVC waterstops, elastomeric bearing pads, sponge rubber fillers, prestressing steel, prestressing earthquake cables, and shotcrete shall conform to the requirements of AWWA D110.
- b. A PVC waterstop shall be installed in the wall to base joint as shown on the Drawings. Field splices shall be in accordance with the manufacturer's specifications. The waterstops shall be installed so as to form a continuous watertight dam. Adequate provisions shall be made to support and protect the waterstop during the progress of the work. Where the waterstop is placed in a concrete cove attached to the inner face of the wall, the cove shall attain 60 percent of its 28-day strength prior to the start of prestressing the wall.
- c. Circumferential Prestressing
  - 1) Stress readings on a calibrated stressometer, furnished by the tank manufacturer, shall be made on every tenth prestressing wire [or strand], or a minimum of one reading per vertical foot for each layer. A running log shall be maintained by the tank manufacturer of the stress readings and used to determine the final number of wires required.
  - 2) In computing the final tension in the wires, an allowance for prestress loss due to creep, shrinkage, elastic deformation, and residual compression shall be provided for. The tank manufacturer shall submit an "as-built" revision to

the design diagram showing the location and number of wires actually used for the project records only.

d. Shotcreting

- 1) No prestressing wire shall remain exposed during inclement weather over a holiday or weekend, it shall be covered with shotcrete and subsequently wet cure.
- 2) Vertical shooting wires shall be installed to establish uniform and correct thickness of shotcrete. Shooting wires shall be at 2-ft on center around the circumference of the tank. The final coat shall be applied true to shooting wires so as to form a cylindrical surface.
- 3) At the end of the day's work, or similar stoppage period, the shotcrete shall be sloped off at an angle of approximately 45 degrees. Before placing adjacent sections, the sloped portions shall be thoroughly cleaned and wetted by means of air and water blast. Shotcrete with a strength lower than specified shall be removed and replaced with sound material.
- 4) The shotcrete shall be cured by keeping the shotcrete continuously wet for 7 days. Natural curing may be allowed if the relative humidity is at or above 85 percent.
- 5) Dry mix/wet mix shotcrete shall receive a gun finish free from ridges or other defects. Flash coating for finishing will not be permitted.

E. Baffle Curtains

1. The baffles shall be suitable for installation in the ground storage tank as shown on the Contract Drawings and shall conform to the dimensions and clearances shown.
2. The baffles shall include custom fabricated reinforced geomembrane curtain material, anchor bolts and all necessary appurtenances. Each baffle shall be tested to withstand chlorine, extreme temperatures, abrasion and hydraulic shock, and shall have a prudent safety factor for all stresses that may occur during fabrication, erection, intermittent, or continuous 24-hour per day operation. Baffles shall be provided by the ground storage tank contractor.
3. All submerged materials, except anchors and hardware, shall be non-corroding plastics. Anchor bolts and hardware shall be manufactured from 316 Stainless Steel.
4. The manufacturer shall provide written certification to the Engineer that all equipment furnished complies with all applicable requirements of these specifications and has been in use in similar applications for a minimum of 5 years.
5. Materials
  - a. Baffle/curtain shall be NSF 61 certified.
  - b. Baffle/curtain material shall be 30 mil minimum polyester liner. Liner material shall be 8130 XR-3 PW as manufactured by Seaman Corporation, or approved equal.
  - c. Baffle/curtain shall have 3/8-inch, polypro rope in the top, bottom and sides for supporting ballast. The top edge shall have double 2 x 2¼ inch stainless steel angles bolted on each side of the reinforced hem with lifted points adequate to permanently suspend the curtain, spaced 6 feet on center. The fiberglass angle needs to be anchored every 3 feet on bottom and sides.



- d. The baffle/curtain shall be supported by 5/8-inch 316 stainless steel wedge bolts or 316 stainless steel embedded anchor cast into the roof, side and bottom slab at 6 feet on center, supplied and installed by the Contractor.
- e. The baffle/curtain shall be attached to the sides and bottom anchorage with a 2 x 2 x 1/4-inch fiberglass angle or a 2 x 2 x 3/16-inch stainless steel angle bolted to the side and bottom at 6'-0" centers. Curtain hem shall be doubled at both sides and bottom connections; bottom hem shall have an additional layer of material.
- f. Baffles shall be installed in accordance with the manufacturer's recommendations as approved by the Engineer.

F. Wrap-Around Staircase and Platform

- 1. Designed and installed by tank manufacturer.
- 2. Material to be aluminum, hardware shall be 316ss in accord with specification Section 055000, Metal Fabrications.
- 3. Handrail in accord with specification Section 055200, Metal Railings.
- 4. Provide lockable gate at top of the platform.
- 5. Stairs, platforms, and railing shall comply with OSHA and local building codes.

G. Ladders

- 1. Ladders shall be installed at locations shown on the Drawings. Ladders, ladder accessories and ladder clearances shall be installed to conform to the requirements of OSHA.
- 2. Ladder supports shall be installed by stainless steel expansion bolts or stainless-steel bolts with cast-in-place threaded inserts. Prior to installing expansion bolts, the reinforcing bars shall be located with a "rebar locator" supplied by the tank manufacturer. The location of the reinforcing bars shall be marked on the concrete surface indicating the spacing and direction of the bars.
- 3. Where interference occurs, adjust anchor locations to clear reinforcing bars and alter supports at no additional cost to the Owner.

H. Roof hatches

- 1. Roof hatch(es) shall be installed at locations shown on the Drawings. The hatches shall be installed on a concrete curb with a minimum height of 4-in and a minimum of 4-in wide. The hatches shall be installed with a watertight gasket and stainless-steel expansion bolts.

I. Handrail.

- 1. Handrail shall be installed at locations shown on the Drawings. The handrails shall be installed to conform to the requirements of OSHA.
- 2. Installation of the handrails shall be either by stainless steel expansion bolts or cast-in-place threaded inserts. Prior to installing expansion bolts, the reinforcing bars shall be located with a "rebar locator" supplied by the tank manufacturer. The location of the reinforcing bars shall be marked on the concrete surface indicating the spacing and direction of the bars.
- 3. Where interference occurs, adjust anchor locations to clear reinforcing bars and alter supports at no additional cost to the Owner.

4. Handrail attached to the precast or cast-in-place dome roof shall be installed with stainless steel bolts and thin slab ferrule inserts. Expansion bolts shall not be allowed.

J. Ventilation Fans

1. Ventilator fans shall be installed at locations shown on the Drawings. The fans shall be installed on a concrete curb with a minimum height of 4-in and a minimum of 4-in wide. The ventilators shall be installed with a watertight gasket, stainless steel expansion bolts and a security device.
2. Inlet and outlet flanges shall be continuously welded to fan casing constructed of heavy gauge aluminum angle rings.
3. Concentricity of fan casing shall be ensured through use of welding jigs and fixtures.
4. Guide vanes shall be integrally welded with the outer housing providing a substantial weldment.

K. Fan Intake Hoods and Eyelid Ventilators

1. Hoods shall meet the wind load requirement as shown on the structural drawings. The calculations shall be performed by a professional engineer registered in the State of Florida and submitted to the Engineer for approval.
2. The eyelid ventilators shall be installed at locations shown on the Drawings. The invert of the eye lid ventilators shall be installed 6-in above the design overflow elevation.

L. Wall Manway(s)

1. Manway(s) shall be installed at locations shown on the Drawings.
2. The wall manway shall have an interior ladder to the bottom of the tank and shall have a grab bar installed above the center line of the manway of the same material as the ladder.

M. Liquid Level Indicators

1. Liquid level indicators shall be installed at locations shown on the Drawings.

N. Coatings

1. All coatings shall be applied a minimum of 28 days after final application of concrete and shotcrete, and after completion of leak testing and drying of concrete in accordance with Section 3.3.B.
2. The tank manufacturer shall be responsible for the paint and coatings. The tank construction company shall apply and have system responsibility for all interior and exterior coatings and shall not subcontract the work.
3. Application procedures for coatings shall meet the requirements of Section 2.2 and the manufacturer's recommendations.
4. The interior coating systems shall be designed for a corrosive hydrogen sulfide environment resulting in a pH of 3.0 or greater.
5. Tank manufacturer shall issue a 10-year warranty on internal and external coating system directly to the Owner from date of substantial completion. The coating manufacturer shall provide a letter to the Owner documenting that coatings were applied in accordance to the coating manufacturer's recommendations.
6. Installation Standards: Install Work according to AWWA D110 standards.

### 3.2 TOLERANCES

- A. Section 014000 - Quality Requirements specifies requirements for tolerances.
- B. Maximum Variation from Plumb <0.1%.
- C. Maximum Offset from Indicated Alignment: <0.1%.

### 3.3 FIELD TESTING

#### A. Compression Testing

- 1. Compression tests specimens shall be taken during construction from the first placement of each class of concrete specified herein and at intervals thereafter as selected by the Engineer to ensure continued compliance with these Specifications. At least one set of test specimens shall be made for each 50 cubic yards of shotcrete and every 100 cubic yards of concrete placed. Each set of test specimens shall be a minimum of 5 cylinders.
- 2. Compression test specimens for concrete/shotcrete shall conform to ASTM C172/C172M for sampling and ASTM C31/C31M for making and curing test cylinders. Test specimens shall be 6-inch diameter by 12-inch high or 4-inch diameter by 8-inch high cylinders.
- 3. Compression test shall be performed in accordance with ASTM C39/C39M. Two test cylinders will be tested at 7 days and two at 28 days. The remaining cylinder will be held to verify test results, if needed.

#### B. Testing the Completed Tank(s)

- 1. After the tank has been completed, but before any backfill is placed, the tank shall be filled slowly in the presence of the Engineer. Filling of the tank shall be completed in 25% increments in accordance with the pre-loading program indicated on Drawing M-2. Careful observation for leaks shall be made and any leaks that occur shall be immediately repaired.
- 2. The tank shall be kept full of water until the Engineer is satisfied that all defects have been discovered and repaired. There shall be no flowing water allowed through the walls or floor slab. Damp spots that glisten on the surface of the tank(s) and spots where moisture can be picked up on a dry hand will not be allowed. Damp spots on the top of footing projections that are not from flowing water shall not be considered to be leakage.
- 3. The maximum allowable leakage for a 24-hour period, after a 48-hour period, in which the entire tank interior surface has been wetted, shall not exceed 0.05 percent of the tank volume. If the liquid volume loss exceeds this amount, leakage shall be considered excessive and the tank shall be repaired and retested.
- 4. All water for the first test will be furnished by the Owner. However, Contractor shall be responsible for supplying water to the tank at means acceptable to the Owner. A meter can be placed on well discharge to monitor flow for construction purposes. The Owner shall be reimbursed for water required for retesting at the normal water rate. The use of this water supply shall be such that it does not adversely affect the normal pressure and flow in the distribution system. If additional pumps, piping, or valves are needed Contractor shall supply and install for testing.
- 5. Leakage testing with water and drying of concrete will be completed prior to coating application.

### 3.4 ADJUSTING

- A. Section 017300 - Execution specifies requirements for starting and adjusting.

### 3.5 CLEANING AND DISINFECTION

- A. Section 017300 - Execution specifies requirements for cleaning.
- B. The tank(s) shall be disinfected in accordance with AWWA C652, Chlorination Method 2, or JEA-preferred method and as specified herein.
- C. The Contractor shall provide all labor, material, and facilities required to chlorinate the tank(s).
- D. The chlorine solution shall be applied directly to all surfaces of the tank(s) including the underside of the roof by spray equipment.
- E. Two alternatives are allowed for disinfection as follows:

- 1. Chlorination Method 1. The water-storage facility shall be filled to the overflow level with potable water to which enough chlorine shall be added to provide a free chlorine residual in the full facility of not less than 10mg/L at the end of a 24-hour period. The chlorine, either as calcium hypochlorite or sodium hypochlorite, shall be introduced into the water as described below.

Sodium hypochlorite use. Sodium hypochlorite shall be added to the water entering the storage facility by means of a chemical-feed pump or shall be applied by hand-pouring into the storage facility and allowing the influent water to provide the desired mixing. When a chemical-feed pump is used, the concentrated chlorine solution shall be pumped through an appropriate solution tube so as to inject the high-concentration in the filling water. The solution tube shall be inserted through an appropriate valve located on the inlet pipe and near the storage facility, or through an appropriate valve located on the storage facility such that the chlorine solution will mix readily with the filling water. When sodium hypochlorite is poured into the storage facility, the filling of the storage facility shall begin immediately thereafter or as soon as any removed manhole covers can be closed. Sodium hypochlorite may be poured through the cleanout or inspection manhole in the lower course or level of the storage facility, in the riser pipe of an elevated tank, or through the roof manhole. Sodium hypochlorite shall be poured into the water in the storage facility when the water is not more than 3 ft. (0.9 m) in depth, nor less than 1 ft. (0.3 m) in depth or as close thereto as manhole locations permit.

Calcium hypochlorite use. Calcium hypochlorite granules or tablets broken or crushed to sizes not larger than ¼ in (6.4 mm) maximum dimension may be poured or carried into the storage facility through the cleanout or inspection manhole in the lower course or level of the storage facility, into the riser pipe of an elevated tank, or through the roof manhole. The granules or tablet shall be located so that the influent water will circulate through the calcium hypochlorite, dissolving it during the filling operation. The calcium hypochlorite shall be placed only on dry surfaces unless adequate precautions are taken to provide ventilation or protective breathing equipment.

Retention period. After the storage facility has been filled with the disinfecting water, it shall stand full as follows: for a period of not less than 24 hr. when the storage facility has been filled with water that has been mixed with sodium hypochlorite or calcium hypochlorite within the storage facility.

Handling of disinfection water. After the retention period, the free chlorine residual in the storage facility shall be reduced to a concentration appropriate for distribution by completely draining the storage facility and refilling with potable water, or by a combination of additional holding time and blending with potable water having a lower chlorine concentration. Following this procedure and subject to satisfactory bacteriological testing, appropriate chlorine residual, and acceptable aesthetic water quality, the water may be delivered to the distribution system.

The environment into which the chlorinated water is to be discharged shall be inspected, and if there is any likelihood that the chlorinated discharge will cause damage, a reducing agent shall be applied to the water to be discharged to neutralize the chlorine residual in the water. Federal, state or provincial, and local environmental regulations may require special provision or permits prior to disposal of highly chlorinated water. Proper authorities should be contacted prior to disposal of highly chlorinated water.

2. Chlorination Method 2. A solution of at least 200- mg/L available chlorine shall be applied directly to the surfaces of parts of the storage facility that would be in contact with water when the storage facility is full to the overflow elevation.

Method of application. The chlorine solution may be applied with suitable brushes or spray equipment. The solution thoroughly coat surfaces to be treated, including the inlet and outlet piping, and shall be applied to any separate drain piping such that it will have available chlorine of not less than 10 mg/L when filled with water. Overflow piping need not be disinfected.

Retention. The disinfected surfaces shall remain in contact with the strong chlorine solution for at least 30 min. after which potable water shall be admitted, the drain piping purged of the 10-mg/L chlorinated water, and the storage facility then filled to its overflow level. Following this procedure and subject to satisfactory bacteriological testing, appropriate chlorine residual, and acceptable aesthetic water quality, the water may be delivered to the distribution system.

Adding chlorine. Chlorine shall be added to the storage facility by the method described above. The actual volume of the 50-mg/L chlorine solution shall be such that, after the solution is mixed with filling water and the storage facility is kept full for 24 hr., there will be a free-chlorine residual of not less than 2 mg/L.

### 3.6 PROTECTION

- A. Section 017300 - Execution specifies requirements for protecting finished Work.

END OF SECTION 434163

FORM 434163-A  
P.E. CERTIFICATION FORM

The undersigned hereby certifies that the undersigned is a professional engineer licensed in the  
State of Florida and that has been employed by

\_\_\_\_\_ to design  
(Name of Contractor)

one 2.0 MG wire- wrapped, prestressed concrete in conformance with Section 434163 for the **Rivertown  
Water Treatment Plant Project.**

The undersigned further certifies that the undersigned has performed the design of one 2.0 MG Ground  
Storage Tank No. 1, that said design is in conformance with all applicable local, state and federal codes,  
rules, and regulations, including the requirements AWWA D110 and that its signature and P.E. stamp  
have been affixed to all calculations and drawings used in, and resulting from, the design.

- A. The undersigned hereby agrees to make all “as-built” design drawings and calculations available  
to the Owner's representative within seven days following written request therefor by the  
Owner.

\_\_\_\_\_  
P.E. Name

\_\_\_\_\_  
Contractor's Name

\_\_\_\_\_  
Signature

\_\_\_\_\_  
Signature

\_\_\_\_\_  
Address

\_\_\_\_\_  
Title

\_\_\_\_\_  
Address

## SECTION 463342 – DIAPHRAGM-TYPE METERING PUMPS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Provide chemical metering pumps as shown on the drawings and as specified herein.
- B. All chemical metering pumps shall be pre-engineered and as specified herein as manufactured by Grundfos to align with JEA Water and Wastewater Standards Manual, latest edition.
  - 1. Two chemical metering pumps for sodium hypochlorite for disinfection in the chemical building
- C. The work includes, but is not limited to, the purchase and installation of new equipment as shown on the drawings and specified herein.

#### 1.3 RELATED REQUIREMENTS

- A. Section 013300 “Submittals”.
- B. Section 017823 “Operation and Maintenance Data”.
- C. Section 407000 “Instrumentation for Process Systems”
- D. Section 330531.16 “Polyvinyl Chloride Pressure Pipe for Water Service”.
- E. Electrical work not herein specified is included in Division 26. A 120 volt/1 phase power supply will be provided under Division 26 to each dual metering pump control panel, as shown on the drawings.
- F. Electric motors shall be furnished as part of the work of this section and shall be in accordance with Division 26.

#### 1.4 SUBMITTALS

- A. Copies of all materials required to establish compliance with the Specifications shall be submitted in accordance with the provisions of Section 013300. Submittals shall include at least the following:

1. Data on the characteristics and performance of all pumps, including Manufacturer's certified rating data.
2. Certified shop drawings showing all important details of construction, dimensions, and anchor bolt locations.
3. Descriptive literature, bulletins, and/or catalogs of the equipment.
4. The total weight of the equipment.
5. A complete total bill of materials.
6. A list of the manufacturer's recommended spare parts with the manufacturer's current price for each item. Include gaskets, packing, etc. on the list.
7. All information required by Section 013300.
8. Complete data on motors in accordance with Division 26.
9. Complete wiring diagrams and schematics of each control panel, controllers, control device and operator's station furnished under this section.
10. Complete wiring diagrams and schematics of all power and control systems showing wiring requirements between all system components, motors, sensors, control panels, etc., including connections to work of other sections.
11. Data on noise.
12. The recommended grades of lubricants, along with references to alternative equal products by other manufacturers.
13. Certification by the supplier that the equipment and materials to be provided are suitable for the service intended.
14. A complete description of chemical resistance of the component materials that will come in contact with chemicals, as specified herein.
15. A letter of certification from the supplier that the chemical metering skid system design and installation are sufficient for satisfactory operation of the metering system.
16. In the event that it is impossible to conform with certain details of the Specifications due to different manufacturing techniques, describe completely all non-conforming aspects.

B. Operating and Maintenance Data and Training:

1. Operating and maintenance instructions shall be furnished to the Engineer as provided in Section 017823. The instructions shall be prepared specifically for this installation and shall include all required cuts, drawings, equipment lists, descriptions, etc. that are required to instruct operating and maintenance personnel unfamiliar with such equipment.
2. A factory representative who has a complete knowledge of the proper operation and maintenance shall be provided for a minimum of 1 full day solely to instruct representatives of the Owner and Engineer on proper operation and maintenance of the equipment. If there are difficulties in operation of the equipment due to the manufacturer's design or fabrication, additional service shall be provided at no additional cost to the Owner.
3. The technical representative shall have at least four years of experience in chemical system training and instruction. Training sessions shall be scheduled not less than two weeks in advance. Written training materials consisting of the final O&M manuals shall be provided to each of the Owner's personnel in attendance and shall remain with the trainees.

1.5 REFERENCE STANDARDS

A. National Electrical Manufacturers Association (NEMA)



- B. American Society for Testing and Materials (ASTM)
- C. American National Standards Institute (ANSI)
- D. Anti-Friction Bearing Manufacturers Association (AFBMA)
- E. American Welding Society (AWS)
- F. Occupational Safety and Health Administration (OSHA)
- G. Underwriters Laboratories (UL)
- H. Where reference is made to one of the above standards, the revision in effect at the time of contract award shall apply.

#### 1.6 QUALITY ASSURANCE

- A. The pumps covered by these Specifications are intended to be standard pumping equipment, as modified by these Specifications, of proven ability, as manufactured by a single manufacturer, having long experience in the production of such pumps. The pumps furnished shall be designed, constructed, and installed in accordance with the best practices and methods, and shall operate satisfactorily when installed as specified herein and shown on the drawings.
- B. Should equipment which differs from these Specifications be offered and approved by Engineer and Owner as equal to that specified, such equipment shall be acceptable only on the basis that any revisions in the design and/or construction of the structure, piping, appurtenant equipment, electrical work, etc. required to accommodate such a substitution shall be made at no additional cost to the Owner and be as approved by the Owner, and Engineer.

#### 1.7 SYSTEM DESCRIPTION

- A. Sodium Hypochlorite – Disinfection
  - 1. The 10% to 15% commercial sodium hypochlorite solution from the two 6000-gallon double wall high density crosslinked polyethylene tanks (HDXLPE) shall be fed without dilution to one primary application point in the injection vault.
  - 2. For the primary disinfection application points in the injection vault, the variable speed pumps will be controlled by the plant SCADA system based on the raw water flow rate and on the finished water chlorine analyzer.
- B. Refer to the Process and Instrumentation Diagrams in the Drawings for specific control requirements of the chemical pump systems.

#### 1.8 TOOLS AND SPARE PARTS

- A. All special tools required for normal operation and maintenance shall be furnished with the equipment.

- B. Manufacturer's Preventive maintenance kit shall include the following spare parts at a minimum:
  - 1. One diaphragm assembly.
  - 2. Two sets of valve gaskets, one set of seals, and O-rings.
- C. All tools and spare parts shall be packed and identified in accordance with manufacturer's recommendations.
- D. With the O&M manual submittal, provide a list of all spare and replacement parts with individual prices and location where they are available. Prices shall remain in effect for a period of not less than one year after final acceptance.

#### 1.9 POWER SUPPLY

- A. All motors and items of equipment shall be designed for operation on a power supply as shown on Electrical drawings.

#### 1.10 DELIVERY, STORAGE, AND HANDLING

- A. All pumps, controllers, motors, and appurtenances shall be shipped from the Manufacturer in protective cartons or containers.
- B. All flanges, pipe connections, and electrical connections shall be suitably protected to prevent damage during delivery, storage, and installation.
- C. The Manufacturer shall provide written instructions on storage and handling of the equipment to the Contractor.

#### 1.11 WARRANTY

- A. The equipment shall be warranted by the Manufacturer for a period of one (1) year from date of beneficial use, to be free from defects in workmanship, design or material. If the equipment should fail during the warranty period due to a defective part(s), it shall be replaced in the machine and the unit(s) restored to service at no additional cost to the Owner.
- B. The Manufacturer's warranty period shall start concurrently with the Contractor's warranty period. No exception to this provision shall be allowed.

### PART 2 - PRODUCTS

#### 2.1 GENERAL

- A. The Specifications are intended to give a general description of what is required, but do not cover all details which may vary in accordance with the exact requirements of the equipment as offered. They are, however, intended to cover the furnishing, delivery, installation and field testing of all materials, equipment and apparatus as required. Any additional auxiliary

equipment necessary for the proper operation of the proposed installation not mentioned in these Specifications or shown on the drawings shall be furnished and installed.

- B. The pumps shall be rigidly and accurately anchored into position by Contractor in accordance with manufacturer's installation recommendations. All necessary foundation bolts, plates, nuts and washers shall be furnished and installed by Contractor in accordance with manufacturer's recommendations. Anchor bolts shall be Titanium for the sodium hypochlorite metering pumps. Each pump shall be rigidly mounted to the concrete pad base. Pump pads are located in a containment area inside the Chemical Building in the event of a chemical leak.
- C. Contractor shall be responsible for coordinating all modifications requirements to connect the new chemical metering pumps to the existing chemical metering skid including modifications to existing skid piping and replacement of reducers.
- D. Stainless steel nameplates giving the name of the manufacturer, model number and serial number, capacity, and other pertinent data shall be attached to each pump and motor.
  - 1. Pump nameplates shall include capacity, head, speed, and any other pertinent information.
  - 2. Motor nameplates shall include horsepower, speed, voltage, amperes, service factor and any other pertinent data.
- E. The chemical feed pumps shall be mechanical diaphragm metering pumps metering pumps as manufactured by Prominent, no substitutions will be accepted. All pumps shall be the products of a single manufacturer.

## 2.2 METERING PUMPS – GENERAL

- A. Pumps shall be variable speed chemical feed microprocessor-controlled, mechanically actuated diaphragm metering pumps, motor driven, as manufactured by Grundfos and shall be of suitable materials for pumping the respective chemical solutions. Each pump shall be capable of receiving a 4-20 mA external signal for flow pacing and allow manual control at the pump. Single ball type check valves shall be provided on the suction and discharge, including a replaceable ball guide. The pumps shall be dry-lift self-priming and capable of indefinite operation without process fluid.
  - 1. All pumps shall be designed to deliver the capacity tabulated below at the minimum discharge pressure specified.
  - 2. All pumps shall be provided with a manual micrometer type stroke adjustment mechanism, to permit 0 to 100 percent capacity control while in motion, on each head. The mechanism shall provide positive repeatable settings within plus or minus 1 percent over the entire range. Pump delivery shall be repeatable within plus or minus 1 percent accuracy over a 10:1 range.
  - 3. All pumps shall be provided with pressure relief valves with a set pressure of 50 psig maximum. Set pressure shall be field adjustable.

Sodium Hypochlorite Metering Pumps	
(Chemical Building – 12.5 % solution strength)	
Number of Units	2 (1 duty/1 standby)
Capacity (maximum)	32 gal/hr

Capacity (minimum) 2.9 gal/hr  
Horsepower 1/8 Hp  
Maximum Back Pressure (as created by backpressure valve) 25 psig  
Model Used for Design: Grundfos DDA 120

- B. The metering pumps shall all be driven by variable speed motors, mechanically actuated, disc diaphragm, and meet the following design and performance criteria. Each metering pump shall have an electronic variable speed control. The pumps shall be Grundfos DDA 120.
- C. The diaphragm shall be constructed of a steel core, vulcanized into nylon-reinforced EPDM, with PTFE-faced fluid contact surface. The diaphragm shall be of a convex design fitting into a concave liquid end to minimize dead volume and promote flow of solids in suspension.
- D. Drives and Capacity Control (Motorized Pumps)
1. Stroke frequency control for motorized pumps shall be done with an integral dual function VFD and stepper motor pump controller. The first 1/3 of the frequency in strokes per minutes will operate with the stepper motor and pump frequency greater than 1/3 will operate with the internal VFD. Control shall be switchable between manual or external control via 4-20 mA signal. In manual mode, stroke frequency control shall be manually adjusted by touch keypads, with the set stroke rate displayed on the pump's LCD. In external mode, the pump shall be capable of receiving a 4-20 mA input via optional external control cable. The metering pump shall be capable of remote ON-OFF operation using the PAUSE function via a voltage-free contact relay through an optional control cable. Pump shall include TEFC, four-pole AC motor.
  2. Stroke length control shall be adjustable manually by means of a stroke length knob, in increments of 1%, from 0% to 100% of stroke length. The stroke length shall be displayed on the pump LCD in 1% increments.
- E. Drives and Capacity Control
1. Stroke length control shall be adjustable manually by means of a stroke length knob, in increments of 1%, from 0% to 100% of stroke length. The stroke length shall be displayed on the pump LCD in 1% increments.
  2. Programming shall allow pump to be calibrated so as to display pump output in gallons/hour or liters/hour, and stroke frequency in strokes per minute. The flow calibration feature shall be maintained when stroke length is changed up to plus or minus 10% on the stroke length knob. If stroke length is changed by more than 10%, a yellow warning light will light and a flashing message "calib" will appear indicating re-calibration is required.
  3. The pump shall be equipped with the programmable function of pressure levels to allow pump to operate at reduced pressures from the maximum rated pressure of the pump.
  4. The pump shall be equipped with the programmable function of electronic interlocking of the keypad by access code to prevent unauthorized adjustments to the pump.
  5. Keypad shall allow for scrolling and display on LCD such parameters as stroke frequency, stroke length, stroke counter, pump output in gals/hr or l/hr, dosing quantity, mA current input being received by pump, and indication of external mode.
  6. Stroke frequency control shall be manually adjusted by touch keypads, with the set stroke rate displayed on the LCD.
  7. The metering pump shall be capable of receiving a pulse input via optional external control cable such that 1 pulse gives 1 pump stroke rate. The pump shall be capable of

remote ON-OFF operation using the pause function via a voltage free contact relay through an optional control cable.

8. The pump shall accept an analog signal such that stroke frequency is proportional to 4-20mA or 20-4mA, the choice of which is programmable at the pump. Analog to digital converters external to the pump shall not be allowed.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. The chemical metering pumps shall be installed in accordance with manufacturer's instructions and recommendations in locations shown on the drawings. Installation shall include furnishing the required oil and grease for initial operation. The grades of oil and grease shall be in accordance with the recommendations of the manufacturer. Anchor bolts shall be set in accordance with the shop drawings.

### 3.2 INSPECTION AND TESTING

- A. Contractor is responsible for assuring services, labor, and equipment of the manufacturer as specified herein. The equipment manufacturer shall furnish the services of a competent and experienced representative who has complete knowledge of proper operation and maintenance of the equipment to inspect the installed equipment, supervise the initial test run, and to provide instructions to the plant personnel. Three visits shall be provided by chemical metering skid manufacturer. The first visit shall be to conduct inspection of installation and shall be a minimum of one day. The second visit shall be a minimum of three days and shall complete start-up and operate and supervise the preliminary test (no chemicals) and the full functional test. The third visit shall be to instruct plant personnel in the operation and maintenance of the equipment and shall be a minimum of one day. The final copies of operation and maintenance manuals specified in Section 017823 must have been delivered to the Owner prior to scheduling the third visit for the instruction period.
- B. The second visit to complete start-up shall consist of the preliminary test without chemicals on the first day, flushing on the second day, and then full functional testing on the third day.

#### 1. Preliminary Test without Chemicals

- a. Upon completion of installation, the manufacturer, shall perform a preliminary test (no chemicals) over the full range of each system to ensure the functioning of all component parts. The test shall be over the full range of capacity. The manufacturer shall furnish all labor and equipment. Air and power shall be supplied by the Contractor. Approval of the preliminary test by the Engineer and Owner shall not constitute final acceptance of the equipment furnished.

#### 2. Full Functional Test

- a. Full functional testing shall be performed in the presence of the Owner and a qualified manufacturer's representative on the system. The manufacturer shall furnish all labor materials and equipment required for such tests and shall correct

any deficiencies noted by repairing or replacing the defective component and retesting as required until the equipment meets the Specifications. A performance check shall be made on each metering pump with the chemical it is intended to pump. Pumps shall be tested at 10%, 20%, 50%, 75%, and 100% of scale, as required. The total error based on the field determined instrument errors, shall not exceed plus or minus two percent of the actual flow for the pumps. If, during running of the tests, one or more points appear to be out by more than the specified amount, the manufacturer shall make such adjustments or alterations as are necessary to bring equipment up to specification performance. Following such adjustment, the tests shall be repeated for all specified points to ensure compliance. Thirty days will be allowed for any changes necessary to meet the specifications. Otherwise the Owner reserves the right to have the rejected equipment removed from the site and replaced by satisfactory equipment that operates in accordance with the Specifications. Chemicals for the full operating test will be furnished by the Owner.

END OF SECTION 463342

## **Appendix A – Final Geotechnical Report**







## **Geotechnical Exploration and Evaluation Report Phase 2**

### **Rivertown Water Treatment Plant St. Johns County, Florida**

**CSI Geo Project No.: 71-19-127-02  
CDM Smith Project No.: 237938  
Purchase Order: 91630  
JEA Contract No.: 141-18**

*Prepared by:*

**CSI Geo, Inc.  
2394 St. Johns Bluff Road S., Suite 200  
Jacksonville, FL 32246  
Tel: (904) 641-1993  
Fax: (904) 641-0057**

*Prepared for:*

**CDM Smith, Inc.**

**June 29, 2020**

# CSI Geo

Geotechnical • CMT • CEI

June 29, 2020

Mr. David J. Prah, P.E.  
CDM Smith Inc.  
4651 Salisbury Road, Suite 420  
Jacksonville, Florida 32256

**RE:** Rivertown Water Treatment Plant  
St. Johns County, Florida

**Subject:** Geotechnical Exploration and Evaluation Report (Phase 2)  
CSI Geo Project No.: 71-19-127-02  
CDM Smith Project No.: 237938, Purchase Order: 91630  
JEA Contract No.: 141-18

Dear Mr. Prah:

CSI Geo, Inc. (CSI Geo) has performed the authorized geotechnical exploration and laboratory testing program at the proposed site of the Jacksonville Electric Authority (JEA) Rivertown Water Treatment Plant in St. Johns County, Florida. The overall design includes three wells (Well Nos. 1, 2, and 3), a ground storage tank (GST), a retention pond, new pipelines, an access road, and miscellaneous structures. The geotechnical investigation was conducted in two phases. The preliminary phase (Phase No. 1) was conducted for the 100-foot diameter Ground Storage Tank (GST No. 1), retention pond, and miscellaneous structures located within the area of Well No. 1. The findings of Phase No. 1 were presented in a Preliminary Geotechnical Exploration and Evaluation Report submitted on January 22, 2020. The second and final phase (Phase No. 2) was conducted for Well Nos. 2 & 3, the access road, and the new pipelines. This report presents our understanding of the subsurface conditions along with our geotechnical design and construction recommendations for Phases No. 1 & 2.

We have enjoyed working with you on this project and look forward to working with you on future projects. If you have any questions concerning this report, please contact our office.

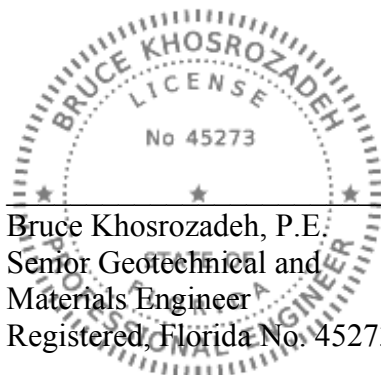
Sincerely,

**CSI Geo, Inc.**



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Nader Amer, Ph.D  
Project Engineer



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# **APPENDIX**

## **Appendix A – Site Maps**

- Site Location Map
- Field Exploration Plan

## **Appendix B – Field Exploration, Evaluation & Laboratory Testing**

- Report of SPT Borings
- Report of Core Borings
- Recommended Soil Parameters for Horizontal Directional Drilling Design
- Recommended Soil Parameters for Sheet Pile Walls
- Tank Settlement Analysis Results
- Summary of Laboratory Test Results
- Grain Size Distribution Curves

## **Appendix C – General Information**

- Key to Soil Classification
- Field and Laboratory Test Procedures

## **1.0 PROJECT INFORMATION**

### **1.1 General Project Information**

The purpose of this geotechnical exploration program was to develop information concerning the subsurface conditions in order to evaluate the site with respect to the proposed JEA Rivertown Water Treatment Plant (WTP) located along CR 244, just south of Greenbriar Road and west of Bartram Trail High School in St. Johns County, Florida. A Site Location Map is included in **Appendix A**.

The overall design includes three wells (Well Nos. 1, 2, and 3), a ground storage tank (GST), a retention pond, new pipelines, an access road, and miscellaneous structures. The geotechnical investigation was conducted in two phases. The preliminary phase (Phase No. 1) was conducted for the 100-foot diameter Ground Storage Tank (GST No. 1), retention pond, and miscellaneous structures located within the area of Well No. 1. The findings of Phase No. 1 were presented in a Preliminary Geotechnical Exploration and Evaluation Report submitted on January 22, 2020. The second and final phase (Phase No. 2) was conducted for Well Nos. 2 & 3, the access road, and the new pipelines. This report presents our understanding of the subsurface conditions along with our geotechnical design and construction recommendations for Phases No. 1 & 2.

### **1.2 Project Description and Existing Conditions**

The overall proposed project features include Well Nos. 1, 2, and 3, concrete pads, a ground storage tank, chemical chlorine storage pad, high service pump station building, generator pad, fuel tank pad, a retention pond inside Well No. 1 area, the access road to Well No. 3, pipelines installed by Horizontal Directional Drilling (HDD) along the west side of Longleaf Pine Parkway, and open cut method of installation pipelines along the east side of Longleaf Pine Parkway.

The site in the gated area of Well No. 1 is relatively flat and cleared with scattered shrubs and small trees. An elevated pre-load embankment approximately two feet higher than the surrounding existing ground surface is situated at the northwest corner of the site. The pre-load embankment was constructed as part of previous plans to construct a ground storage tank, and

the pre-load embankment was intended to reduce the anticipated total settlement. Also, an existing cell tower is located at the southeast corner of the site.

The sites at Wells Nos. 2 and 3 are heavily wooded and gently sloping. Well No. 2 area was partially wet during our geotechnical investigation. We understand that a new access road to Well No. 3 will be constructed, and that the eastern portion of the access road will be retained using permeant sheet pile walls at the intersection with Longleaf Pine Parkway.

The new pipelines consist of HDD pipelines to be installed along the western side of Longleaf Pine Parkway with the entry and exit pits located in front of Well No. 1 area from the south, and Well No. 3 area from the north. The new pipelines also consist of pipes to be constructed using open cut method of installation and to be installed across Longleaf Pine Parkway to connect with existing pipelines along the eastern side of Longleaf Pine Parkway. The site at the new pipeline corridors is generally flat along Longleaf Pine Parkway embankment and surrounded by wetlands and heavily wooded areas from the east and west outside the roadway embankment.

Information regarding this project was provided to CSI Geo, Inc. (CSI Geo) by Mr. David Prah, P.E. of CDM Smith, Inc. (CDM Smith).

## **2.0 GEOTECHNICAL EXPLORATION**

### **2.1 Field Exploration**

The locations of the test borings (Standard Penetration Test borings & Auger borings) were selected by CDM Smith and located in the field by personnel from CSI Geo using handheld GPS equipment. Therefore, the test locations should be considered approximate. The approximate geographical coordinates for each test location are presented on the Report of SPT Borings and Report of Core Borings included in **Appendix B**. All Standard Penetration Test (SPT) borings were grouted to full depth after boring completion. Soil samples collected were visually classified in the field and then transported to our laboratory for re-classification and testing. Representative soil samples obtained during our field exploration program were visually classified using the Unified Soil Classification System (USCS). The approximate locations of the SPT and auger borings are shown on the Field Exploration Plan sheet included in **Appendix A**. A brief discussion of the drilling, sampling, and field-testing techniques used during the field exploration program is provided in the Field and Laboratory Test Procedures sheet presented in **Appendix C**.

The Report of SPT Borings and Report of Core Borings sheets are included in **Appendix B** and present the descriptions of the subsurface soils encountered, the groundwater levels encountered and the penetration resistance, recorded at the time of drilling. The stratification lines and depth designations on the boring records represent the approximate boundary between the various soils encountered, and the transition from one stratum to the next should be considered approximate.

#### **2.1.1 Ground Storage Tank**

The ground storage tank was explored by means of four SPT borings (B-1 through B-4) located at equal distances along the perimeter of the tank and drilled to a depth of 50 feet below the existing ground surface. The center of the tank was explored by means of SPT boring B-5 drilled to a depth of 100 feet below the existing ground surface.

#### **2.1.2 Pump Station Building, Wells, and Structures on Concrete Pads**

The Well No. 1 concrete pad, the chemical chlorine storage pad, high service pump station building, generator pad, and fuel tank pad were explored by means of a total of six SPT borings



(B-6 through B-11) drilled to a depth of 20 feet below the existing ground surface. Wells Nos. 2 and 3 were explored by means of SPT borings B-18 and B-19, respectively, drilled to a depth of 20 feet below the existing surface. Boring B-19 was extended to 25 feet to extend beneath very loose soils encountered at a depth of 20 feet below the existing ground surface.

### **2.1.3 Horizontal Directional Drilling (HDD)**

The HDD pipeline alignment was explored by means of a total of four SPT borings (B-12 through B-15). SPT boring B-12 was drilled to a depth of 40 feet and SPT borings B-13, B-14, and B-15 were drilled to a depth of 75 feet below the existing ground surface.

### **2.1.4 Open Cut Method of Pipe Installation**

The open cut pipelines were explored by means of SPT borings B-16 and B-17 drilled and extended to the depths of 25 and 30 feet, respectively, below the existing ground surface.

### **2.1.5 Access Road & Sheet Pile Walls**

As instructed by CDM Smith, the area of the proposed access road was evaluated using SPT boring B-15 performed for the HDD pipeline due to its close proximity to the access road entrance and the sheet pile walls locations. SPT boring B-15 was drilled to a depth of 75 feet below the existing ground surface.

### **2.1.6 Retention Pond**

The area of the proposed retention pond was explored by means of a total of two auger borings (A-1 and A-2) drilled to a depth of 15 feet below the existing ground surface.

## **2.2 Laboratory Testing**

Quantitative laboratory testing was performed on representative samples of the soils collected during the field exploration program and were performed to better define the composition of the soils encountered. Representative samples for the laboratory testing program were selected and the laboratory tests were performed to determine moisture contents, fines content, organic content, grain size analyses, and Atterberg limits of the soils encountered. Results of the laboratory testing performed are included in **Appendix B**.

### **3.0 SUBSURFACE CONDITIONS**

#### **3.1 General**

An illustrated representation of the subsurface conditions encountered in the proposed construction areas is shown on the Report of SPT Borings and Report of Core Borings sheets presented in **Appendix B**. The soil conditions outlined below highlight the major subsurface stratification. The Report of SPT Borings and Report of Core Borings in the **Appendix** should be consulted for a detailed description of the subsurface conditions encountered at each boring location. When reviewing the Report of SPT Borings and Report of Core Borings, it should be understood that soil conditions may vary between the borings and outside of the explored areas.

#### **3.2 Soil Conditions**

It should be cautioned that soil conditions at the site are highly erratic in nature and contain unsuitable material consisting of organic and highly organic soils and clays that are variable in thickness and depth throughout the site. It is emphasized that due to the erratic nature of these soils, the thickness and depth of the unsuitable material may vary from those noted herein, and that in some locations the unsuitable material may be deeper.

##### **3.2.1 Ground Storage Tank**

Unsuitable organic slightly silty sands (SP-SM/PT) were encountered in the upper 5 to 6 feet of depth below the existing ground surface in the areas of borings B-1 and B-2. However, the unsuitable organic soils appear to be erratic in nature and therefore, the presence of unsuitable organic soils should be expected at varying depths and thicknesses throughout the site. Removal of the unsuitable organic soils will be required, and it is strongly recommended that allowances are made for possible presence of such soils in other areas of the tank.

Below the organic soils, the area is generally underlain by very loose to medium dense sands (SP), slightly silty sands (SP-SM), and silty sands (SM) to the depths of 32 to 33.5 feet followed by dense silty sands and highly weathered limestone to the depths of 35.5 to 42 feet below the existing ground surface. Underlying the weathered limestone, medium dense to dense clayey sands (SC), silty sands (SM), and hard calcareous sandy silts (ML/MH), generally referred to as

Marl formation, were encountered until the boring termination depths of 50 and 100 feet below the existing ground surface.

### **3.2.2 Pump Station Building and Structures on Concrete Pads**

Review of test borings (B-6 through B-11) indicates that these areas are generally underlain by unsuitable organic slightly silty sands (SP-SM/PT) and organic silty sands (SM/PT), generally in the upper 4 to 8 feet of depth below the existing ground surface. Wood was also encountered in boring B-6 between the depths of 8 and 9 feet below the existing ground surface. Generally, the unsuitable organic soils and wood pieces appear to be highly erratic in nature. It is emphasized that due to the erratic nature of these soils, the thickness and depth of the unsuitable material may vary from those noted herein, and that in some locations the unsuitable material may be deeper. It should be cautioned that over-excavation of the unsuitable organic soils will be required.

Beneath the unsuitable organic soils these areas are generally underlain by very loose to medium dense sands (SP), slightly silty sands (SP-SM), and silty sands (SM) until the boring termination depth of 20 feet below the existing ground surface.

### **3.2.3 Well No. 1**

Unsuitable organic slightly silty sands (SP-SM/PT) were encountered in SPT boring B-9 in the upper 4 of depth below the existing ground surface. It should be noted that over-excavation of the unsuitable organic soils will be required. Beneath the unsuitable organic soils, loose to dense sands (SP) were encountered until the boring termination depth of 20 feet below the existing ground surface.

### **3.2.4 Well No. 2**

Unsuitable highly organic silty sands (SM/PT) were encountered in the upper 2 of depth below the existing ground surface. It should be noted that over-excavation of the unsuitable organic soils will be required. Beneath the unsuitable organic soils, very loose to loose sands (SP) and slightly silty sands (SP-SM) were encountered to a depth of 12 feet, followed by very loose to medium dense clayey sands (SC) until the termination depth of 20 feet below the existing ground surface.

### **3.2.5 Well No. 3**

The area of Well No. 3 is generally underlain by very loose to medium dense sands (SP), slightly silty sands (SP-SM), and clayey sands (SC) to a depth of 12 feet below the existing ground surface. Beneath these soils, firm sandy clays (CH) were encountered to a depth of 16 feet followed by loose silty sands (SM) until the boring termination depth of 25 feet below the existing ground surface.

### **3.2.6 Horizontal Directional Drilling (HDD)**

Review of SPT borings B-12 through B-15 indicates that the HDD corridor is generally underlain by very loose to very dense sands (SP) and slightly silty sands (SP-SM) to a depth of 17 to 37 feet below the existing ground surface. It is noted that very soft sandy clays (CL) and silts (MH) were encountered between 17 and 32 feet of depth in borings B-12 and B-13. Beneath these soils, very loose to medium dense slightly silty sands (SP-SM), clayey sands (SC) and silty sands (SM) were encountered to depths ranging from 37 to 42 feet followed by very stiff to hard sandy clays (CH, CL / MARL) and medium dense to very dense clayey sands (SC / MARL) until the boring termination depths. It should be noted that soil conditions along the HDD corridor are erratic in nature and contain very soft clays with variable thicknesses and depths and may from those noted herein.

### **3.2.7 Open Cut Method of Pipe Installation**

Review of SPT borings B-16 and B-17 indicates that the pipeline areas to be installed by open cut method of installation are generally underlain by very loose to medium dense sands (SP), slightly silty sands (SP-SM), and silty sands (SM) to a depth of 17 to 22 feet below the existing ground surface. Beneath these soils, very soft to firm sandy clays and clays (CH) were encountered to a depth of 22 feet, followed by slightly silty sands (SP-SM) until the deepest termination depth of 25 feet below the existing ground surface.

### **3.2.8 Access Road & Sheet Pile Walls**

Due to its close proximity, SPT boring B-15 performed for the HDD alignment was utilized to evaluate the general subsurface conditions for the access road and sheet pile walls. Review of SPT boring B-15 indicates that the area of the access road and sheet pile walls is generally underlain by very loose to dense sands (SP) and slightly silty sands (SP-SM) to a depth of 37 feet

below the existing ground surface. Beneath these soils, very stiff to hard sandy clays (CH / MARL) were encountered until the boring termination depth of 75 feet below the existing ground surface.

### **3.2.9 Retention Pond**

Review of auger borings A-1 and A-2 indicates that the area of the retention pond is generally underlain by fine sands (SP), slightly silty fine sands (SP-SM), and silty fine sands (SM) until the borings termination depth of 15 feet below the existing ground surface. It should be cautioned that soil conditions within the proposed retention pond are highly erratic in nature and contain unsuitable material consisting of unsuitable organic and highly organic soils and clays that are variable in thickness and depth throughout the site. It is emphasized that due to the erratic nature of these soils, presence of unsuitable organic and clayey soils should be anticipated, and that the thickness and depth of the unsuitable material may vary from those noted herein, and that in some locations the unsuitable material may be deeper.

## **3.3 Groundwater Conditions**

The groundwater levels were measured and recorded as encountered at the time of drilling. The depths of the groundwater level and estimated seasonal high water level at the test locations are marked on the Report of SPT Borings and Report of Core Borings sheets presented in the **Appendix B**.

### **3.3.1 Ground Storage Tank and Miscellaneous Structures**

Review of the test borings B-1 through B-11 indicates that groundwater was encountered at depths ranging from 6 to 7 feet below the existing ground surface. The estimated seasonal high ground water table ranged from 5 to 6 feet below the existing ground surface.

### **3.3.2 Well No. 1**

Review of the test boring B-9 indicates that groundwater was encountered at the depth of 6 feet below the existing ground surface. The estimated seasonal high ground water table is estimated to be at 5 feet below the existing ground surface.

### **3.3.3 Well No. 2**

Review of the test boring B-18 indicates that groundwater was encountered at the depth of 3 feet below the existing ground surface. The estimated seasonal high ground water table is estimated at 1.5 feet below the existing ground surface. Standing water was observed in the vicinity of the boring.

### **3.3.4 Well No. 3**

Review of the test boring B-19 indicates that groundwater was encountered at the depth of 1.5 feet below the existing ground surface. The estimated seasonal high ground water table is estimated to be at ground surface. Standing water was not observed at the time of drilling.

### **3.3.5 Horizontal Directional Drilling (HDD) Pipelines**

Review of the test borings B-12 through B-15 indicates that groundwater was encountered was encountered at depths ranging from 2 to 7 feet below the existing ground surface.

### **3.3.6 Open Cut Pipelines**

Review of the test borings B-16 and B-17 indicates that groundwater was encountered was encountered at depths ranging from 4.5 to 6 feet below the existing ground surface. The estimated seasonal high ground water table ranged from 3.5 to 5 feet below the existing ground surface.

### **3.3.7 Access Road & Sheet Pile Walls**

Review of the test boring B-15 indicates that groundwater was encountered at the depth of 5 feet below the existing ground surface.

### **3.3.8 Retention Pond**

Review of the borings A-1 and A-2 indicates that groundwater was encountered at depths ranging from 1.5 to 4 feet below the existing ground surface. The estimated seasonal high ground water table ranged from 0.5 to 3 feet below the existing ground surface.

Determination of the estimated seasonal high groundwater table was made using the methodology described by the United States Department of Agriculture (USDA) Soil

Conservation Service (SCS). In sandy soils the method involves examining soil cuttings from the borings for subtle changes in root content and soil coloration. These subtle changes are indicators of the highest level the groundwater level has been for a prolonged period.

Fluctuations of the groundwater level should be anticipated as a result of fluctuations of the nearby creeks and tributaries, seasonal climatic variations, surface water runoff patterns, construction activities, and other related factors. During seasonal high precipitation periods, groundwater levels can be expected to vary from the levels recorded during this exploration. Therefore, design drawings and specifications should account for the possibility of groundwater level variations, and construction planning should be based on the assumption that such variations will occur.

## **4.0 GEOTECHNICAL ENGINEERING EVALUATION AND RECOMMENDATIONS**

### **4.1 Basis of Evaluation & Recommendations**

The following recommendations are based on the previously presented project information and the data provided to us. The discovery of site and/or subsurface conditions during construction that deviate from the data obtained in this exploration should be reported to us for our review.

### **4.2 Foundation Design & Construction Recommendations**

Based on the results of our evaluation, the storage tank, the buildings, and miscellaneous structures can be founded on shallow bearing footings proportioned for a maximum gross allowable soil bearing capacity of 2,000 psf, provided that the unsuitable organic soils and very loose soils encountered in the upper 8 feet of depth are removed in their entirety and replaced with suitable compacted material in the dry.

Upon satisfactory removal of all unsuitable soils, we recommend that the exposed soils must first be compacted in the dry. This compactive effort should help improve the overall uniformity and bearing conditions of the near surface and underlying soils. Site work and construction techniques in general should be performed in accordance with our subsequent recommendations. The foundations may be constructed directly on compacted sands or natural soils, #57 stone, lean concrete, or structural fill. The granular free-draining soils should be compacted to a density of at least 95 percent of the Modified Proctor maximum dry density (ASTM D 1557). Extensive dewatering will be required to backfill and compact in the dry. If #57 stone is recommended as backfill of the over excavation, it is recommended that it should be wrapped around with filter fabric or geotextile as a separation layer to prevent settlement due to migration of fine soil particles into the aggregate layer.

Additionally, we recommend that techniques in **Section 4.4** be implemented to reduce the effects of settlement of ground storage tank and pipe connections.



### **4.3 Bearing Capacity and Anticipated Settlement**

#### **4.3.1 Ground Storage Tank**

We understand that the GST will be supported on foundations placed at or near existing grade with some fill added. Using a 2,000 psf bearing capacity, we anticipate the total settlement of the tank to be on the order of 4.0 inches or less. Settlement was calculated using GeoStudio SIGMA/W model. We expect the majority of the settlement to be elastic (short-term) settlement. Based on the tank dimensions provided, we estimate the differential settlement between the center and edge of the tank to be on the order of 1.9 inches or less. A summary of the settlement analysis results is presented in **Appendix B**. These settlement values are below what is typically allowed by designers and tank manufacturers. However, we recommend that settlement mitigation techniques presented in **Section 4.4** of this report be considered.

#### **4.3.2 Pump Station Building, Well Areas, and Structures on Concrete Pads**

Bearing capacity was estimated using both the Terzaghi and Vesic methods. We recommend that shallow foundations should have a minimum footing width of 2 feet with an embedment depth of 2 feet. The maximum allowable soil bearing pressure for use in shallow foundation design should not exceed 2,100 psf. We recommend maximum footing sizes should be limited to 8-feet for isolated column footings and 4-feet for continuous wall footings. Using a maximum bearing pressure of 2,100 psf, we anticipate the total settlement will be on the order of 1-inch or and the differential settlement to be on the order of 0.25 inches less. Settlement was calculated using GeoStudio SIGMA/W model. This settlement is the result of elastic compression of the upper sandy soils. The elastic compression of the sandy soils should occur almost immediately upon the application of the structural dead load during construction. In general, the existing subgrade exhibits a soil unit weight of 105 pcf and friction angle of 29 degrees.

### **4.4 Settlement Mitigation Techniques for the Ground Storage Tank**

#### **4.4.1 Preloading**

Based on the estimated total settlement and differential settlement results, it is our opinion that that the settlements are below, but close, to what is typically allowed by designers and tank manufacturers. Therefore, settlement mitigation measures may not be required during construction. If required, preloading is considered as a feasible settlement mitigation technique for the proposed tank. Preloading involves loading of the tank area prior to permanent

construction in order to induce settlement that would otherwise take place during and after construction. Preloading options include (1) filling the tank with water prior to putting it in operation or (2) placing and removing an earthen fill embankment prior to tank construction.

If required, preloading can be done by first constructing the storage tank without making pipe connections, followed by filling the storage tank with water in 25% increments. Settlement should be monitored during the preload operation and at the end of each increment by monitoring/ surveying the tank itself. This would allow the geotechnical engineer or his/her representative to determine how the soils are responding and when the preload can be terminated. After the preload is completed, the pipe connections can be made and the tank can be placed in operation. This technique is a viable option assuming accommodations are made to acquire and discharge the water.

#### **4.4.2 Pipe Connections**

If the estimated differential settlement of 1.9 inches is considered to be over the threshold allowed between the tank and pipe connections, we recommend moving the connections or fittings outward away from the tank, if feasible, so that the distortion caused by differential settlement is lessened compared to being closer to the tank. Flexible piping connections are another option, which are able to bend and compensate for any settlement between the tank and pipe connections.

#### **4.5 Floor Slab Design & Construction Recommendations**

The floor slab may be constructed directly on compacted fine sands, natural soils, or structural fill. The granular free-draining soils should be compacted to a density of at least 95 percent of the Modified Proctor maximum dry density to a depth of at least 12 inches. A gravel frost protection layer is not considered necessary, although a vapor barrier should be installed to help reduce dampness of the surface of the slab. In addition, a thin lift of approximately 3 inches of sand may be placed above the vapor barrier to minimize curling of the slab, which occurs due to the difference in curing rates between the top and bottom of the slab.

Based on our review and evaluation of the test data and site conditions, we recommend that a modulus of subgrade reaction “k” value of 100 pci to be used for concrete slab design.

#### **4.6 Recommended Design Soil Parameters for Horizontal Directional Drilling (HDD)**

Pipes installed using HDD should follow the latest JEA Water & Wastewater Standards Manual. We recommend that soil parameters assumptions and interpretations for the horizontal directional drilling design follow the information provided in the Recommended Design Soil Parameters for Horizontal Directional Drilling tables included in **Appendix B**. Soil parameters provided in the tables are representative of the soil conditions at the variable depths and have been generated based on N-values that were corrected for hammer efficiency and overburden pressure.

#### **4.7 Open Cut Excavations for Pipes**

In general, we consider the subsurface soil conditions at the site to be favorable for support of the proposed pipes over a properly prepared and compacted subgrade, provided that the site preparation and earthwork construction recommendations in this report are followed.

It should be noted that over-excavation will be required in several areas due to the presence of large roots and unsuitable organic soils. Depending on the design pipe invert elevations, it is likely that some excavated suitable soils will get mixed with unsuitable organic and/or plastic soils during construction and should be regarded as unsuitable for backfill purposes. We recommend that allowances be made for possible overruns in quantities of subsoil removal and replacement with select backfill.

Outside the limits of the unsuitable soils, the area generally consists of sands (SP & SP-SM) which should be considered suitable for use in construction. We anticipate that the buried pipelines will exert little downward pressure on the subgrade soils. In areas where the surrounding groundwater level is above the pipe invert elevation, the lines should be designed to resist lateral earth pressures and hydrostatic uplift pressures appropriate to their depth below the existing grade and the seasonal high-water level.

#### **4.8 Access Road**

Generally, the near surface subgrade soils along the access road consist of sands (SP & SP-SM) material, which should be considered suitable for use in construction. However, it is anticipated the majority of the near surface subgrade soils are underlain by large roots. Therefore, site preparation consisting of the removal of large trees, vegetation, surficial topsoil, and any unsuitable organic soils will be necessary. This should be followed by placement of the select backfill or structural fill as needed to achieve the design finished pavement grades. Following the removal of unsuitable organic soils and backfilling with suitable soils, we consider the subsurface conditions at the site to be favorable for support of the access road, if a properly prepared subgrade is provided.

#### **4.9 Sheet Pile Wall Design Recommendations**

We understand that the proposed access road embankment to Well No. 3 will require permanent sheet pile retaining wall to support the embankment. Therefore, we recommend that the soil parameters included in **Appendix B** of this report be used for the sheet pile wall design.

#### **4.10 Suitability of Borrow Materials for Construction**

It should be cautioned that soil conditions at the site are highly erratic in nature and contain unsuitable material consisting of organic and highly organic soils and clays that are variable in thickness and depth throughout the site. It is emphasized that due to the erratic nature of these soils, the thickness and depth of the unsuitable material may vary from those noted herein, and that in some locations the unsuitable material may be deeper.

The near surface soil in the areas of Well Nos. 1 & 2 are generally underlain by unsuitable organic slightly silty sands (SP-SM/PT) and highly organic silty sands (PT) encountered in the upper 2 to 8 feet of depth below the existing ground surface, which are considered unsuitable for backfilling and construction. It should be noted that over-excavation of the unsuitable organic soils will be required. The near surface soils in the remaining areas outside Wells No. 1 & 2, and at the retention pond, are generally underlain by fine sands (SP: USCS), slightly silty sands (SP-SM), silty sands (SM), and clayey sands (SC) in the upper 22 to 35 feet of depth below the existing grades, followed by sandy clays (CH/CL) to the termination depths of the borings.

Fine sands (SP) and slightly silty fine sands (SP-SM) are considered as select material. Silty fine sands (SM) may contain excess moisture and will be difficult to dry and to compact. Therefore, silty fine sands should not be used at this site under the tank or the building foundations. Plastic clayey sands (SC), highly plastic sandy clays (CL/CH), and unsuitable organic soils should be considered unsuitable for backfilling and compaction purposes.

We recommend that allowance be made for overruns in quantities of subsoil removal and replacement with select backfill. It should be noted that unsuitable organic soils boundaries and limits are approximate and represent soils encountered at each boring location. Subsurface variance between borings may occur and should be anticipated.

Unsuitable organic soils, silty soils, and plastic soils should be stockpiled separately from the select soils in order to avoid contaminating the select material. In addition, an extensive dewatering system will be required in order to lower the groundwater level prior to excavation. This practice should allow the select SP and SP-SM soils to drain adequately prior to being excavated and stockpiled. Without a dewatering system, the stockpiled material will stay saturated, thus being difficult to dry and to compact for backfilling purposes.

## **5.0 PAVEMENT DESIGN GUIDELINES & RECOMMENDATIONS**

### **5.1 Site Preparation**

If needed, a certain degree of site preparation consisting of the removal of large trees and their roots, unsuitable organic soils, sands with many roots, vegetation, surficial topsoil may be required. This should be followed by placement of the select backfill or structural fill as needed to achieve the design finished pavement grades.

### **5.2 Stabilized Subgrade**

For new pavement construction, the areas to be paved should be stripped and grubbed, filled and compacted. The top 12 inches of soils beneath the base course material shall be a stabilized subgrade with a minimum LBR value of 40 and it shall be compacted to at least 98 percent of its Modified Proctor maximum dry density.

### **5.3 Limerock Base**

The base course could consist of Limerock with a Limerock Bearing Ratio of 100. We recommend a base course at least six inches thick under standard pavements, i.e. under automobiles and lightweight truck; and eight inches for heavy equipment areas. The base course may be placed and compacted in one single layer. All base course materials should be placed and compacted to at least 98 percent of its modified proctor maximum dry density.

### **5.4 Wearing Surface**

A 1-1/2 (minimum) inch layer of type III (or FDOT Type S-1) asphalt concrete having a minimum Marshall stability of 1,000 pounds is recommended for wearing surface in automobile parking areas. For heavy equipment areas, 2 inches of Type III or Type S-1 asphalt concrete is recommended. The asphalt concrete layer should be compacted to at least 98 percent of laboratory density.

## **6.0 SITE PREPARATION & CONSTRUCTION RECOMMENDATIONS**

### **6.1 Existing Utilities**

The locations of existing utilities should be established prior to construction. Provisions should be made to relocate utilities interfering with the proposed alignments and construction, as needed. Underground pipes that are not operational should be either removed, plugged, or grouted in place otherwise they may become conduits for subsurface erosion and cause settlements.

### **6.2 Initial Site Preparations**

All vegetation, topsoil, gravel, roots and organic zones should be removed from the construction area for a distance of at least (5) feet beyond the construction area limits and structures footprint. The depth to which stripping will be required will vary to some degree. Some localized areas may require more than 12 inches of stripping to remove significant root zones.

### **6.3 Groundwater Control**

Groundwater level was encountered at depths ranging from ground surface to 7.0 feet beneath the existing ground surface at the time of drilling. Generally, dewatering may be achieved by conventional open pumping using ditches graded to a sump or by using a deep well point system. However, it is anticipated that extensive dewatering will be required to backfill and compact in the dry. The groundwater level should be maintained at least 2 feet below the bottom of any excavations made during construction and below the surface of any vibratory compaction operations.

### **6.4 Surface Water Control**

The need for surface water runoff control should be anticipated during the site preparation and foundation construction process. Lack of proper controls could result in ponding of surface water in shallow foundation bearing areas and on compacted surfaces. Ponded water, combined with machine or foot traffic during construction operations or other activities, could disturb otherwise acceptable soils or previously compacted existing soils, causing instability, “pumping”, and generally unacceptable conditions. The ponded water will also impede or prevent necessary soil compaction operations and make construction trafficability difficult.

Surface water can be controlled by proper grading of the site and by the use of temporary drainage ditches, diversion berms, and/or pumping from drainage controlled collection points.

### **6.5 Removal of Unsuitable Materials & Excavation Backfill Recommendations**

Unsuitable organic soils were encountered in the areas of Well Nos. 1 and 2 in the upper 2 to 8 feet below the existing grades. These unsuitable organic soils are considered unsuitable material and should be completely removed/excavated in their entirety and backfilled with suitable material. It should be cautioned that soil conditions at the site are highly erratic in nature and contain unsuitable material consisting of organic and highly organic soils and clays that are variable in thickness and depth throughout the site. It is emphasized that due to the erratic nature of these soils, the thickness and depth of the unsuitable material may vary from those noted herein, and that in some locations the unsuitable material may be deeper. The approximate limits of unsuitable organic limits are summarized in the table below:

#### **APPROXIMATE OVER-EXCAVATION LIMITS OF REMOVAL OF UNSUITABLE SOILS**

Location	Reference Boring(s)	Approximate Over-Excavation Depth*
Ground Storage Tank (GST)	B-1 & B-2	8 feet
Well No. 1 Pad	B-9	4 feet
Well No. 2 Pad	B-18	2 feet
Chemical Chlorine Storage	B-6	9 feet
High Service Pump Station Building	B-7 & B-8	8 feet
Fuel Tank	B-10	6 feet
Generator	B-11	5 feet

\* Depth below existing ground surface

Excavated unsuitable soils should be replaced with No. 57 stone or clean sands placed in maximum 1-foot loose lifts and compacted in the dry to densities equivalent to 95 percent of the Modified Proctor maximum dry density. When #57 stone is recommended as backfill of the over excavation, it is recommended that it should be wrapped around with filter fabric or geotextile as a separation layer to prevent settlement due to migration of fine soil particles into the aggregate layer. When excavating to remove unsuitable materials, it is very likely that the excavated



suitable soils will get mixed with unsuitable organic soils during construction. Therefore, it is our opinion that some of the excavated material should be regarded as unsuitable for backfill purposes. We recommend that allowance be made for overruns in quantities of subsoil removal and replacement with select backfill. It should be noted that unsuitable organic soils boundaries and limits are approximate and represent soils encountered at each boring location. Subsurface variance between borings may occur and should be anticipated.

Due to the wooded nature of the site in some areas, extensive root zones should be expected. If left in place the root zones may contribute to some long-term decay related settlements. In the heavily wooded areas, and depending on design finished grades, it may be desirable to remove large root systems by using a root rake on track-mounted equipment to uproot and remove large root mat sections. It is recommended that the upper 12 to 18 inches of surficial soils be root raked. Insufficient removal in the surficial soils can result in low density results due to higher concentrations of low density material and high moisture contents.

## **6.6 Excavation Protection**

All excavations should meet OSHA Excavation Standard Subpart P regulations for Type C soils. A trench box or braced sheet pile structures may be considered to support open excavations. The soil support system shall be designed according to OSHA by a Florida registered Professional Engineer.

## **6.7 Site & Fill Compaction**

After initial clearing and stripping operations have been completed, and upon satisfactory removal of unsuitable organic soils, the exposed soils in the proposed construction areas should be compacted to densities equivalent to 95 percent of the Modified Proctor maximum dry density (ASTM D1557). This compactive effort should help improve the overall uniformity and bearing conditions of the near-surface and underlying soils.

Structural fill may be placed in loose lifts not exceeding 12 inches. Each lift of fill should be compacted until densities equivalent to at least 95 percent of the Modified Proctor maximum dry density are uniformly obtained. Structural fill should consist of an inorganic, non-plastic, granular soil containing less than 12 percent material passing through the No. 200 mesh sieve

(relatively clean sand with a Unified Soil Classification of SP or SP-SM). Areas not supporting foundations, pavements, or any structures, and not receiving structural fill, can be compacted in the dry to at least 90 percent of the Modified Proctor maximum dry density provided the soils consist of relatively clean soils with no unsuitable soils.

## **6.8 Disturbed Soil Conditions**

Should the soils experience “pumping” and subsequent soil strength loss during compaction operations, compaction work should be terminated and: (1) the disturbed soils removed and backfilled with “dry” structural fill soils, which are then compacted; or (2) the excess moisture content within the disturbed soils allowed to dissipate before re-compaction. Furthermore, the groundwater level should be checked and controlled as necessary in order to help ensure proper drawdown of any high groundwater conditions that may be causing the “pumping” conditions during compaction or construction activity upon these soils.

## **6.9 Pipe Backfill and Compaction of Pipe Backfill**

The SP and SP-SM type soils are considered select material and suitable for use as backfill. Silty sands (SM) can be treated as select material, however, they may contain excess moisture and may be difficult to dry and to compact. Clayey sands (SC) and sandy clays (CL/CH) should be considered as plastic and highly plastic materials, respectively, and should be excavated to a minimum depth of one foot below the design invert elevations and replaced with suitable SP and SP-SM fill material. If encountered, organic soils should be removed in their entirety. Plastic clayey sands (SC), highly plastic sandy clays (CL/CH), and all organic soils should be considered unsuitable for backfilling and compaction purposes.

It should be cautioned that soil conditions at the site are highly erratic in nature and contain unsuitable material consisting of organic and highly organic soils and clays that are variable in thickness and depth throughout the site. It is emphasized that due to the erratic nature of these soils, the thickness and depth of the unsuitable material may vary from those noted herein, and that in some locations the unsuitable material may be deeper. As mentioned earlier, some of the excavated suitable soils will likely get mixed with unsuitable soils and/or plastic soils during construction. Therefore, some or all the excavated material may become unsuitable for backfill purposes. We recommend that allowance be made for overruns in quantities of subsoil removal and replacement with select backfill.

The backfill material within the excavation should be placed in thin loose lifts not exceeding 6 inches in thickness. The backfill material should be compacted by the use of hand-operated equipment. The backfill material should be granular (SP & SP-SM) fill with less than 10 percent material passing the no. 200 mesh sieve and containing less than 3 percent organic matter. The backfill material should be compacted to a minimum density of 98% or 95% of maximum dry density obtained from the Modified Proctor compaction test (ASTM D1557), as required by JEA. The moisture content during compaction should be maintained within  $\pm 3$  percent of the optimum moisture content as obtained from the Modified Proctor compaction test. Handheld compaction equipment should be used for the backfill placed around the pipes and to a height of 2 feet above the pipes. Heavier equipment may be used on the remaining backfill lifts placed above 2 feet. However, care should be taken not to damage the pipe below. The pipe should be designed to withstand the anticipated dead (overburden) and live loads.

#### **6.10 Roadway Subgrade Stabilization and Compaction**

The upper one foot of the subgrade soil should be stabilized to achieve an LBR Value of 40 with a maximum plasticity index of 6. The stabilization procedures and the stabilizing materials should be as presented in the Standard Specifications.

#### **6.11 Foundation Bearing Surface Preparation**

The upper 24 inches of bearing soils should be compacted to densities equivalent to at least 95 percent of the material's maximum dry density as determined by the Modified Proctor test. Concentrated root zones or other unsuitable matter encountered at the bearing level should be completely removed and replaced with compacted structural fill material. If plastic soils are encountered at the bottom of the foundation they should be regarded as unsuitable soils and should be removed to a depth of at least 2 feet beneath the bottom of the foundation. Excavated unsuitable soils should be replaced with clean sands placed in maximum 1-foot loose lifts and compacted to densities equivalent to 95 percent of the Modified Proctor maximum dry density. As noted earlier, silty fine sands may contain excess moisture and will be difficult to dry and to compact. Therefore, silty fine sands should not be used at this site under the tank or the building foundations.

## **7.0 QUALITY CONTROL & TESTING GUIDELINES**

Prior to initiating compaction operations, we recommend that representative samples of the structural fill material to be used and acceptable exposed in-place soils be collected and tested to determine their compaction and classification characteristics. The maximum dry density, optimum moisture content, gradation and plasticity characteristics should be determined. These tests are needed for compaction quality control of the structural fill and existing soils and to determine if the fill material is acceptable.

A representative number of in-place field density tests should be performed in the compacted existing soils and in each lift of structural fill or backfill to confirm that the required degree of compaction has been obtained. At least one test per lift should be made for every 1,000 square feet of structure area and every 25 feet for the tank's foundation perimeter. The bearing level soils should be inspected and tested by an engineering technician acting under the direction and supervision of the geotechnical engineer in order to evaluate the density and acceptability of the bearing material prior to steel placement and foundation construction.

## **8.0 REPORT LIMITATIONS**

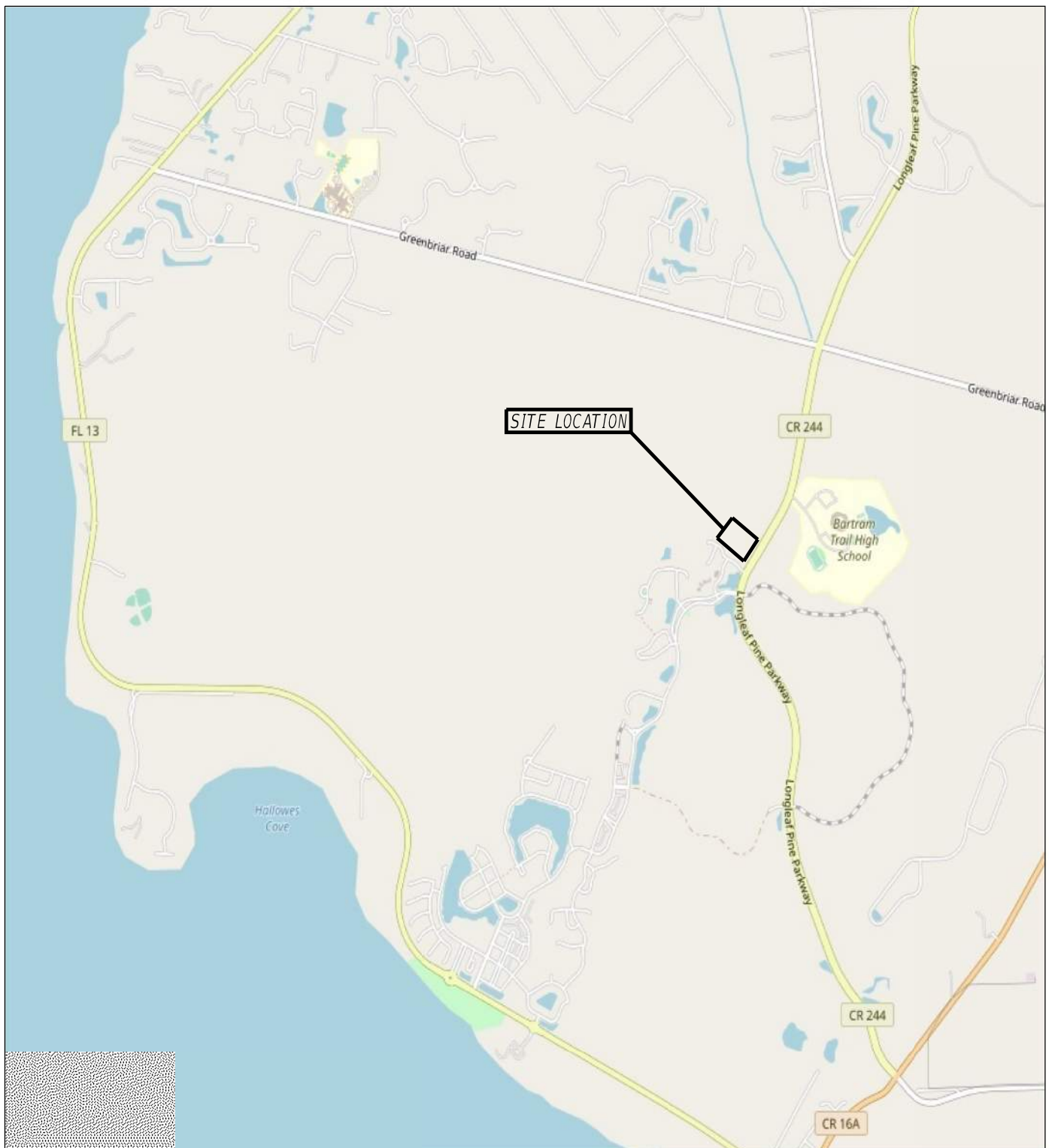
The subsurface exploration program including our evaluation and recommendations was performed in general accordance with accepted geotechnical engineering principles and standard practices. CSI Geo is not responsible for any independent conclusions, opinions, or interpretations made by others based on the data presented in this report.

This report does not reflect any variations that may occur adjacent or between soil borings. The discovery of any site or subsurface condition during construction that deviates from the findings and data as presented in this report should be reported to CSI Geo for evaluation. If the location of the proposed project features is changed, our office should be contacted so our recommendations can be re-evaluated. We recommend that CSI Geo be given the opportunity to review the final design drawings and specifications to ensure that our recommendations are properly included and implemented.

# **Appendix A – Maps**

- Site Location Map
- Field Exploration Plan

## **Site Location Map**



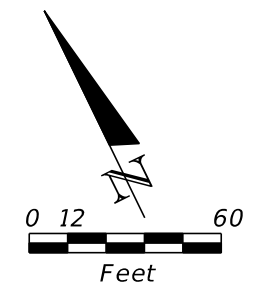
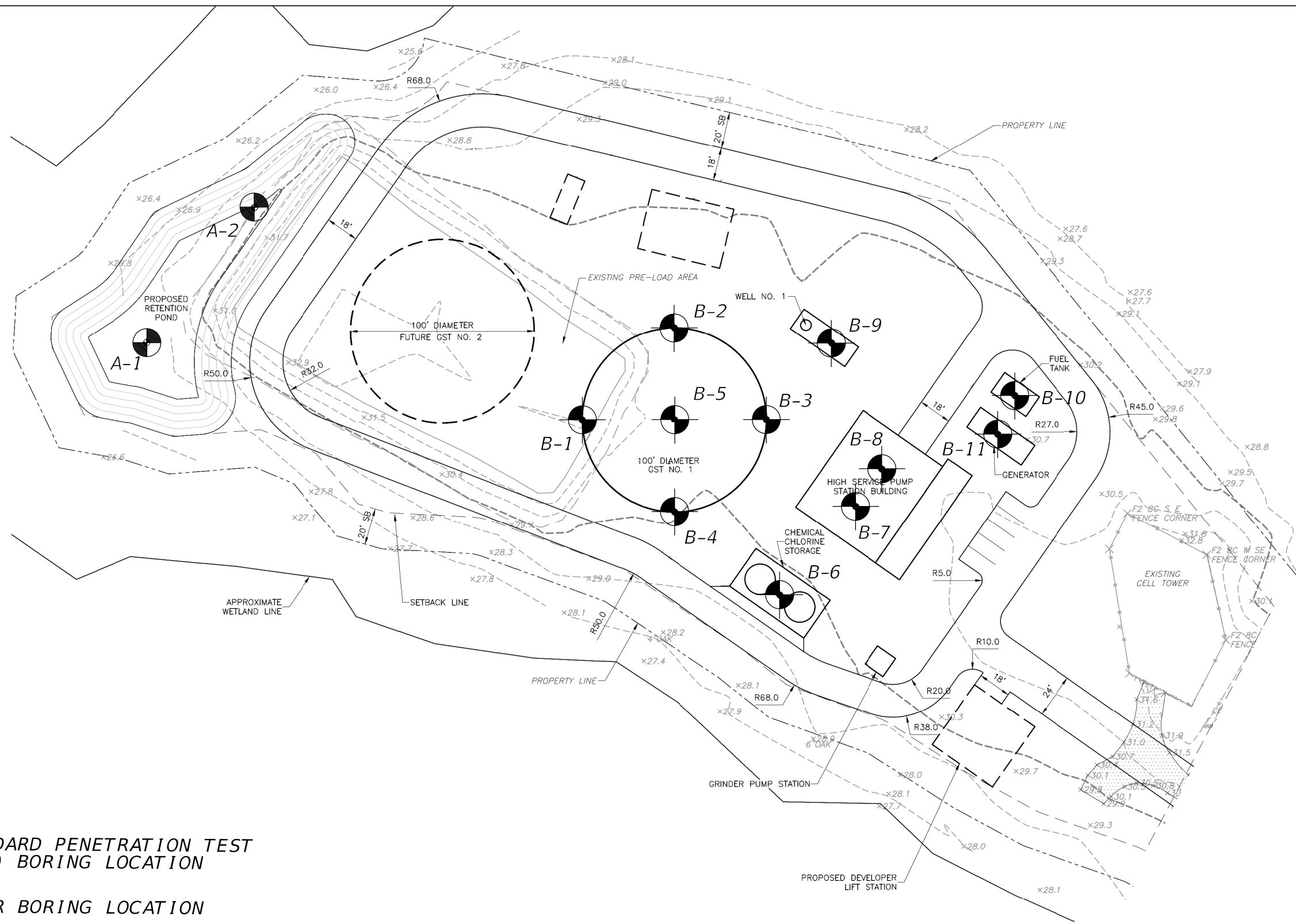
CSI GEO, INC.  
2394 ST. JOHNS BLUFF ROAD S., SUITE 200  
JACKSONVILLE, FLORIDA 32246

SITE LOCATION MAP  
RIVERTOWN WATER TREATMENT PLANT  
ST. JOHNS COUNTY, FLORIDA



# **Field Exploration Plan**





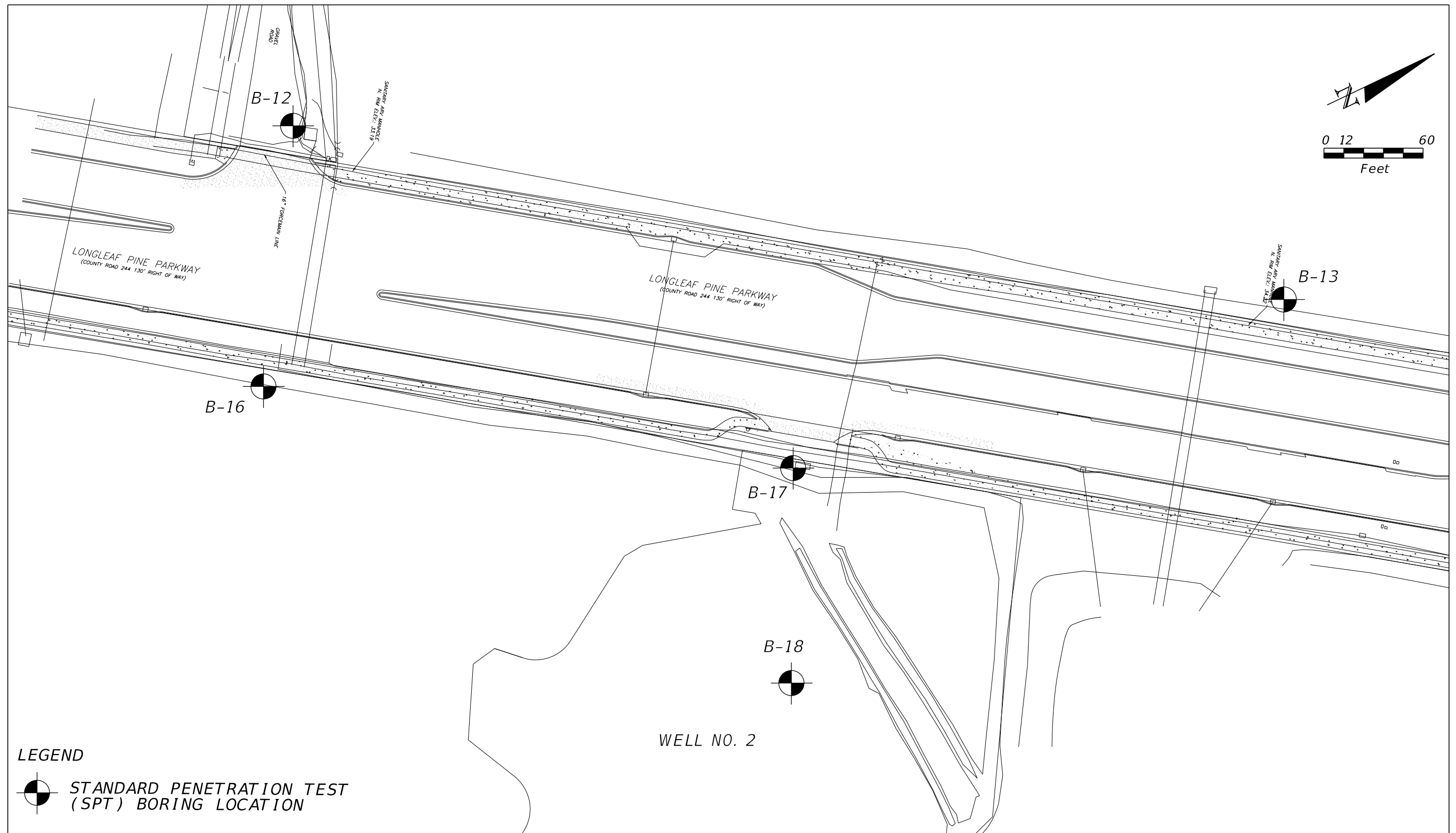
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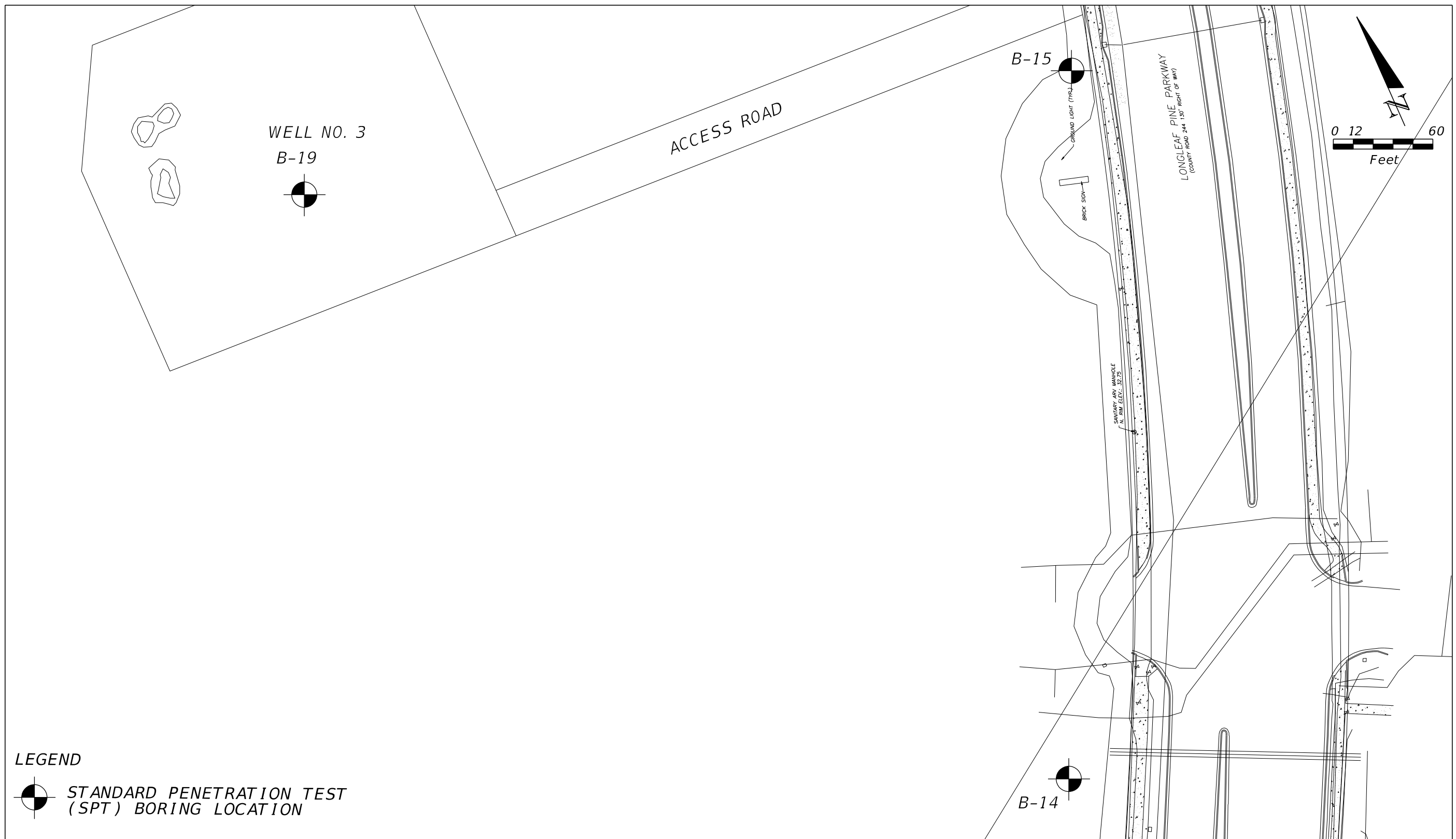
- STANDARD PENETRATION TEST (SPT) BORING LOCATION
- AUGER BORING LOCATION

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GEOTECHNICAL ENGINEERING  
 CONSTRUCTION MATERIAL TESTING  
 CONSTRUCTION ENGINEERING INSPECTION

FIELD EXPLORATION PLAN  
 RIVERTOWN WATER TREATMENT PLANT  
 ST. JOHNS COUNTY, FLORIDA







## **Appendix B – Field Exploration, Evaluation & Laboratory Testing**

- Report of SPT Borings
- Report of Core Borings (Retention Pond)
- Recommended Soil Parameters for Horizontal Directional Drilling Design
- Recommended Soil Parameters for Sheet Pile Walls
- Tank Settlement Analysis Results
- Summary of Laboratory Test Results
- Grain Size Distribution Curves

# **Report of SPT Borings**



# GROUND STORAGE TANK (GST)

## LEGEND



FINE SAND (SP);  
SLIGHTLY SILTY FINE SAND  
(SP-SM); SLIGHTLY CLAYEY  
FINE SAND (SP-SC)



SANDY SILT (MH)



SILTY FINE SAND (SM)



ORGANIC SLIGHTLY SILTY SAND  
(SP-SM/PT); ORGANIC SILTY  
SAND (SM/PT); WOOD PIECES;  
HIGHLY ORGANIC SILTY SAND (PT)



CLAYEY FINE SAND (SC)



LIMESTONE



SANDY CLAY (CL/CH)



SHELLS



CLAY (CH)



GRAVEL

(SP) USCS SOIL CLASSIFICATION SYSTEM

ESTIMATED SEASONAL HIGH GROUND WATER LEVEL

GROUND WATER LEVEL AT TIME OF DRILLING

B.T. SPT BORING TERMINATION

50/X" BLOWS PER X INCREMENTS IN INCHES

WOH WEIGHT OF HAMMER

N STANDARD PENETRATION RESISTANCE IN BLOWS PER FOOT. NUMBERS TO THE LEFT OF BORING INDICATE N-VALUES

## GRANULAR MATERIALS

RELATIVE DENSITY	AUTOMATIC HAMMER SPT N-VALUE (BLOWS/FT)
VERY LOOSE	LESS THAN 3
LOOSE	3-8
MEDIUM DENSE	8-24
DENSE	24-40
VERY DENSE	GREATER THAN 40

## STANDARD PENETRATION TEST DATA

SPOON INSIDE DIA. 1.44 INCHES  
SPOON OUTSIDE DIA. 2.0 INCHES  
ASTM STANDARD DROP HAMMER

AVG. HAMMER DROP 30.0 INCHES  
HAMMER WEIGHT 140.0 LBS

## SILTS AND CLAYS

CONSISTENCY	AUTOMATIC HAMMER SPT N-VALUE (BLOWS/FT)
VERY SOFT	LESS THAN 1
SOFT	1-3
FIRM	3-6
STIFF	6-12
VERY STIFF	12-24
HARD	GREATER THAN 24

## NOTES:

1) DRILL AND PENETRATION TESTING  
WAS PERFORMED IN ACCORDANCE  
WITH ASTM D-1586.

2) LAYER BOUNDARIES ARE APPROXIMATE  
AND MAY VARY BETWEEN OR AWAY FROM  
BORING LOCATIONS.

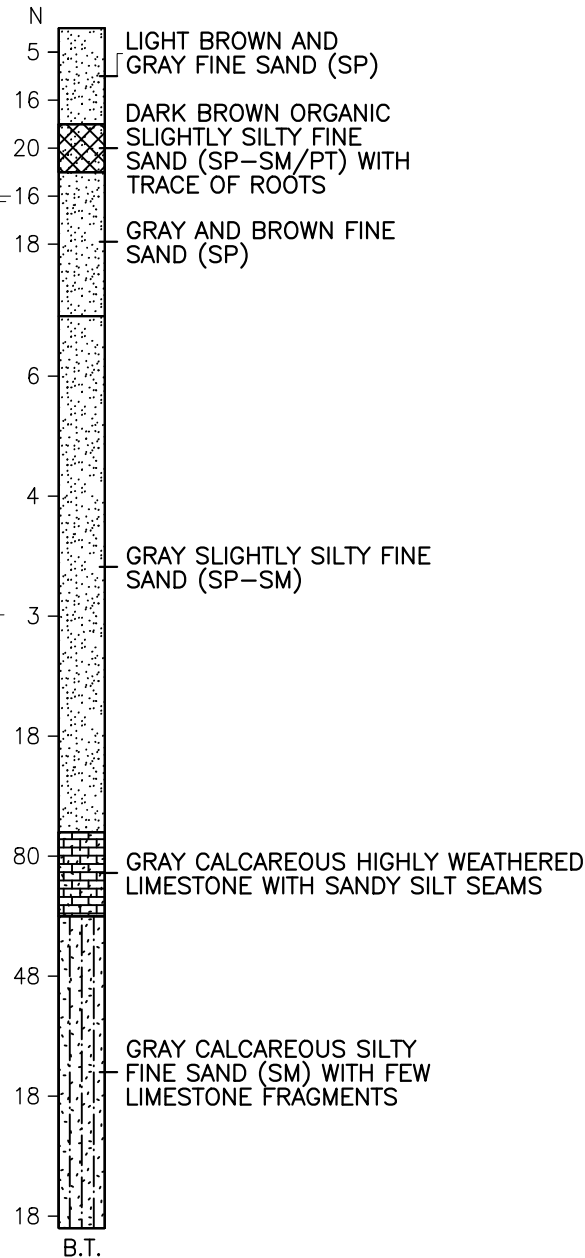
ELEV.  
(FT.)



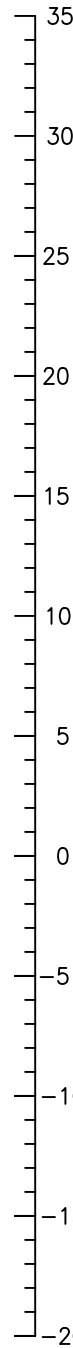
B-1  
LAT: 30°02'42.58"N  
LONG: 81°37'5.93"W  
ELEV.: 33.2'  
DATE: 12-11-19  
HAMMER: AUTO

W=27  
-200=12  
OC%=7.3

W=35  
-200=7



ELEV.  
(FT.)



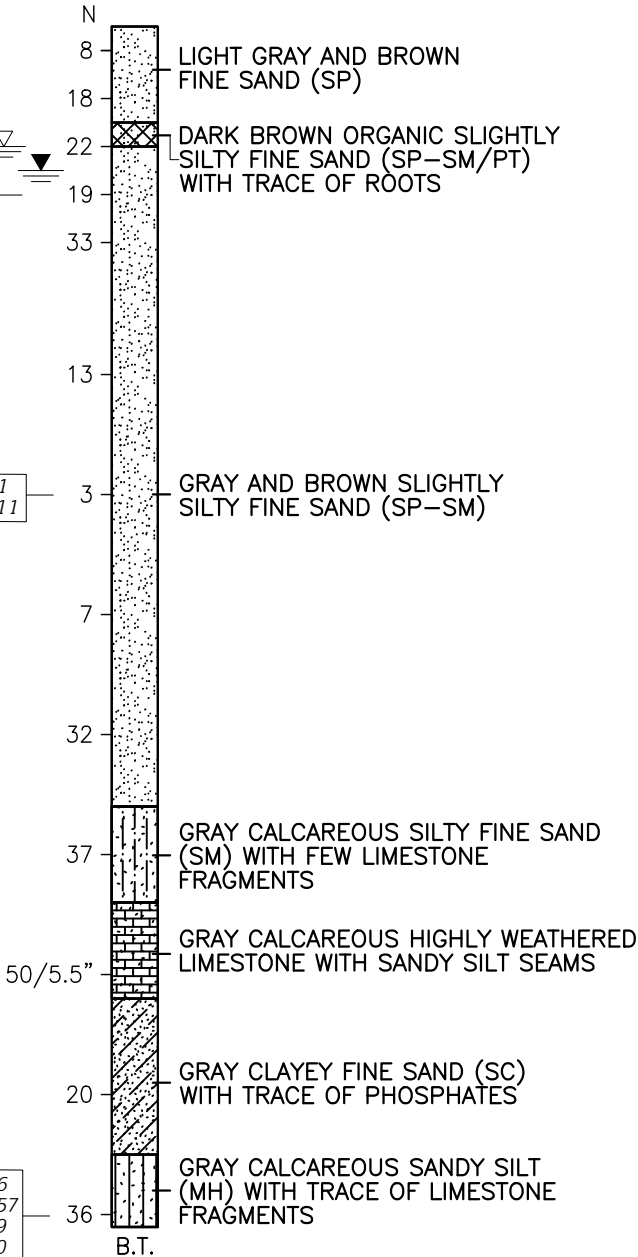
B-2  
LAT: 30°02'42.99"N  
LONG: 81°37'5.46"W  
ELEV.: 30.6'  
DATE: 12-10-19  
HAMMER: AUTO

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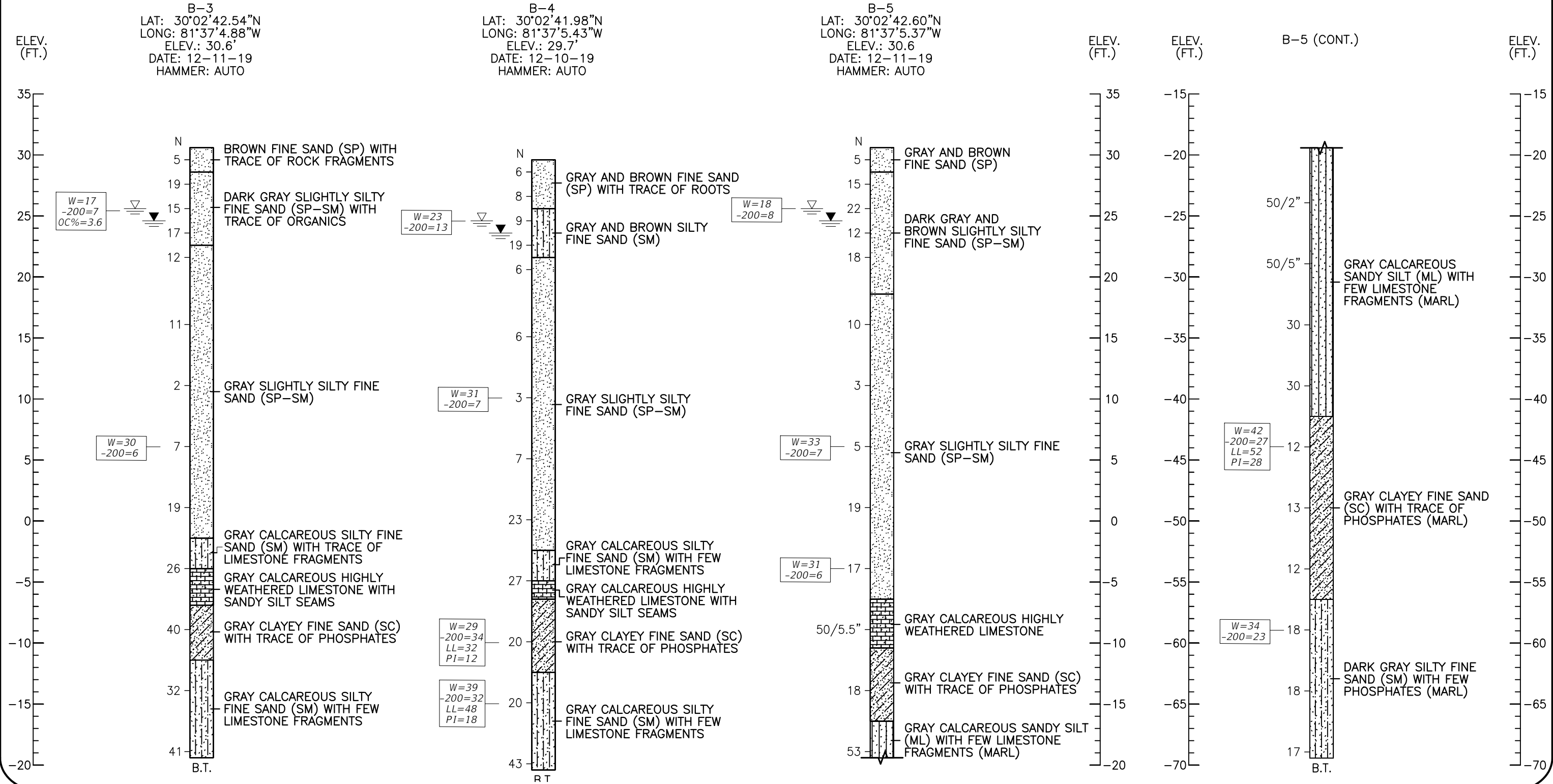
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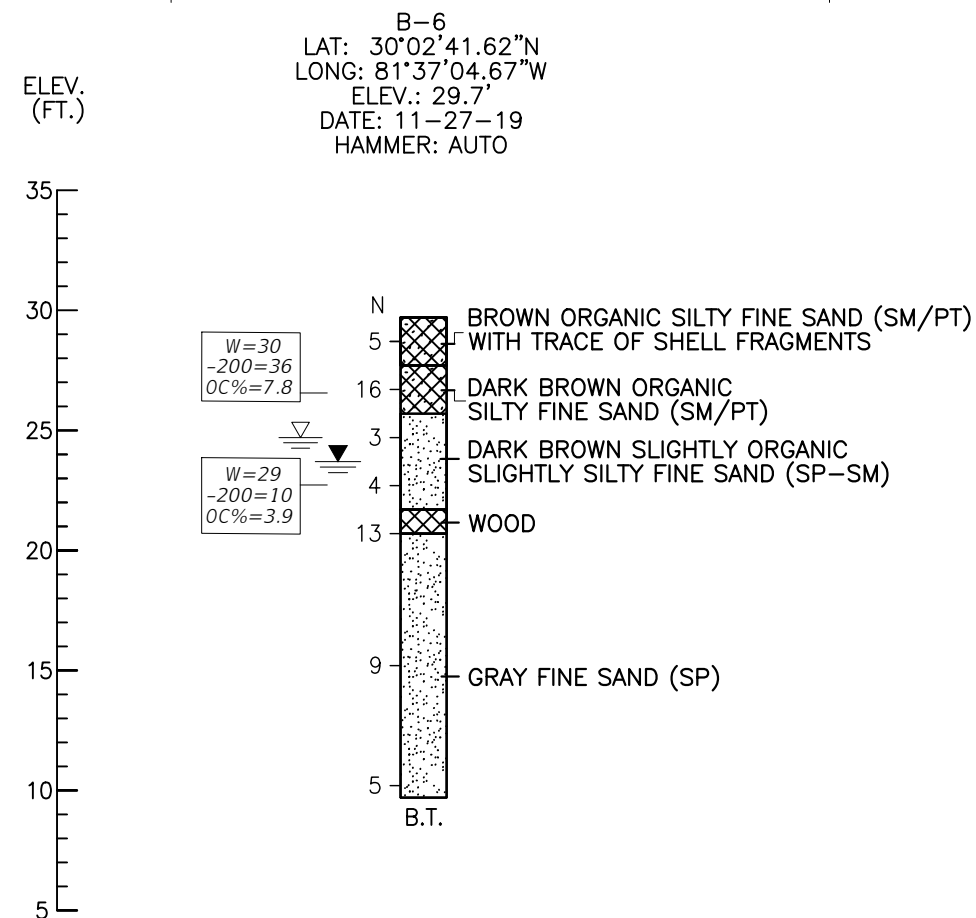
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PI=40



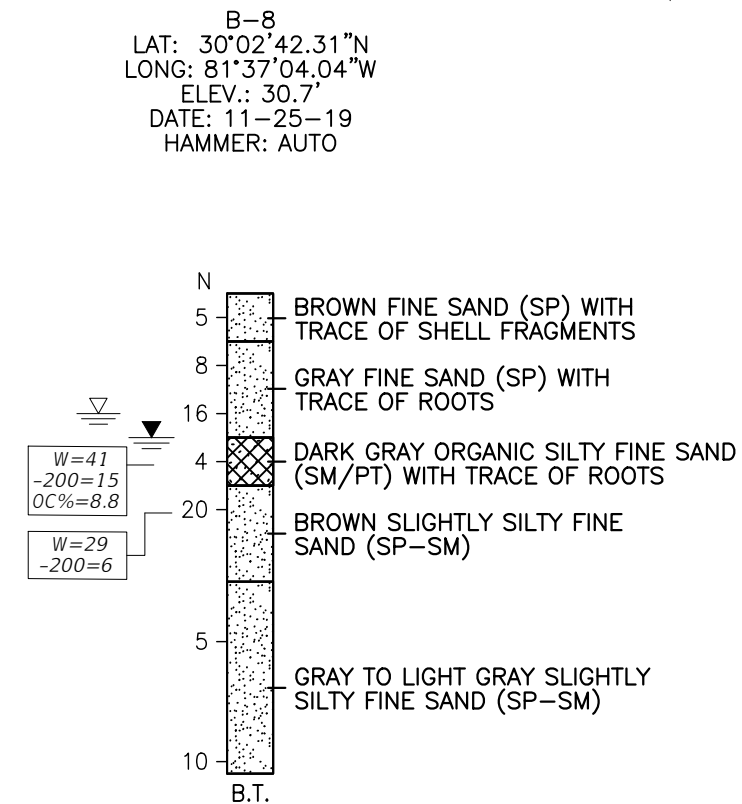
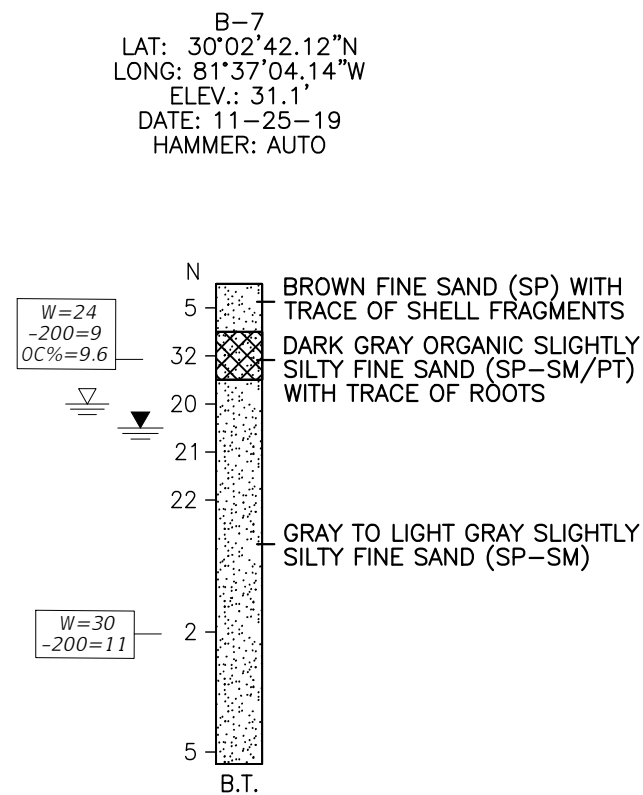
GROUND STORAGE TANK (GST)

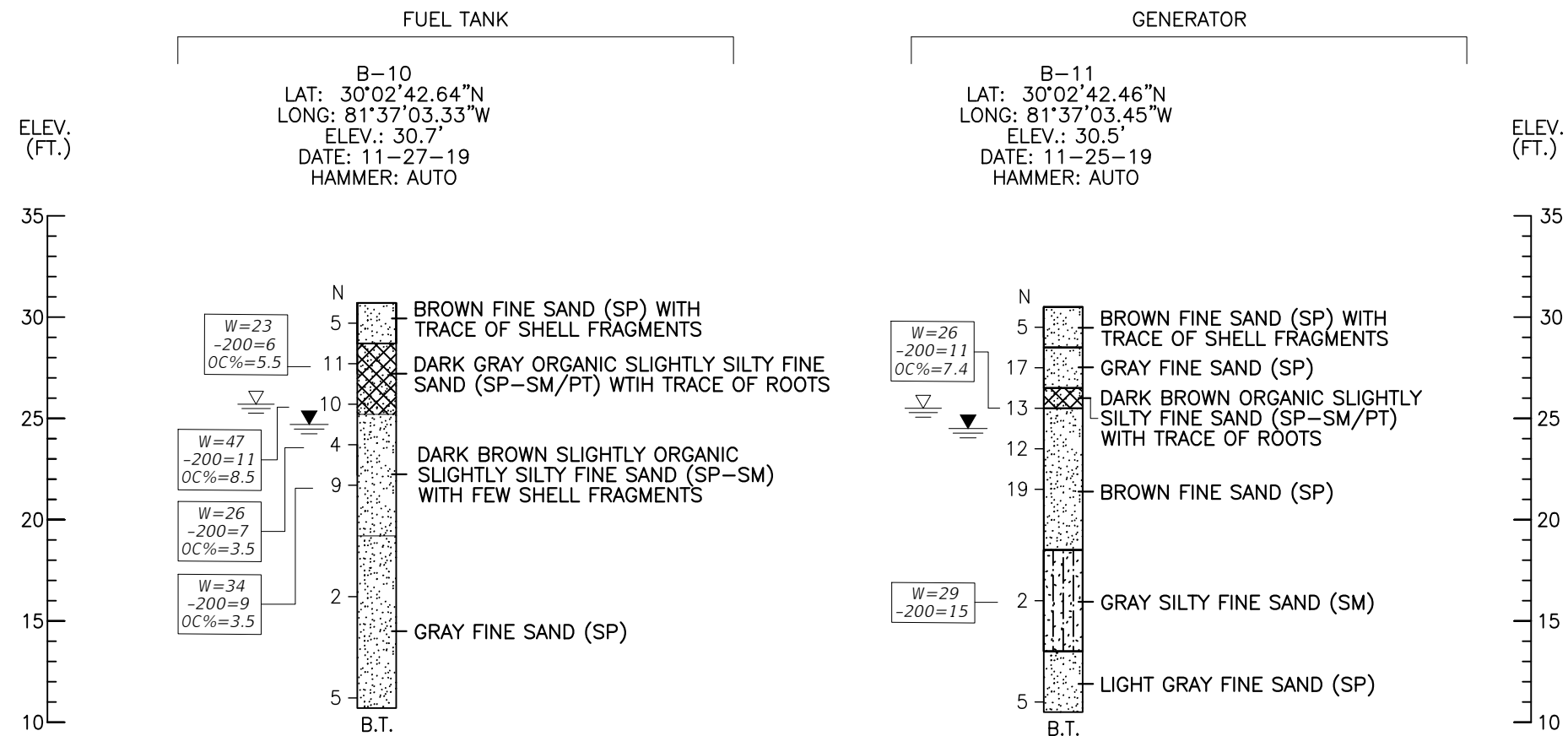


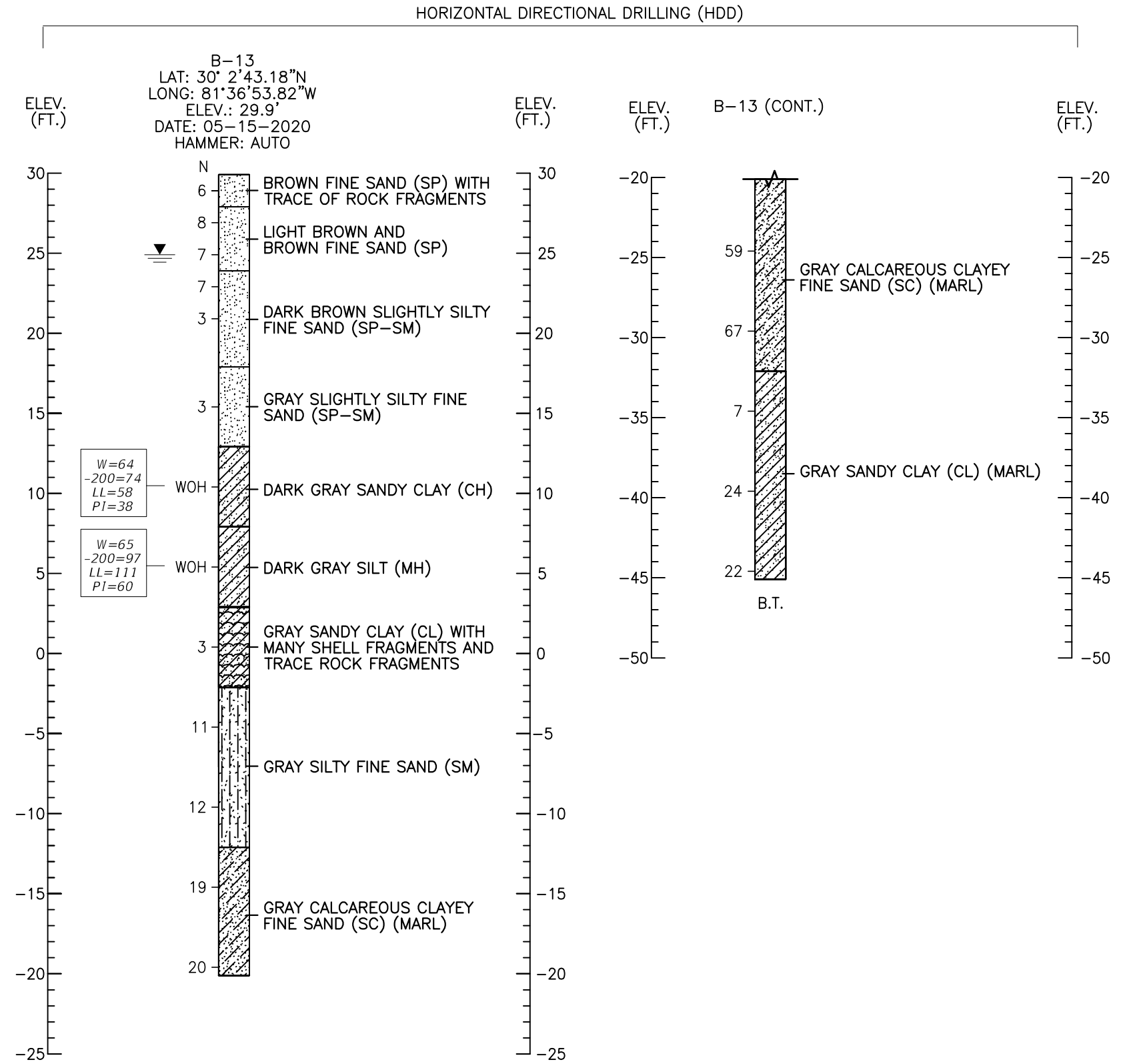
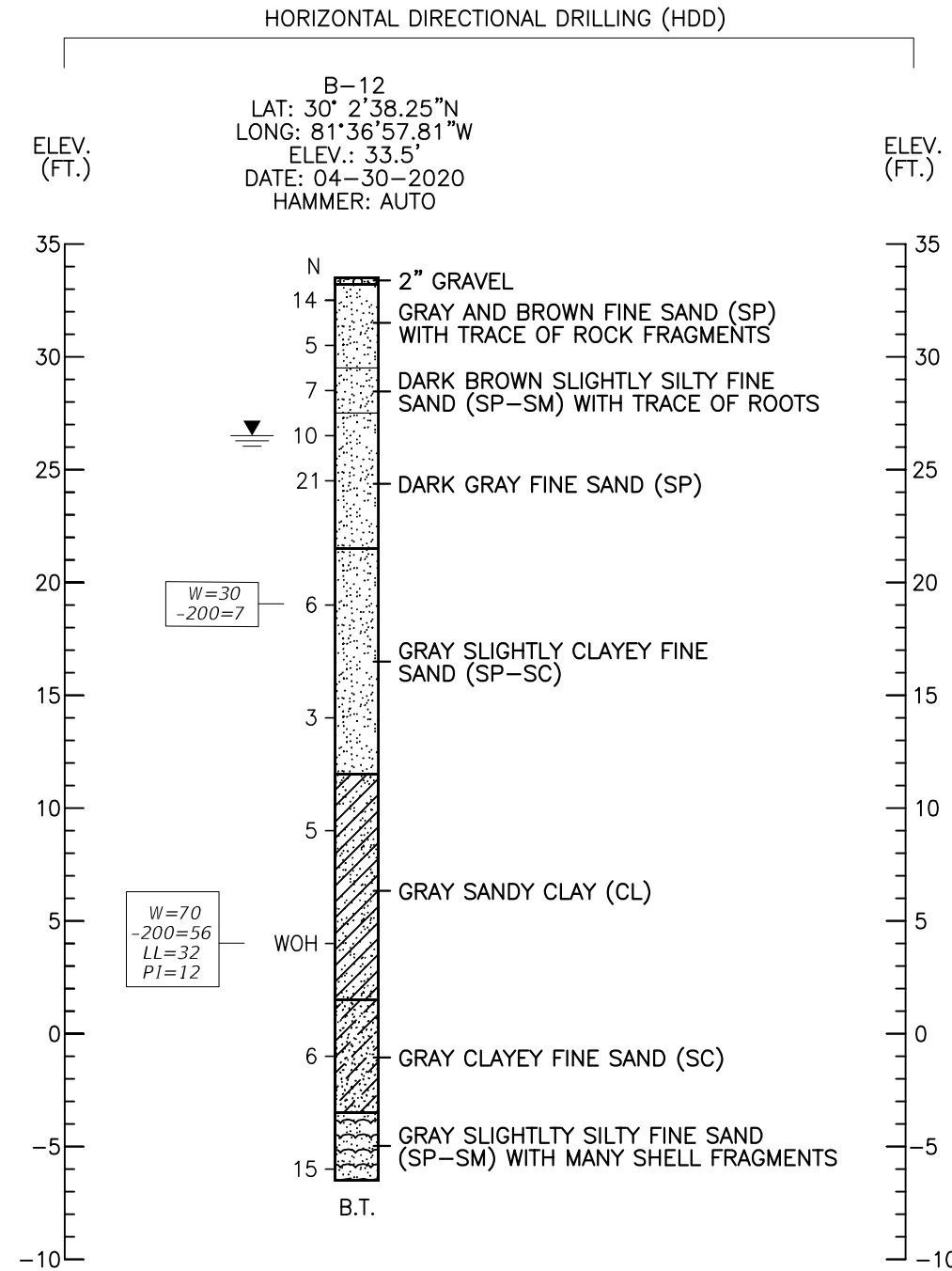
# CHEMICAL CHLORINE STORAGE



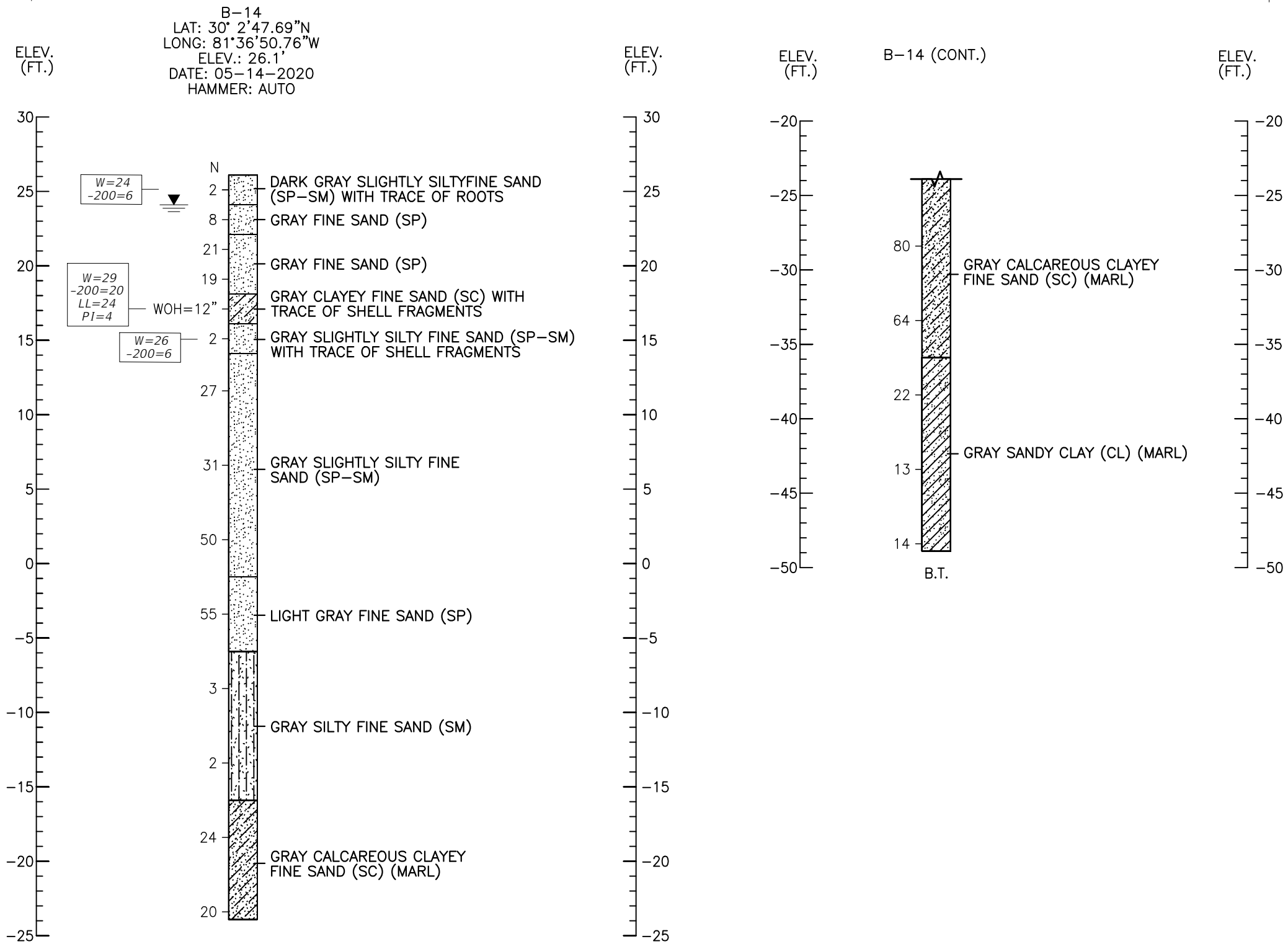
# HIGH SERVICE PUMP STATION BUILDING



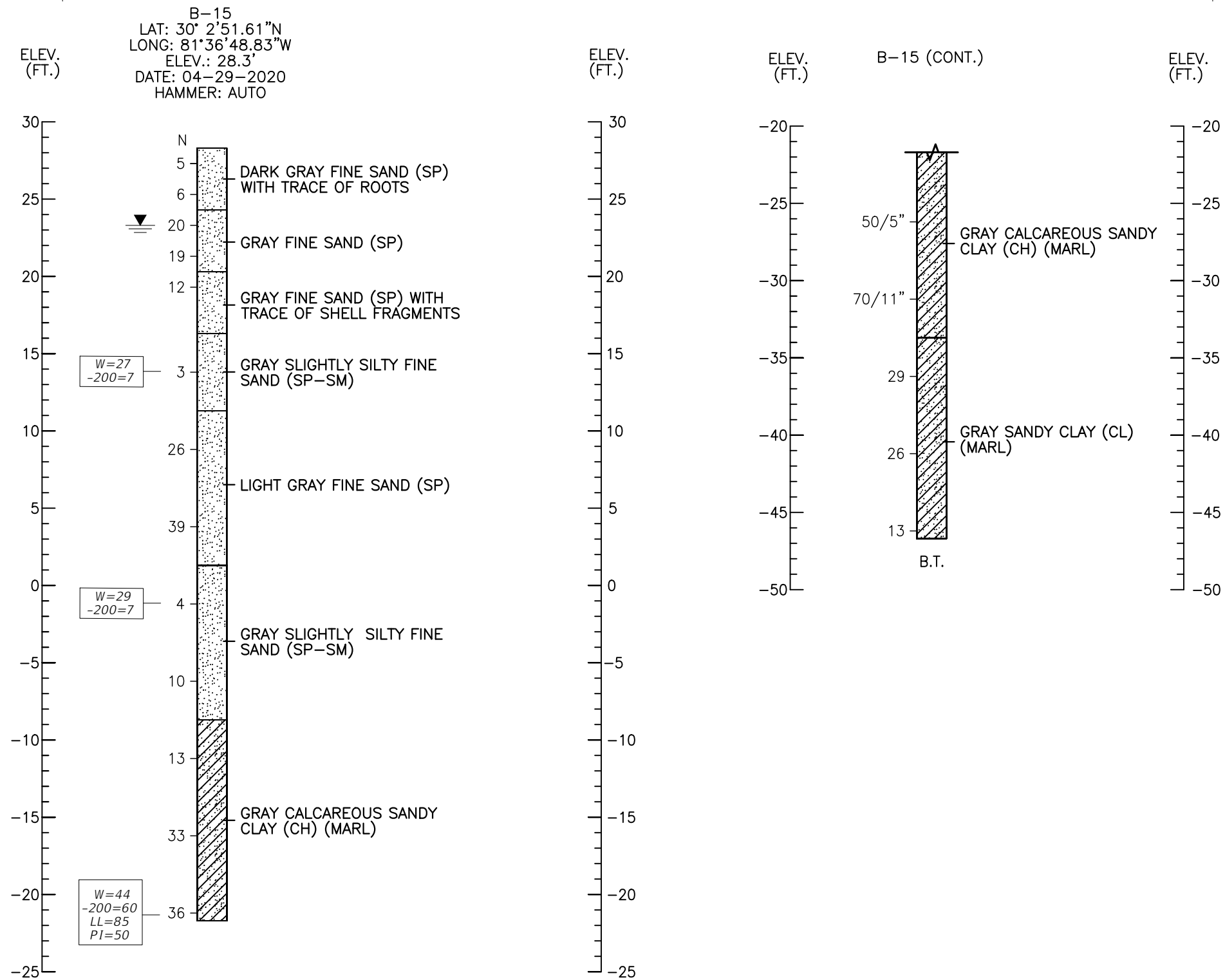


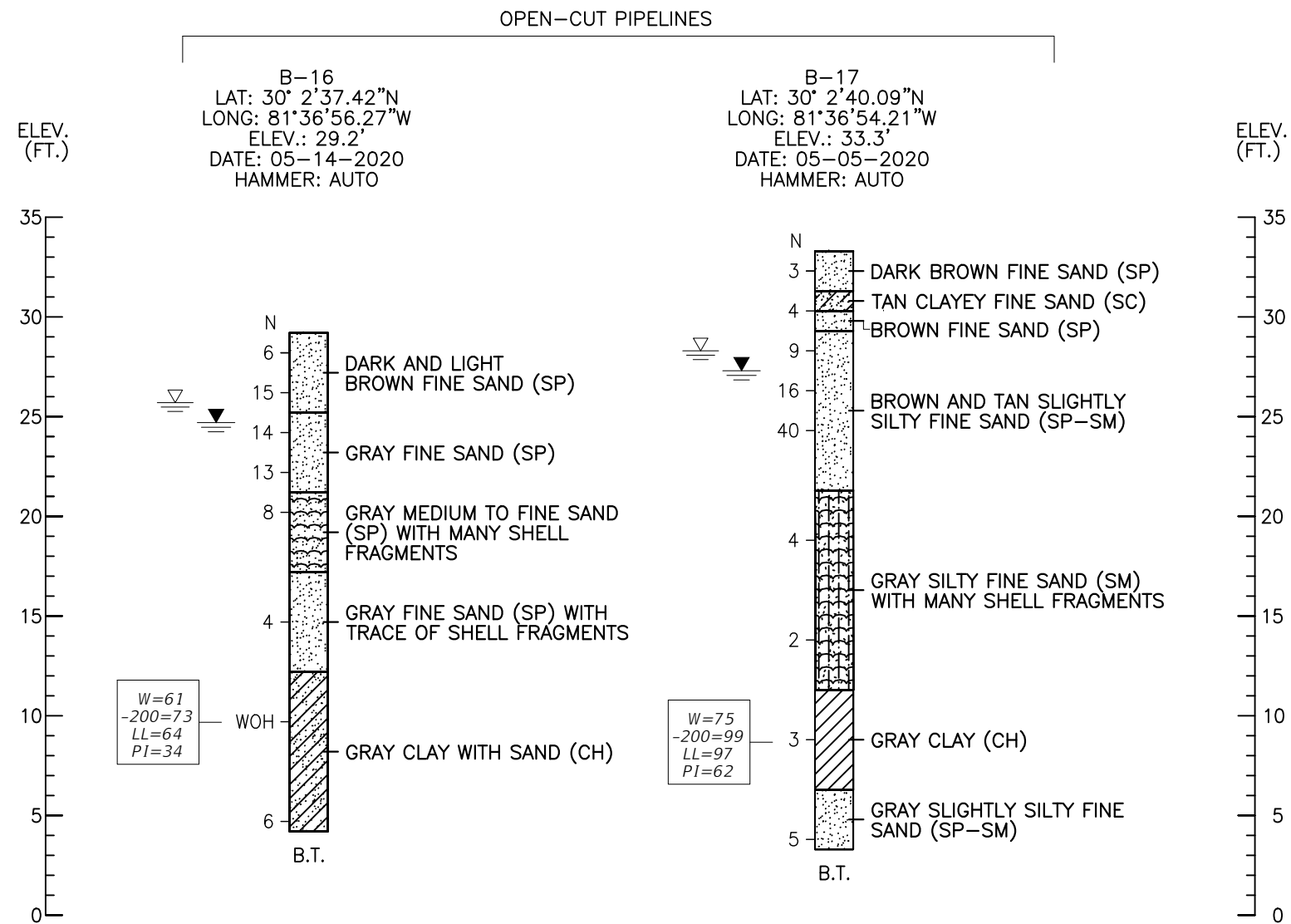


# HORIZONTAL DIRECTIONAL DRILLING (HDD)

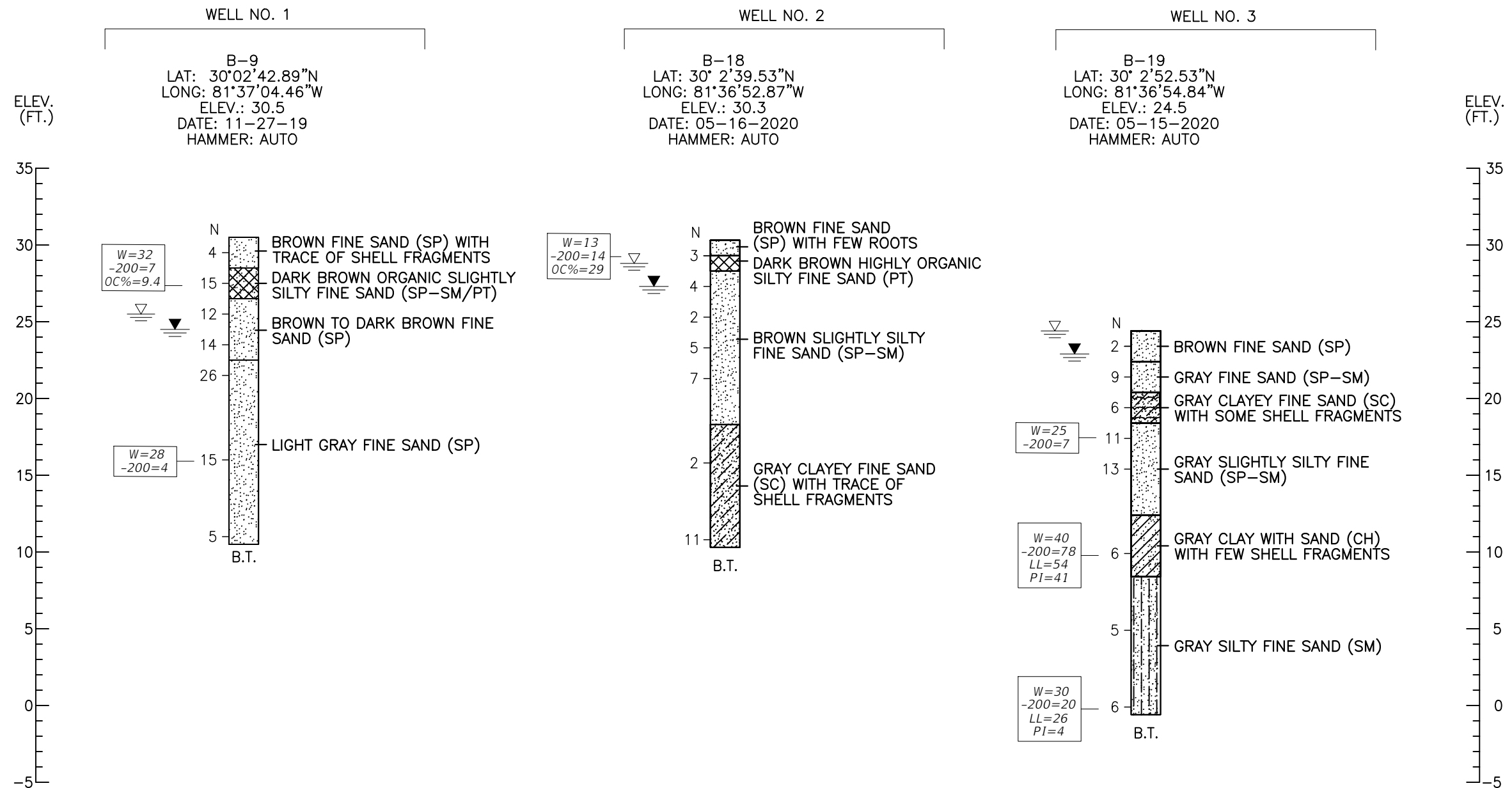


HORIZONTAL DIRECTIONAL DRILLING (HDD) & ACCESS ROAD











# **Report of Core Borings**



LEGEND

 FINE SAND (SP);  
SLIGHTLY SILTY FINE SAND (SP-SM)

 SILTY FINE SAND (SM)

(SP) USCS SOIL CLASSIFICATION SYSTEM

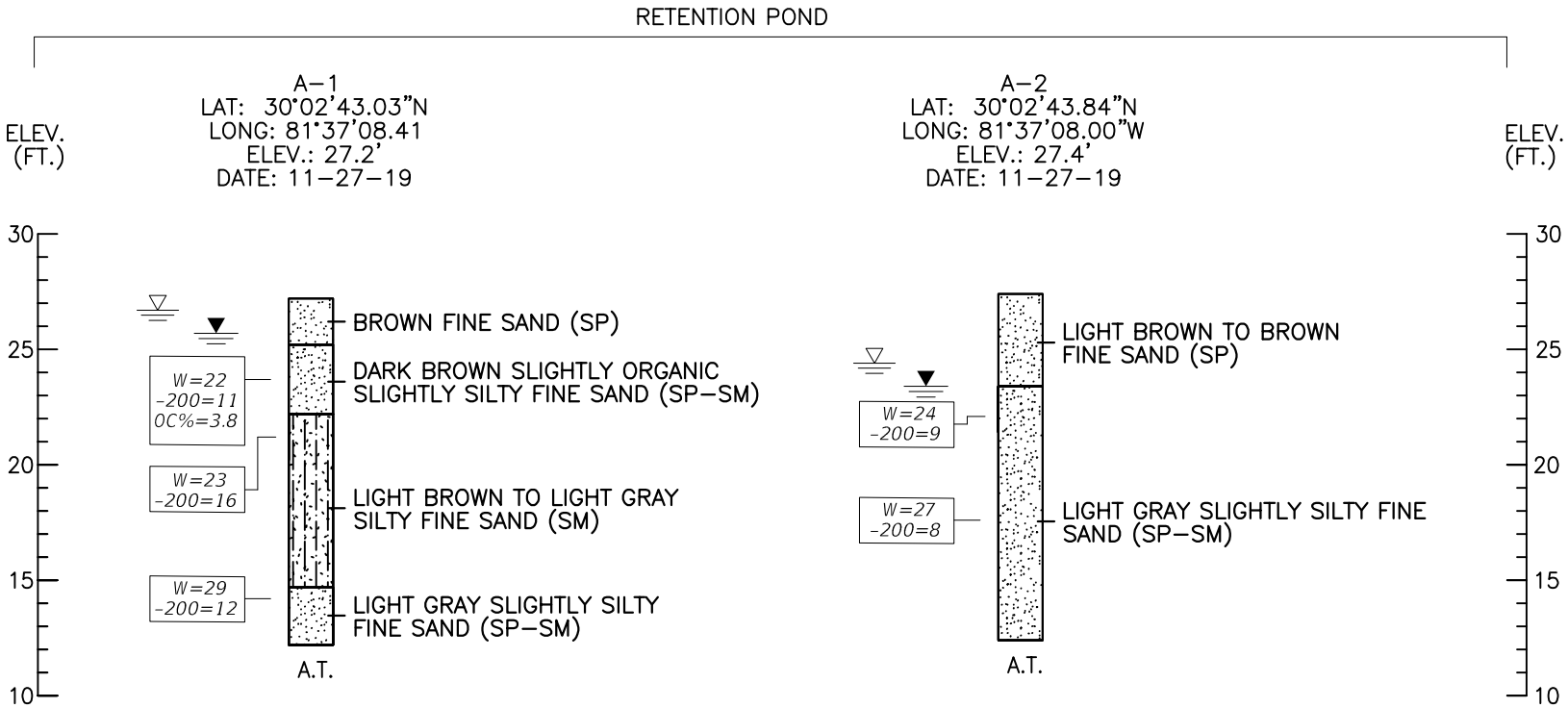
 ESTIMATED SEASONAL HIGH GROUND  
WATER LEVEL

 GROUND WATER LEVEL AT TIME OF  
DRILLING

A.T. AUGER BORING TERMINATION

NOTES:

LAYER BOUNDARIES ARE APPROXIMATE AND  
MAY VARY BETWEEN OR AWAY FROM BORING  
LOCATIONS.





# **Recommended Soil Parameters for Horizontal Directional Drilling Design**

## RECOMMENDED SOIL PARAMETERS FOR HORIZONTAL DIRECTIONAL DRILLING DESIGN

### **Boring B-12**

Soil Parameter	Loose to Medium Dense Sands	Loose Sands	Firm Clays	Very Soft Clays	Loose to Medium Dense Clayey Sands and Sands
Depth (ft)	0.0' - 12.0'	12.0' - 22.0'	22.0' - 27.0'	27.0' - 32.0'	32.0' - 40.0'
Saturated unit weight (pcf)	115	100	95	90	105
Effective unit weight for input purposes (pcf)	53	38	33	28	43
Estimated friction angle $\phi$ (degrees)	33	27	-	-	29
Cohesion (psf)	-	-	900	200	29
At Rest Pressure Coefficient ( $K_o$ )	0.46	0.55	1.0	1.0	0.52
Active Pressure Coefficient ( $K_a$ )	0.29	0.38	1.0	1.0	0.35
Passive Pressure Coefficient ( $K_p$ )	3.39	2.66	1.0	1.0	2.88

Soil parameters provided in the tables are representative of the soil conditions at the variable depths and have been generated based on N-values that were corrected for hammer efficiency and overburden pressure.

### **Boring B-13**

Soil Parameter	Loose Sands	Very Soft Clays	Medium Dense Silty and Clayey Sands	Very Dense Clayey Sands	Stiff to Very Stiff Clays
Depth (ft)	0.0' - 17.0'	17.0' - 32.0'	32.0' - 52.0'	52.0' - 62.0'	62.0' - 75.0'
Saturated unit weight (pcf)	105	90	115	120	105
Effective unit weight for input purposes (pcf)	43	28	53	58	43
Estimated friction angle $\phi$ (degrees)	30	-	30	35	-
Cohesion (psf)	-	200	-	-	2,000
At Rest Pressure Coefficient ( $K_o$ )	0.50	1.0	0.50	0.43	1.0
Active Pressure Coefficient ( $K_a$ )	0.33	1.0	0.33	0.27	1.0
Passive Pressure Coefficient ( $K_p$ )	3.00	1.0	3.00	3.69	1.0

Soil parameters provided in the tables are representative of the soil conditions at the variable depths and have been generated based on N-values that were corrected for hammer efficiency and overburden pressure.



## RECOMMENDED SOIL PARAMETERS FOR HORIZONTAL DIRECTIONAL DRILLING DESIGN

### **Boring B-14**

Soil Parameter	Medium Dense to Dense Sands	Very Loose Sands	Dense to Very Dense Sands	Very Loose Silty Sands	Medium Dense Clayey Sands	Very Dense Clayey Sands (Marl)	Very Stiff Clays (Marl)
Depth (ft)	0.0' - 8.0'	8.0' - 12.0'	12.0' - 32.0'	32.0' - 42.0'	42.0' - 52.0'	52.0' - 62.0'	62.0' - 75.0'
Saturated unit weight (pcf)	115	95	120	100	120	120	105
Effective unit weight for input purposes (pcf)	53	33	58	38	58	58	43
Estimated friction angle $\phi$ (degrees)	33	27	36	26	32	35	-
Cohesion (psf)	-	-	-	-	-	-	2,000
At Rest Pressure Coefficient ( $K_o$ )	0.46	0.55	0.41	0.56	0.47	0.43	1.0
Active Pressure Coefficient ( $K_a$ )	0.29	0.38	0.26	0.39	0.31	0.27	1.0
Passive Pressure Coefficient ( $K_p$ )	3.39	2.66	3.85	2.56	3.25	3.69	1.0

Soil parameters provided in the tables are representative of the soil conditions at the variable depths and have been generated based on N-values that were corrected for hammer efficiency and overburden pressure.

### **Boring B-15**

Soil Parameter	Medium Dense Sands	Very Loose Sands	Dense Sands	Loose Sands	Dense Clayey Sands	Hard Clays
Depth (ft)	0.0' - 12.0'	12.0' - 17.0'	17.0' - 27.0'	27.0' - 37.0'	37.0' - 62.0'	62.0' - 75.0'
Saturated unit weight (pcf)	115	100	120	105	120	115
Effective unit weight for input purposes (pcf)	53	38	58	43	58	53
Estimated friction angle $\phi$ (degrees)	33	28	36	28	33	-
Cohesion (psf)	-	-	-	-	-	2,000
At Rest Pressure Coefficient ( $K_o$ )	0.46	0.53	0.41	0.53	0.46	1.0
Active Pressure Coefficient ( $K_a$ )	0.29	0.36	0.26	0.36	0.29	1.0
Passive Pressure Coefficient ( $K_p$ )	3.39	2.77	3.85	2.77	3.39	1.0

Soil parameters provided in the tables are representative of the soil conditions at the variable depths and have been generated based on N-values that were corrected for hammer efficiency and overburden pressure.

## **Recommended Soil Parameters for Sheet Pile Walls**

## RECOMMENDED SOIL PARAMETERS FOR SHEET PILE WALLS

### **Boring B-15**

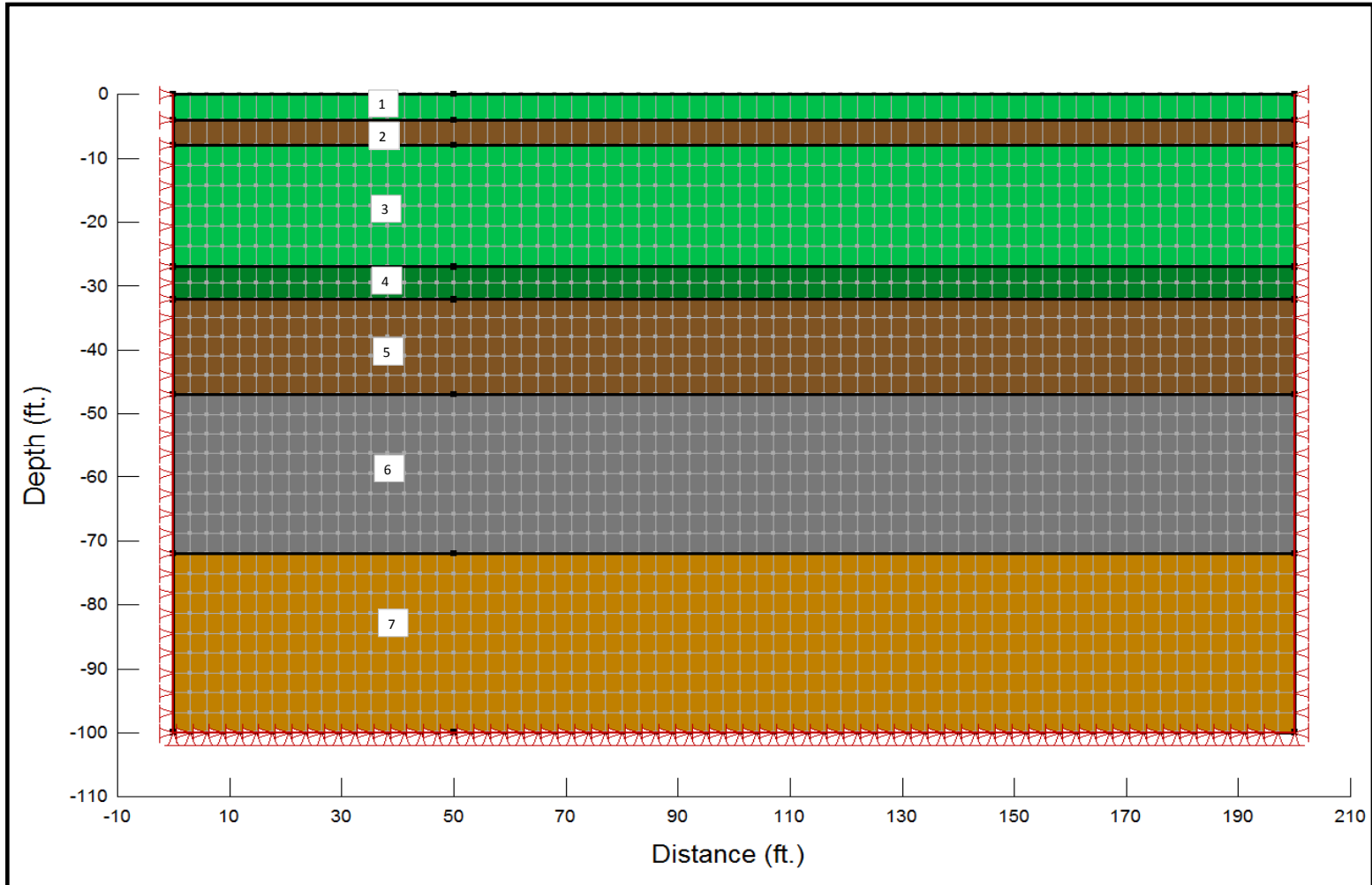
Soil Parameter	Medium Dense Sands	Very Loose Sands	Dense Sands	Loose Silty Sands
Depth (ft)	0.0' - 12.0'	12.0' - 17.0'	17.0' - 27.0'	27.0' - 37.0'
Saturated unit weight (pcf)	115	100	120	105
Effective unit weight for input purposes (pcf)	53	38	58	43
Estimated friction angle $\phi$ (degrees)	33	28	36	27
Estimated Wall Friction (degrees)	17	14	18	14
Cohesion (psf)	-	-	-	-
At Rest Pressure Coefficient ( $K_o$ )	0.46	0.53	0.41	0.55
Active Pressure Coefficient ( $K_a$ )	0.29	0.36	0.26	0.38
Passive Pressure Coefficient ( $K_p$ )	3.39	2.77	3.85	2.66

## **Tank Settlement Analysis Results**

## Settlement Analysis Results

Analysis Information	
Project:	Rivertown WTP
Location:	B-5
Bearing Pressure	2,000 psf
GWT:	5' in depth

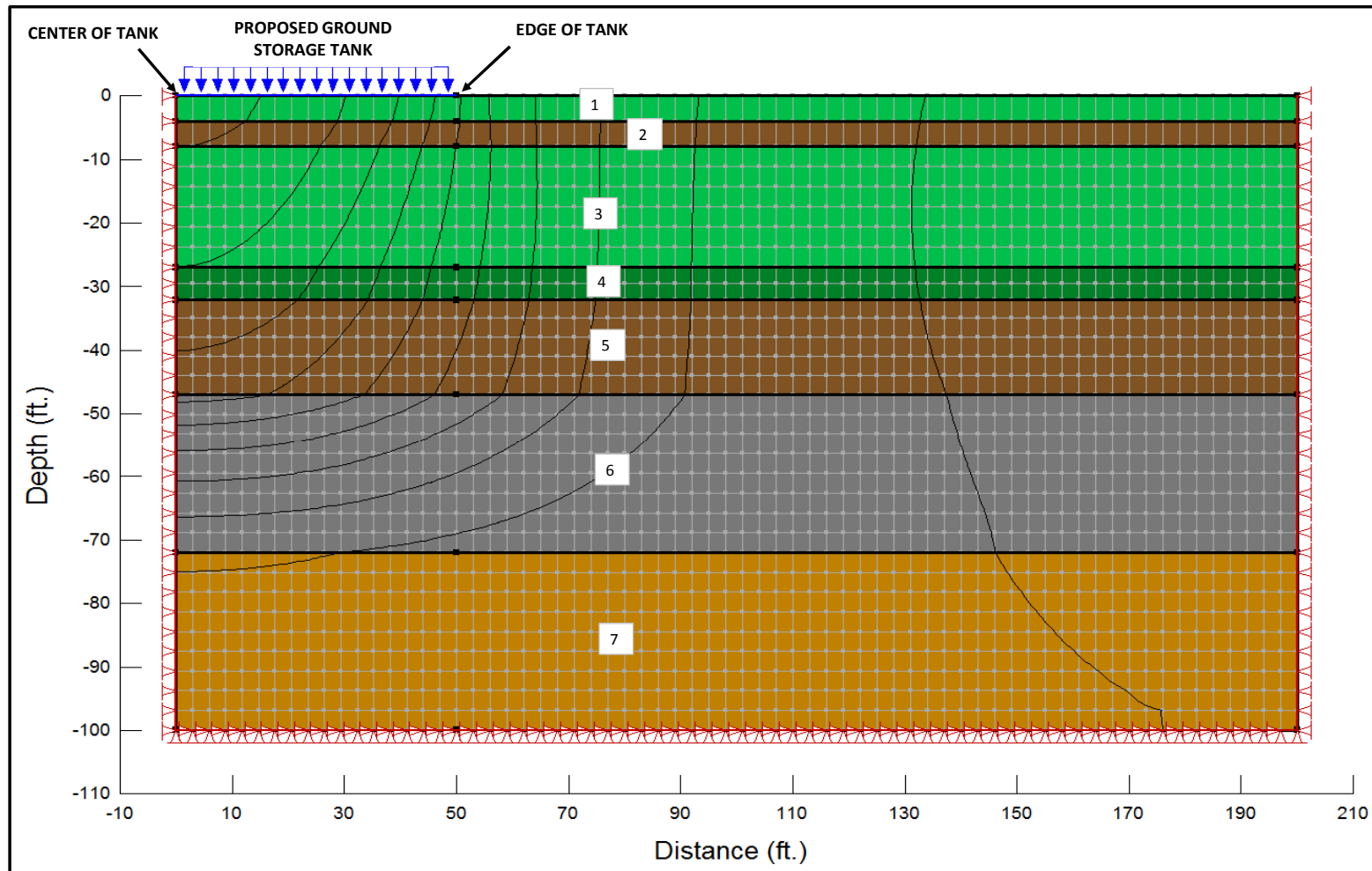
Soil Information									
Stratum	Color	Description	Unit Weight (pcf)	Elastic	Consolidation				
				E (ksf)	OCR	e <sub>o</sub>	C <sub>c</sub>	C <sub>v</sub> (ft <sup>2</sup> /day)	C <sub>α</sub>
1		Medium Dense SP < 20	110	500	-	-	-	-	-
2		Medium Dense SM > 20	115	350	-	-	-	-	-
3		Medium Dense SP < 20	110	500	-	-	-	-	-
4		Medium Dense SP > 20	115	700	-	-	-	-	-
5		Medium Dense SM > 20	115	350	-	-	-	-	-
6		Very Hard SILT	120	-	2.0	0.6	0.4	-	-
7		Medium Dense SC/SM < 20	110	250	-	-	-	-	-



## Settlement Analysis Results

Settlement Results							
Section	Color	Description	Depth to Bottom	Elastic Settlement (in)	Primary Consolidation (in)	Total Settlement (in)	*Differential Settlement (in.)
1	Green	Medium Dense SP < 20	4	0.1	---	0.1	0.0
2	Brown	Medium Dense SM > 20	8	0.2	---	0.2	0.1
3	Green	Medium Dense SP < 20	27	0.6	---	0.6	0.3
4	Brown	Medium Dense SP > 20	32	0.2	---	0.2	0.1
5	Brown	Medium Dense SM > 20	47	0.7	---	0.7	0.4
6	Grey	Very Hard SILT	72	---	1.6	1.6	0.8
7	Orange	Medium Dense SC/SM < 20	100	0.7	---	0.7	0.2
Total						4.0	1.9

\*Differential Settlement is Estimated between Center and Edge of Tank



## **Summary of Laboratory Test Results**

## SUMMARY OF LABORATORY TEST RESULTS

Rivertown Water Treatment Plant  
St. Johns County, Florida  
Water Treatment Plant - Structures

Boring No.	Sample No.	Approximate Depth (ft)	Natural Moisture Content (%)	Organic Content (%)	Percent Passing Sieve Size (%)						Atterberg Limits		Soil Classification Symbol
					#4	#10	#40	#60	#100	#200	LL	PI	
B-1	3	4.0 - 6.0	27	7.3						12			SP-SM/PT
B-1	8	23.5 - 25.0	35							7			SP-SM
B-2	3	4.0 - 5.0	23	6.3						10			SP-SM/PT
B-2	4	6.0 - 8.0	24							11			SP-SM
B-2	7	18.5 - 20.0	31							11			SP-SM
B-2	13	48.5 - 50.0	46							57	79	40	MH
B-3	3	4.0 - 6.0	17	3.6						7			SP-SM
B-3	8	23.5 - 25.0	30							6			SP-SM
B-4	3	4.0 - 6.0	23							13			SM
B-4	7	18.5 - 20.0	31							7			SP-SM
B-4	11	38.5 - 40.0	29							34	32	12	SC
B-4	12	43.5 - 45.0	39							32	48	18	SM
B-5	3	4.0 - 6.0	18							8			SP-SM
B-5	8	23.5 - 25.0	33							7			SP-SM
B-5	10	33.5 - 35.0	31							6			SP-SM
B-5	18	73.5 - 75.0	42							27	52	28	SC
B-5	21	88.5 - 90.0	34							23			SM
B-6	2	2.0 - 4.0	30	7.8						36			SM/PT
B-6	4	6.0 - 8.0	29	3.9	99	98	97	94	48	10			SP-SM
B-7	2	2.0 - 4.0	24	9.6						9			SP-SM/PT
B-7	6	13.5 - 15.0	30							11			SP-SM
B-8	4	6.0 - 8.0	41	8.8						15			SM/PT
B-8	5	8.0 - 10.0	29		100	100	100	97	44	6			SP-SM
B-9	2	2.0 - 4.0	32	9.4						7			SP-SM/PT
B-9	6	13.5 - 15.0	28							4			SP
B-10	2	2.0 - 4.0	23	5.5						6			SP-SM/PT
B-10	3	4.0 - 5.5	47	8.5						11			SP-SM/PT
B-10	4	6.0 - 8.0	26	3.5	100	98	91	86	37	7			SP-SM
B-10	5	8.0 - 10.0	34	3.5						9			SP-SM



**SUMMARY OF LABORATORY TEST RESULTS**

Rivertown Water Treatment Plant  
St. Johns County, Florida  
Water Treatment Plant - Structures

Boring No.	Sample No.	Approximate Depth (ft)	Natural Moisture Content (%)	Organic Content (%)	Percent Passing Sieve Size (%)						Atterberg Limits		Soil Classification Symbol
					#4	#10	#40	#60	#100	#200	LL	PI	
B-11	3	4.0 - 5.0	26	7.4						11			SP-SM/PT
B-11	6	13.5 - 15.0	29							15			SM
B-12	6	13.5 - 15.0	30							7			SP-SC
B-12	9	28.5 - 30.0	70							56	32	12	CL
B-13	7	18.5 - 20.0	64							74	58	38	CH
B-13	8	23.5 - 25.0	65							97	111	60	MH
B-14	1	0.0 - 2.0	24							6			SP-SM
B-14	5	8.0 - 10.0	29							20	24	4	SC
B-14	6	13.5 - 15.0	26							6			SP-SM
B-15	6	13.5 - 15.0	27		100	100	99	96	35	7			SP-SM
B-15	9	28.5 - 30.0	29							7			SP-SM
B-15	13	48.5 - 50.0	44							60	85	50	CH
B-16	7	18.5 - 20.0	61							73	64	34	CH
B-17	8	23.5 - 25.0	75							99	97	62	CH
B-18	1	1.0 - 2.0	13	28.9						14			PT
B-19	4	6.0 - 8.0	25							7			SP-SM
B-19	6	13.5 - 15.0	40							78	54	41	CH
B-19	8	23.5 - 25.0	30							20	26	4	SM

### SUMMARY OF LABORATORY TEST RESULTS

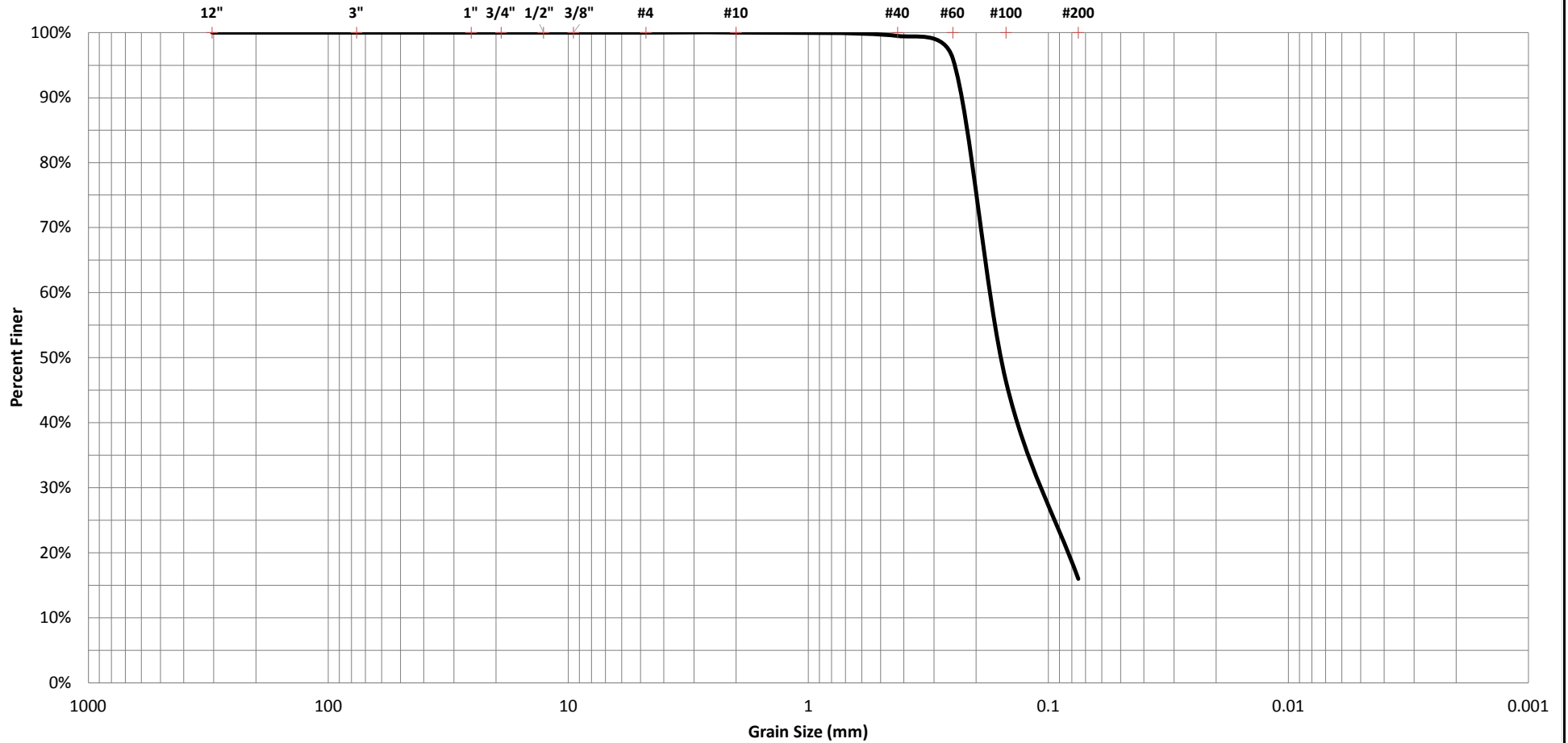
Rivertown Water Treatment Plant  
St. Johns County, Florida  
Retention Pond

Boring No.	Sample No.	Approximate Depth (ft)	Natural Moisture Content (%)	Organic Content (%)	Percent Passing Sieve Size (%)						Atterberg Limits		Soil Classification Symbol
					#4	#10	#40	#60	#100	#200	LL	PI	
A-1	2	2.0 - 5.0	22	3.8						11			SP-SM
A-1	3	5.0 - 7.0	23		100	100	99	96	46	16			SM
A-1	5	12.5 - 15.0	29							12			SP-SM
A-2	2	3.5 - 5.0	24		100	100	99	96	45	9			SP-SM
A-2	4	8.0 - 11.5	27							8			SP-SM

## **Grain Size Distribution Curves**

## GRAIN SIZE DISTRIBUTION GRAPH

### US STANDARD SIEVE SIZES



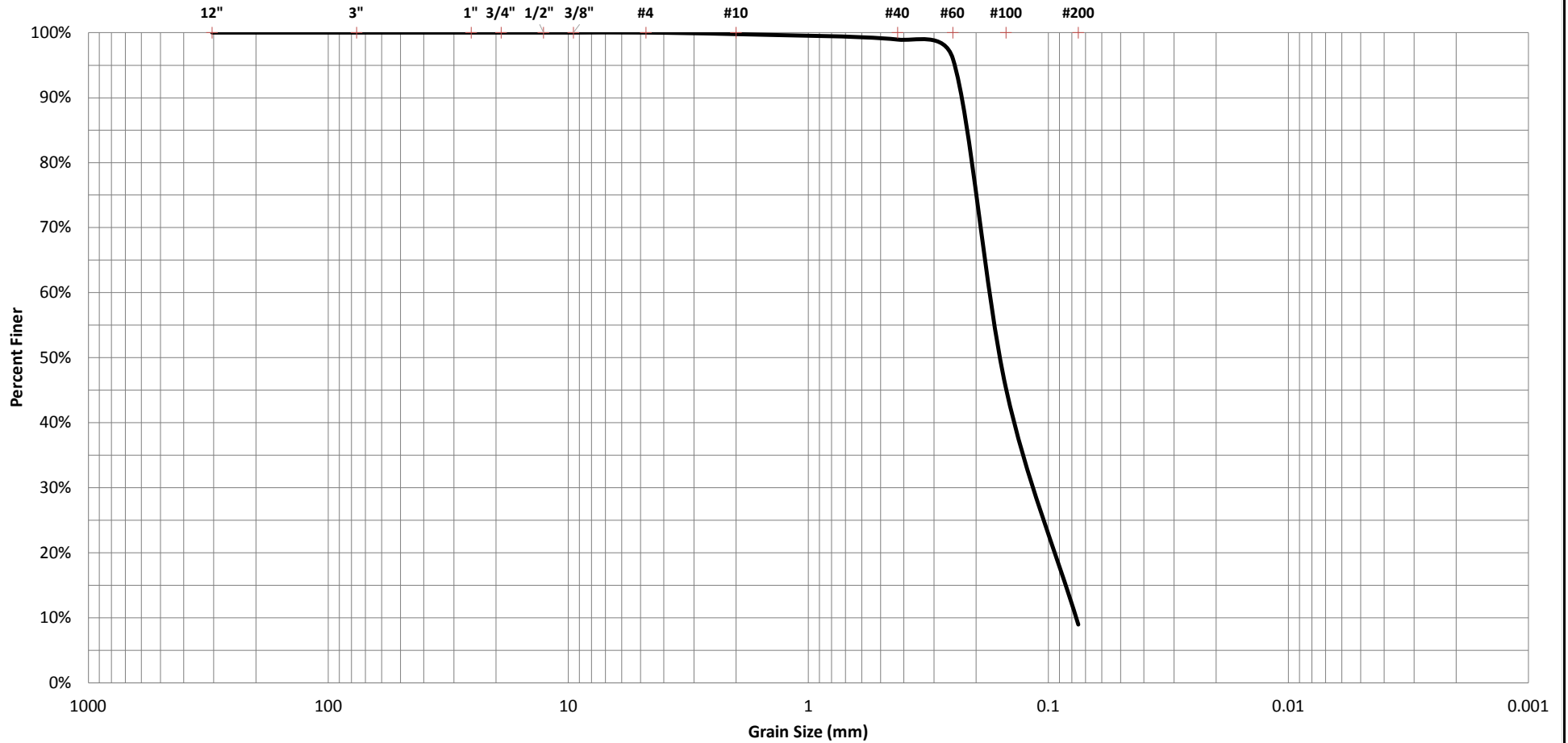
BOULDERS	COBBLES	GRAVEL		SAND			FINES	
		COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY

PROJECT NAME:	Rivertown Water Treatment Plant	BORING NO. / SAMPLE NO.:	A-1 (3)
CSI GEO PROJECT NUMBER:	71-19-127-02	DEPTH (FT.) :	5-7

W%	LL	PL	PI	DESCRIPTION / CLASSIFICATION		CSI Geo, Inc.
23	-	-	-	Light Brown to Light Gray Silty Fine SAND	SM	

## GRAIN SIZE DISTRIBUTION GRAPH

### US STANDARD SIEVE SIZES



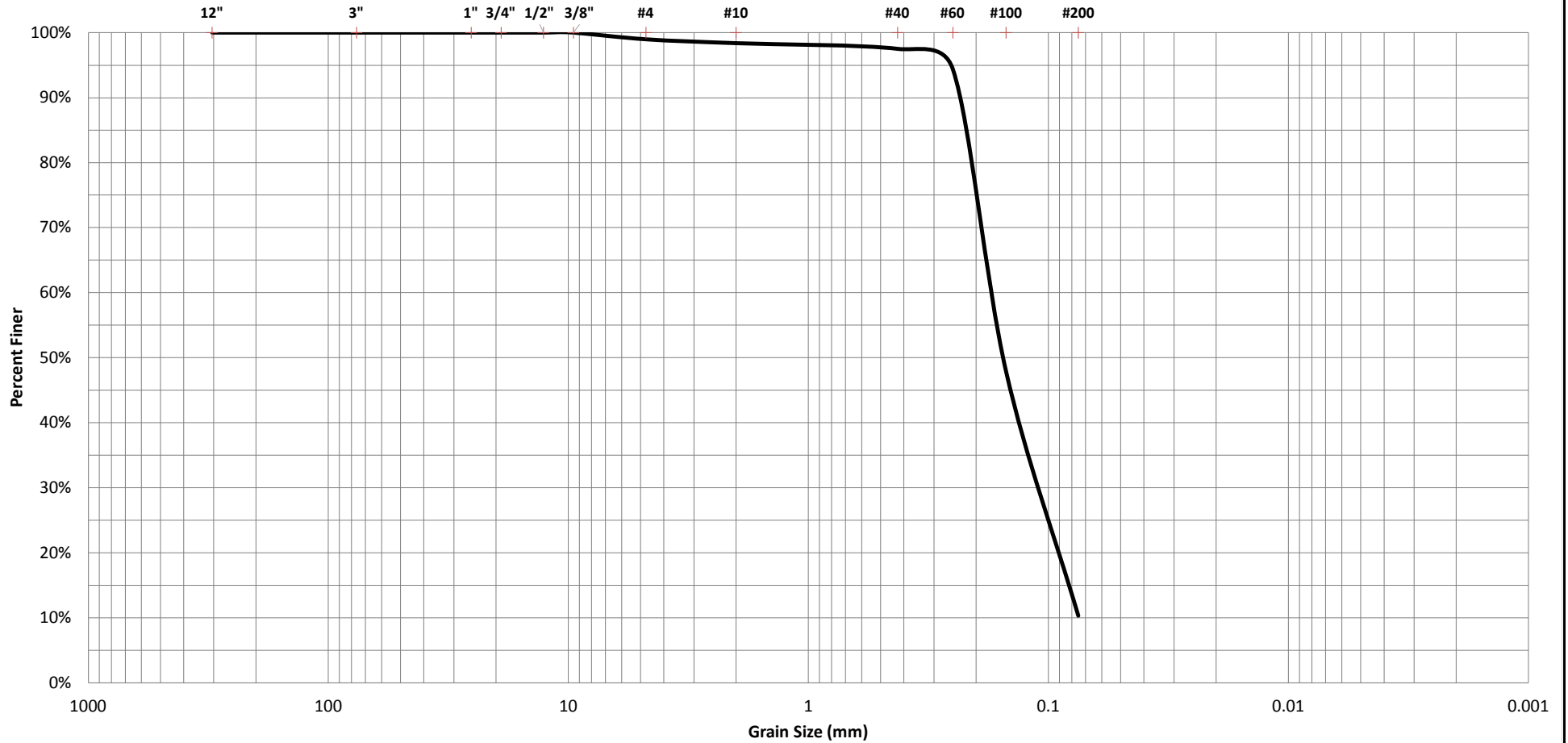
BOULDERS	COBBLES	GRAVEL		SAND			FINES	
		COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY

PROJECT NAME:	Rivertown Water Treatment Plant	BORING NO. / SAMPLE NO.:	A-2 (2)
CSI GEO PROJECT NUMBER:	71-19-127-02	DEPTH (FT.) :	3.5-5

W%	LL	PL	PI	DESCRIPTION / CLASSIFICATION		CSI Geo, Inc.
24	-	-	-	Light Gray Slightly Silty Fine SAND	SP-SM	

## GRAIN SIZE DISTRIBUTION GRAPH

### US STANDARD SIEVE SIZES



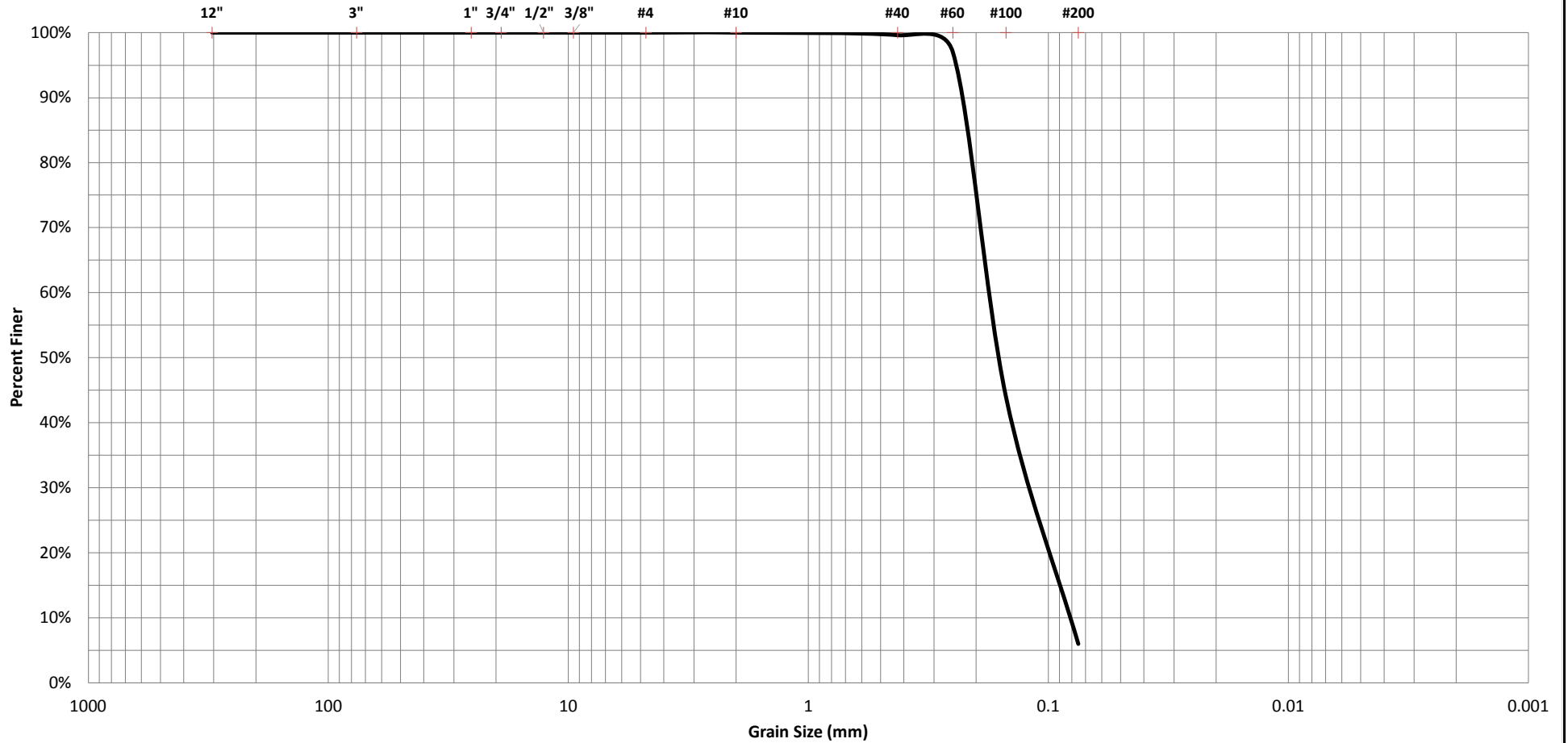
BOULDERS	COBBLES	GRAVEL		SAND			FINES	
		COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY

PROJECT NAME:	Rivertown Water Treatment Plant	BORING NO. / SAMPLE NO.:	B-6 (4)
CSI GEO PROJECT NUMBER:	71-19-127-02	DEPTH (FT.) :	6-8

W%	LL	PL	PI	DESCRIPTION / CLASSIFICATION		CSI Geo, Inc.
29	-	-	-	Dark Brown Slightly Organic Slightly Silty Fine SAND	SP-SM	

## GRAIN SIZE DISTRIBUTION GRAPH

### US STANDARD SIEVE SIZES



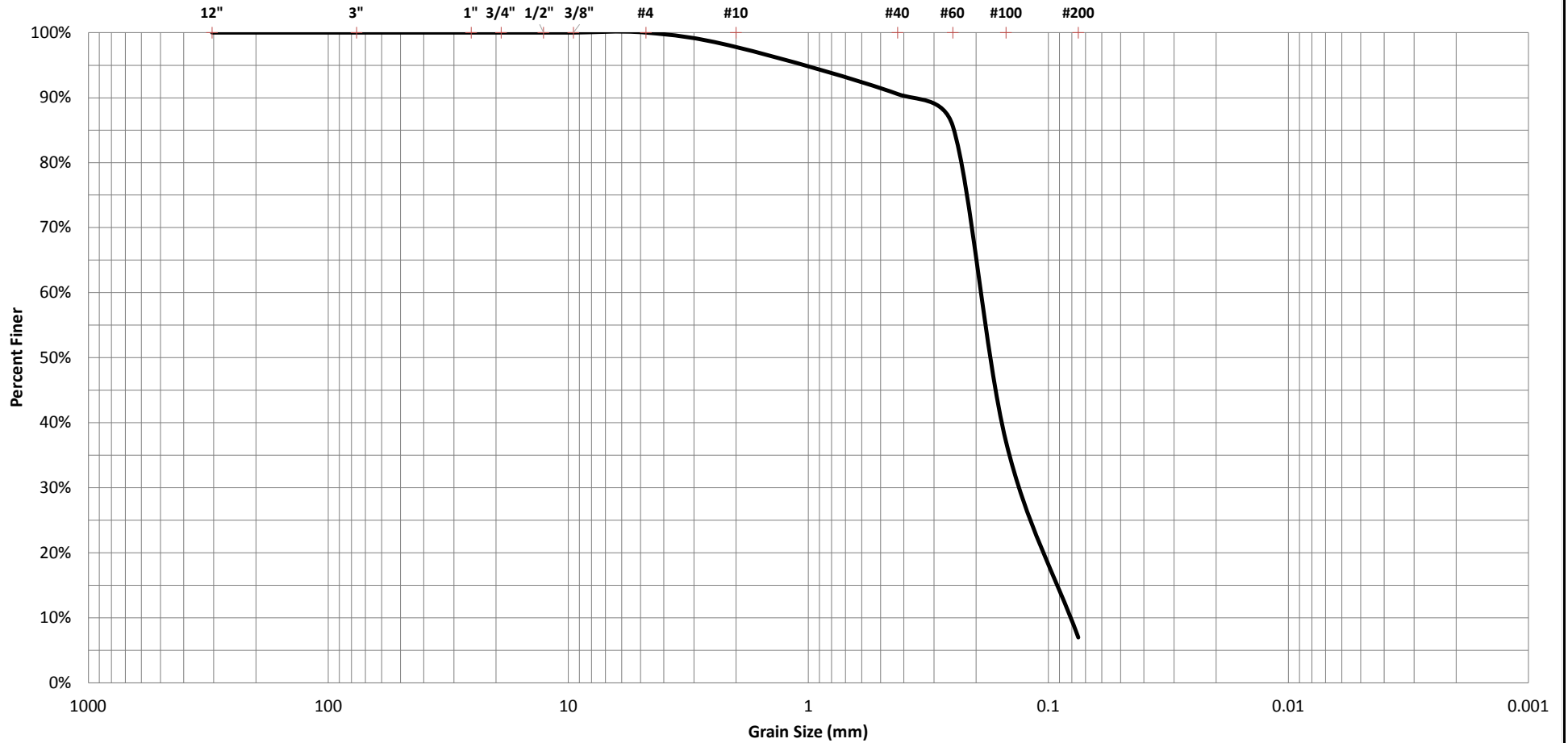
BOULDERS	COBBLES	GRAVEL		SAND			FINES	
		COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY

PROJECT NAME:	Rivertown Water Treatment Plant	BORING NO. / SAMPLE NO.:	B-8 (5)
CSI GEO PROJECT NUMBER:	71-19-127-02	DEPTH (FT.) :	8-10

W%	LL	PL	PI	DESCRIPTION / CLASSIFICATION		CSI Geo, Inc.
29	-	-	-	Brown Slightly Silty Fine SAND	SP-SM	

## GRAIN SIZE DISTRIBUTION GRAPH

### US STANDARD SIEVE SIZES



BOULDERS	COBBLES	GRAVEL		SAND			FINES	
		COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY

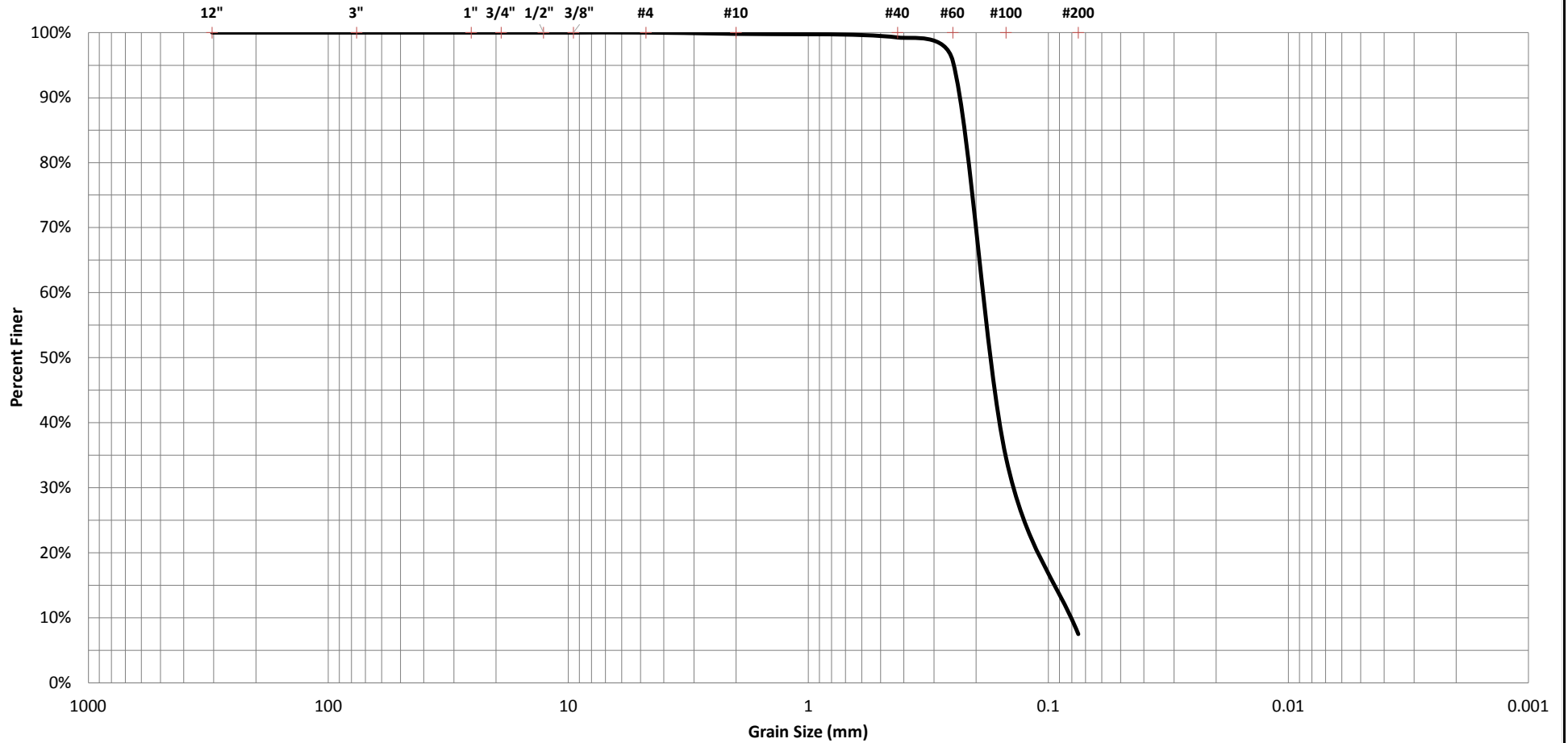
PROJECT NAME:	Rivertown Water Treatment Plant	BORING NO. / SAMPLE NO.:	B-10 (4)
CSI GEO PROJECT NUMBER:	71-19-127-02	DEPTH (FT.) :	6-8

W%	LL	PL	PI	DESCRIPTION / CLASSIFICATION		CSI Geo, Inc.
26	-	-	-	Dark Brown Slightly Organic Slightly Silty Fine SAND with few shell fragments	SP-SM	



## GRAIN SIZE DISTRIBUTION GRAPH

### US STANDARD SIEVE SIZES



BOULDERS	COBBLES	GRAVEL		SAND			FINES	
		COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY

PROJECT NAME:	Rivertown	BORING NO. / SAMPLE NO.:	B-15 (6)
CSI GEO PROJECT NUMBER:	71-19-127-02	DEPTH (FT.) :	13.5-15

W%	LL	PL	PI	DESCRIPTION / CLASSIFICATION		CSI Geo, Inc.
27	-	-	-	Gray Slightly Silty Fine Sand	SP-SM	

# **Appendix C – General Information**

- Key to Soil Classification
- Field and Laboratory Test Procedures

## **Key to Soil Classification**

# KEY TO SOIL CLASSIFICATION

## Correlation of Penetration Resistance with Relative Density and Consistency

<u>Granular Materials</u>		<u>Silts and Clays</u>	
<u>Relative Density</u>	<u>Auto Hammer SPT N-Value (Blows/foot)</u>	<u>Consistency</u>	<u>Auto Hammer SPT N-Value (Blows/foot)</u>
Very Loose	Less than 3	Very Soft	Less than 1
Loose	3 – 8	Soft	1 – 3
Medium Dense	8 - 24	Firm	3 - 6
Dense	24 - 40	Stiff	6 - 12
Very Dense	Greater than 40	Very Stiff	12 - 24
		Hard	Greater than 24

### Particle Size Identification (Unified Soil Classification System)

Boulders:	Diameter exceeds 8 inches
Cobbles:	3 to 8 inches diameter
Gravel:	Coarse - 3/4 to 3 inches in diameter Fine - 4.76 mm to 3/4 inch in diameter
Sand:	Coarse - 2.0 mm to 4.76 mm in diameter Medium - 0.42 mm to 2.0 mm in diameter Fine - 0.074 mm to 0.42 mm in diameter

### Modifiers

These modifiers provide our estimate of the amount of fines (silt or clay size particles) in soil samples.

<u>Approximate Fines Content</u>	<u>Modifiers</u>
5% Fines 12%	Slightly silty or slightly clayey
12% Fines 30%	Silty or clayey
30% Fines 50%	Very silty or very clayey

These modifiers provide our estimate of shell, rock fragments, or roots in the soil sample.

<u>Approximate Content, By Weight</u>	<u>Modifiers</u>
< 5%	Trace
5% to 10%	Few
15% to 25%	Little
30% to 45%	Some
50% to 100%	Mostly

These modifiers provide our estimate of organic content in the soil sample.

<u>Organic Content</u>	<u>Modifiers</u>
1% to 3%	Trace
3% to 5%	Slightly Organic
5% to 20%	Organic
20% to 75%	Highly Organic (Muck)
> 75%	Peat

# **Field and Laboratory Test Procedures**

## **FIELD AND LABORATORY TEST PROCEDURES**

### **FIELD TEST PROCEDURES**

**Standard Penetration Test (SPT) Borings** – The soil penetration test borings were made in general accordance with ASTM D-1586, "Penetration Test and Split-Barrel Sampling of Soils". The borings were advanced by continuous driving the split spoon sampler to a depth of 10 feet below the existing ground surface. Below 10 feet and until boring termination depths, split spoon sampling was performed at a spacing of 5 feet. Bentonite drilling fluid was used below the ground water level to stabilize the sides and to flush the cuttings. At the sampling intervals, the drilling tools were removed and soil samples were obtained with a standard 1.4 inch I.D., 2.0 inch O.D., split-tube sampler. The sampler was first seated six inches and then driven an additional foot with blows of a 140 pound hammer falling 30 inches. The number of hammer blows required to drive the sampler the final foot is designated the "Penetration Resistance". The penetration resistance, when properly interpreted, is an index to the soil strength and density. Representative portions of the soil samples, obtained from the sampler, were containerized and transported to our laboratory. The samples were then examined by a geotechnical engineer to confirm the field classifications.

**Auger Borings** – The auger borings were advanced by the use of a truck mounted auger drill rig. The soils encountered were identified in the field from the cuttings brought to the surface by the augering process. Representative soil samples were placed in glass jars and transported to our laboratory where they were examined by a geotechnical engineer to confirm field classifications.

### **LABORATORY TEST PROCEDURES**

**Natural Moisture Content** – The water content is the ratio, expressed as a percentage, of the weight of water in a given mass of soil to the weight of the solid particles. This test was conducted in the general accordance with ASTM D2216.

**Percent Fine Content** – To determine the percentage of soils finer than No. 200 sieve, the dried samples were washed over a 200 mesh sieve. The material retained on the sieve was oven dried and then weighed and compared with the unwashed dry weight in order to determine the weight of the fines. The percentage of fines in the soil sample was then determined as the percent of weight of fines in the sample to the weight of the unwashed sample. This test was conducted in accordance with ASTM D1140.

**Percent Organic Content** – This test is based on the percent of organics by weight of the total sample. This test was conducted in accordance with FM I - T 267.

**Grain Size Distribution** - The grain size tests were performed to determine the particle size and distribution of the samples tested. Each sample was dried, weighed, and washed over a No. 200 mesh sieve. The dried sample was then passed through a standard set of nested sieves to determine the grain size distribution of the soil particles coarser than the No. 200 sieve. This test was conducted in accordance with ASTM D1140.

**Plasticity (Atterberg Limits)** – The soil's Plastic Index (PI) is bracketed by the Liquid Limit (LL) and Plastic Limit (PL). The LL is the moisture content at which the soil flows as a heavy viscous fluid and is determined in general accordance with FM 1-T 089. The PL is the moisture content at which the soil begins to crumble when rolled into a small thread and is also determined in general accordance with ASTM D4318. The water-plasticity ratio is computed from the above test data. This ratio is an expression comparing the relative natural state of soil with its liquid and plastic consolidation characteristics.

## **Appendix B – Soft Dig Report**





# Vacuum Test Hole Report

FRA Job # 3247  
Work Order 1  
Test Hole # 1  
# of Holes 1  
Date 1/20/2020  
Time N/A

Project Name: JEA Rivertown WTP

Work Order	JEA Rivertown WTP				
Owner	JEA	Client	R.E. Holland & Associates, Inc.		
Contract #	N/A	FPID	N/A		
Utility Owner	UNITI-FIBER	Requested Locate	TELEPHONE FOC	Located Utility	TELEPHONE FOC
Pavement Type	N/A	Pavement Condition	N/A	Soil Condition	SOFT DRY
Material as Found	PVC	Size Expected	2"	Size Found	2"
Utility Condition	GOOD	Ribbon Installed	ORANGE	Utility Direction	NW/SE
Proposed	NEW UTILITIES	Installed	HUB	At	CROWN OF UTILITY

Elevation Survey Pin

N/A

Pavement

N/A

Sub-Pavement

N/A

Cover (Top)

2.70'

Elevation (Top)

N/A

Cover (Bottom)

2.89'

Elevation (Bottom)

N/A

Width

0.19'



Survey Pin Located FR Aleman

Measurement Type US Feet

Northing N/A

Easting N/A

Station N/A

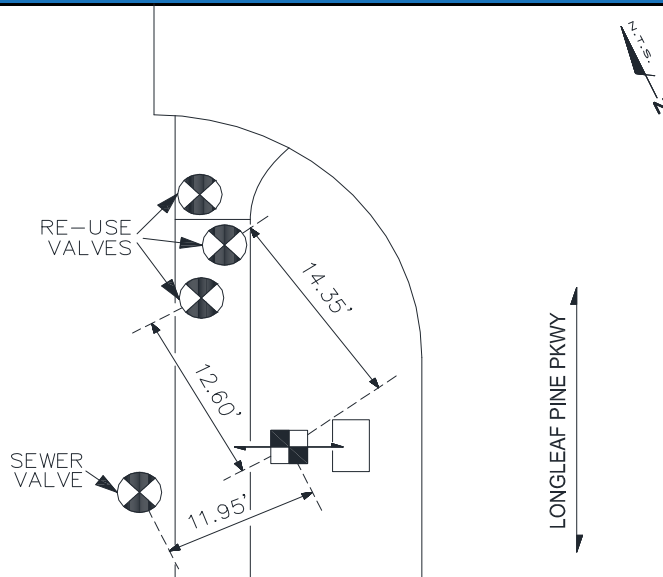
Offset N/A

Horizontal Datum N/A

Vertical Datum N/A

Notes:

Find test hole location in sheet no. C-1, Rivertown WTP RAW Water Main  
Proposed Plan and Profile, provided by client.



FRA Project Manager	Dennis S.	Form	Chris R.	QA/QC Field	Dailys T.
Assistant	Aaron M.	CAD	Dailys T.	QA/QC Office	Chris R.
Cover	DeShawn R.			QA/QC PM	Dennis S.
Latitude	N/A	Longitude	N/A		

# Vacuum Test Hole Report

FRA Job # 3247  
Work Order 1  
Test Hole # 2  
# of Holes 1  
Date 1/20/2020  
Time N/A

Project Name: JEA Rivertown WTP

Work Order	JEA Rivertown WTP				
Owner	JEA	Client	R.E. Holland & Associates, Inc.		
Contract #	N/A	FPID	N/A		
Utility Owner	JEA WATER & SEWER	Requested Locate	FORCE MAIN	Located Utility	FORCE MAIN
Pavement Type	ASPHALT	Pavement Condition	FAIR	Soil Condition	SOFT DRY
Material as Found	PVC	Size Expected	16"	Size Found	16"
Utility Condition	GOOD	Ribbon Installed	GREEN	Utility Direction	NE/SW
Proposed	NEW UTILITIES	Installed	PK	At	CROWN OF UTILITY

Elevation Survey Pin

N/A

Pavement

0.30'

Sub-Pavement

0.60'

Cover (Top)

5.70'

Elevation (Top)

N/A

Cover (Bottom)

7.27'

Elevation (Bottom)

N/A

Width

1.57'



Survey Pin Located FR Aleman

Measurement Type US Feet

Northing N/A

Easting N/A

Station N/A

Offset N/A

Horizontal Datum N/A

Vertical Datum N/A

## Notes:

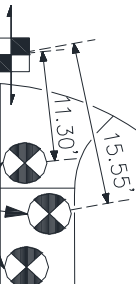
Find test hole location in sheet no. C-1, Rivertown WTP RAW Water Main  
Proposed Plan and Profile, provided by client.

CONC PAD.  
W/TRANS BOX



40.05'

RE-USE  
VALVES



LONGLEAF PINE PKWY

FRA Project Manager	Dennis S.	Form	Chris R.	QA/QC Field	Dailys T.
Assistant	Aaron M.	CAD	Dailys T.	QA/QC Office	Chris R.
Cover	DeShawn R.			QA/QC PM	Dennis S.
Latitude	N/A	Longitude	N/A		

# Vacuum Test Hole Report

FRA Job # 3247  
Work Order 1  
Test Hole # 3  
# of Holes 1  
Date 1/20/2020  
Time N/A

Project Name: JEA Rivertown WTP

Work Order	JEA Rivertown WTP				
Owner	JEA	Client	R.E. Holland & Associates, Inc.		
Contract #	N/A	FPID	N/A		
Utility Owner	JEA WATER & SEWER	Requested Locate	RE-CLAIM	Located Utility	RE-CLAIM
Pavement Type	ASPHALT	Pavement Condition	GOOD	Soil Condition	SOFT DRY
Material as Found	PVC	Size Expected	20"	Size Found	20"
Utility Condition	GOOD	Ribbon Installed	PURPLE	Utility Direction	NE/SW
Proposed	NEW UTILITIES	Installed	PK	At	CROWN OF UTILITY

Elevation Survey Pin

N/A

Pavement

0.40'

Sub-Pavement

0.55'

Cover (Top)

5.63'

Elevation (Top)

N/A

Cover (Bottom)

7.30'

Elevation (Bottom)

N/A

Width

1.67'+/-



Survey Pin Located FR Aleman

Measurement Type US Feet

Northing N/A

Easting N/A

Station N/A

Offset N/A

Horizontal Datum N/A

Vertical Datum N/A

## Notes:

Find test hole location in sheet no. C-1, Rivertown WTP RAW Water Main  
Proposed Plan and Profile, provided by client.

CONC PAD  
W/TRANS BOX



25.80'

31.30'

34.40'

RE-USE  
VALVES



LONGLEAF PINE PKWY



FRA Project Manager	Dennis S.	Form	Chris R.	QA/QC Field	Dailys T.
Assistant	Aaron M.	CAD	Dailys T.	QA/QC Office	Chris R.
Cover	DeShawn R.			QA/QC PM	Dennis S.
Latitude	N/A	Longitude	N/A		

# Vacuum Test Hole Report

FRA Job # 3247  
Work Order 1  
Test Hole # 4  
# of Holes 1  
Date 1/20/2020  
Time N/A

Project Name: JEA Rivertown WTP

Work Order	JEA Rivertown WTP				
Owner	JEA	Client	R.E. Holland & Associates, Inc.		
Contract #	N/A	FPID	N/A		
Utility Owner	JEA WATER & SEWER	Requested Locate	RE-CLAIM	Located Utility	RE-CLAIM
Pavement Type	N/A	Pavement Condition	N/A	Soil Condition	SOFT MOIST
Material as Found	PVC	Size Expected	20"	Size Found	20"
Utility Condition	GOOD	Ribbon Installed	PURPLE	Utility Direction	NW/SE
Proposed	NEW UTILITIES	Installed	HUB	At	CROWN OF UTILITY

Elevation Survey Pin

N/A

Pavement

N/A

Sub-Pavement

N/A

Cover (Top)

7.98'

Elevation (Top)

N/A

Cover (Bottom)

9.65'

Elevation (Bottom)

N/A

Width

1.67'+/-



Survey Pin Located FR Aleman

Measurement Type US Feet

Northing N/A

Easting N/A

Station N/A

Offset N/A

Horizontal Datum N/A

Vertical Datum N/A

## Notes:

Find test hole location in sheet no. C-1, Rivertown WTP RAW Water Main  
Proposed Plan and Profile, provided by client.

CONC PAD  
W/TRANS BOX

48.35'

25.70'

RE-USE  
VALVES

27.60'

LONGLEAF PINE PKWY

FRA Project Manager	Dennis S.	Form	Chris R.	QA/QC Field	Dailys T.
Assistant	Aaron M.	CAD	Dailys T.	QA/QC Office	Chris R.
Cover	DeShawn R.			QA/QC PM	Dennis S.
Latitude	N/A	Longitude	N/A		

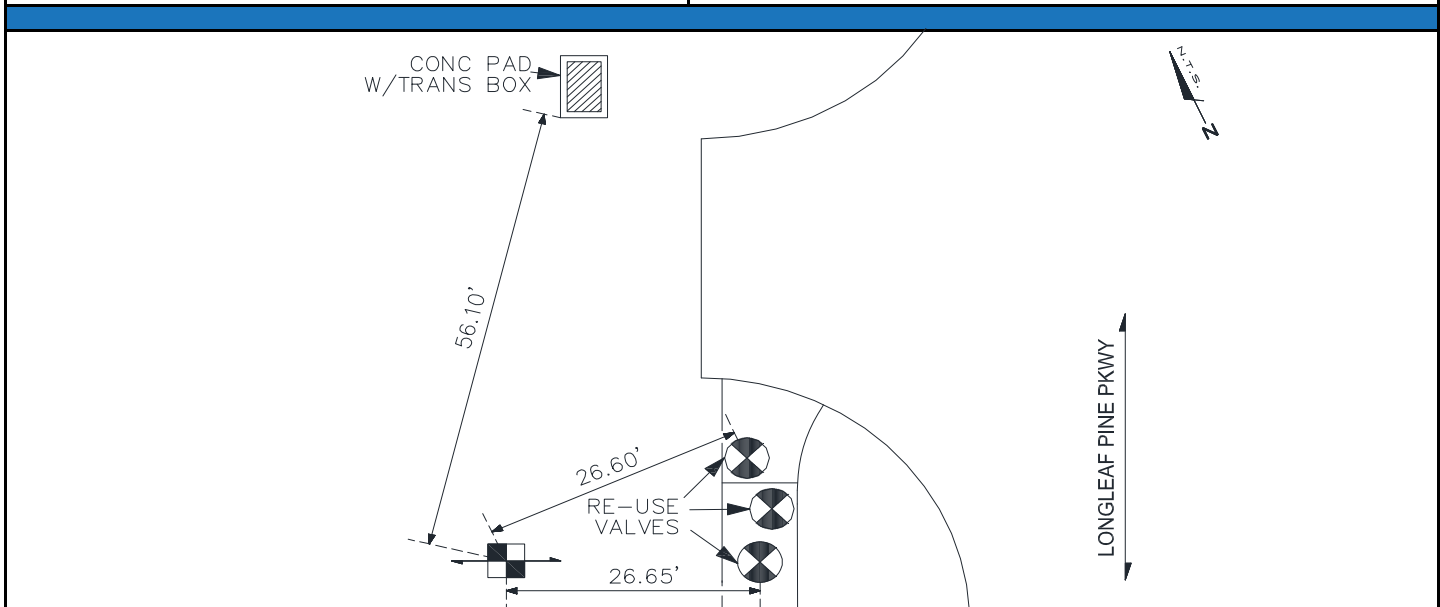
# Vacuum Test Hole Report

FRA Job # 3247  
Work Order 1  
Test Hole # 5  
# of Holes 1  
Date 1/20/2020  
Time N/A

Project Name: JEA Rivertown WTP

Work Order	JEA Rivertown WTP				
Owner	JEA	Client	R.E. Holland & Associates, Inc.		
Contract #	N/A	FPID	N/A		
Utility Owner	JEA WATER & SEWER	Requested Locate	RE-CLAIM	Located Utility	RE-CLAIM
Pavement Type	N/A	Pavement Condition	N/A	Soil Condition	SOFT MOIST
Material as Found	PVC	Size Expected	20"	Size Found	20"
Utility Condition	GOOD	Ribbon Installed	PURPLE	Utility Direction	NW/SE
Proposed	NEW UTILITIES	Installed	HUB	At	CROWN OF UTILITY

<p>Elevation Survey Pin N/A</p> <p>Cover (Top) 7.35'</p> <p>Elevation (Top) N/A</p> <p>Cover (Bottom) 9.02'</p> <p>Elevation (Bottom) N/A</p> <p>Width 1.67'+/-</p> <p>Pavement N/A</p> <p>Sub-Pavement N/A</p>	<p>Survey Pin Located FR Aleman</p> <p>Measurement Type US Feet</p> <p>Northing N/A</p> <p>Easting N/A</p> <p>Station N/A</p> <p>Offset N/A</p> <p>Horizontal Datum N/A</p> <p>Vertical Datum N/A</p> <p>Notes: Find test hole location in sheet no. C-1, Rivertown WTP RAW Water Main Proposed Plan and Profile, provided by client.</p>
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FRA Project Manager	Dennis S.	Form	Chris R.	QA/QC Field	Dailys T.
Assistant	Aaron M.	CAD	Dailys T.	QA/QC Office	Chris R.
Cover	DeShawn R.			QA/QC PM	Dennis S.
Latitude	N/A	Longitude	N/A		

# Vacuum Test Hole Report

FRA Job # 3247  
Work Order 1  
Test Hole # 6  
# of Holes 1  
Date 1/20/2020  
Time N/A

Project Name: JEA Rivertown WTP

Work Order	JEA Rivertown WTP				
Owner	JEA	Client	R.E. Holland & Associates, Inc.		
Contract #	N/A	FPID	N/A		
Utility Owner	UNITI-FIBER	Requested Locate	FOC	Located Utility	FOC
Pavement Type	ROCK	Pavement Condition	N/A	Soil Condition	SOFT DIRT
Material as Found	PVC	Size Expected	2"	Size Found	2"
Utility Condition	GOOD	Ribbon Installed	ORANGE	Utility Direction	NE/SW
Proposed	NEW UTILITIES	Installed	PIN	At	CROWN OF UTILITY

Elevation Survey Pin

N/A

Pavement

N/A

Sub-Pavement

N/A

Cover (Top)

2.70'

Elevation (Top)

N/A

Cover (Bottom)

2.89'

Elevation (Bottom)

N/A

Width

0.19'



Survey Pin Located FR Aleman

Measurement Type US Feet

Northing N/A

Easting N/A

Station N/A

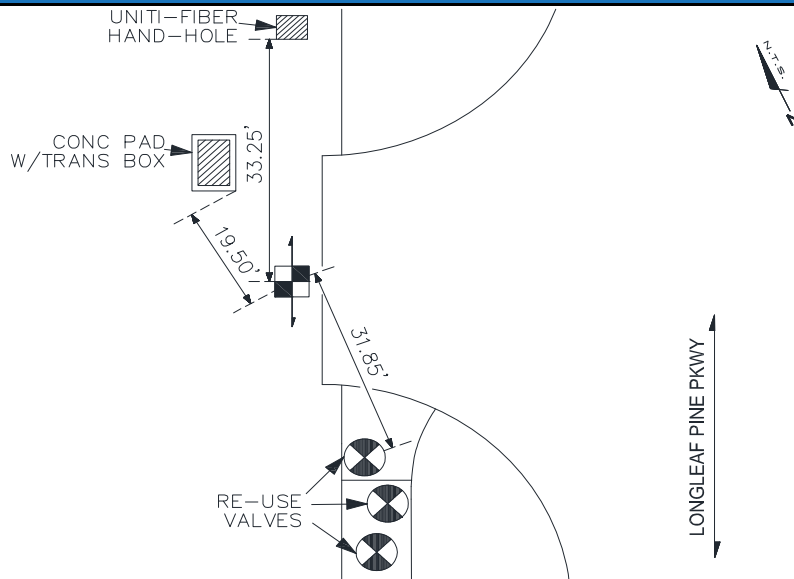
Offset N/A

Horizontal Datum N/A

Vertical Datum N/A

## Notes:

Find test hole location in sheet no. C-1, Rivertown WTP RAW Water Main  
Proposed Plan and Profile, provided by client.



FRA Project Manager	Dennis S.	Form	Chris R.	QA/QC Field	Dailys T.
Assistant	Aaron M.	CAD	Dailys T.	QA/QC Office	Chris R.
Cover	DeShawn R.			QA/QC PM	Dennis S.
Latitude	N/A	Longitude	N/A		

# Vacuum Test Hole Report

FRA Job # 3247  
Work Order 1  
Test Hole # 7  
# of Holes 1  
Date 1/20/2020  
Time N/A

Project Name: JEA Rivertown WTP

Work Order	JEA Rivertown WTP				
Owner	JEA	Client	R.E. Holland & Associates, Inc.		
Contract #	N/A	FPID	N/A		
Utility Owner	FPL	Requested Locate	ELECTRIC	Located Utility	ELECTRIC
Pavement Type	ROCK	Pavement Condition	N/A	Soil Condition	SOFT WET ROCK
Material as Found	UNKNOWN	Size Expected	N/A	Size Found	N/A
Utility Condition	N/A	Ribbon Installed	RED	Utility Direction	NE/SW
Proposed	NEW UTILITIES	Installed	PIN	At	CROWN OF UTILITY

Elevation Survey Pin

N/A

Pavement

N/A

Sub-Pavement

N/A

Cover (Top)

7.80'

Elevation (Top)

N/A

Cover (Bottom)

N/A

Elevation (Bottom)

N/A

Width

N/A



Survey Pin Located FR Aleman

Measurement Type US Feet

Northing N/A

Easting N/A

Station N/A

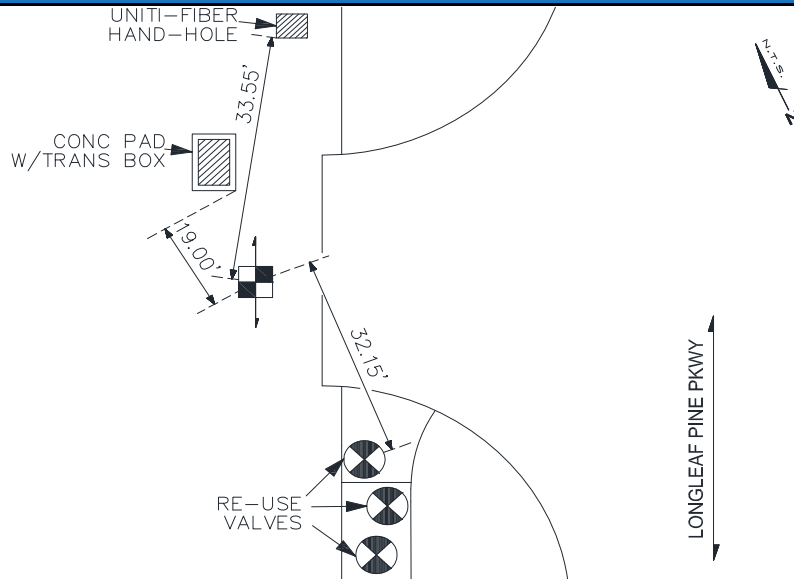
Offset N/A

Horizontal Datum N/A

Vertical Datum N/A

Notes: Dug hole to a depth of 7.80', unable to identify size and material due to depth of utility. Checked with USIC locator to find size expected and prints show N/A on size and material.

Find test hole location in sheet no. C-1, Rivertown WTP RAW Water Main Proposed Plan and Profile, provided by client.



FRA Project Manager	Dennis S.	Form	Chris R.	QA/QC Field	Dailys T.
Assistant	Aaron M.	CAD	Dailys T.	QA/QC Office	Chris R.
Cover	DeShawn R.			QA/QC PM	Dennis S.
Latitude	N/A	Longitude	N/A		

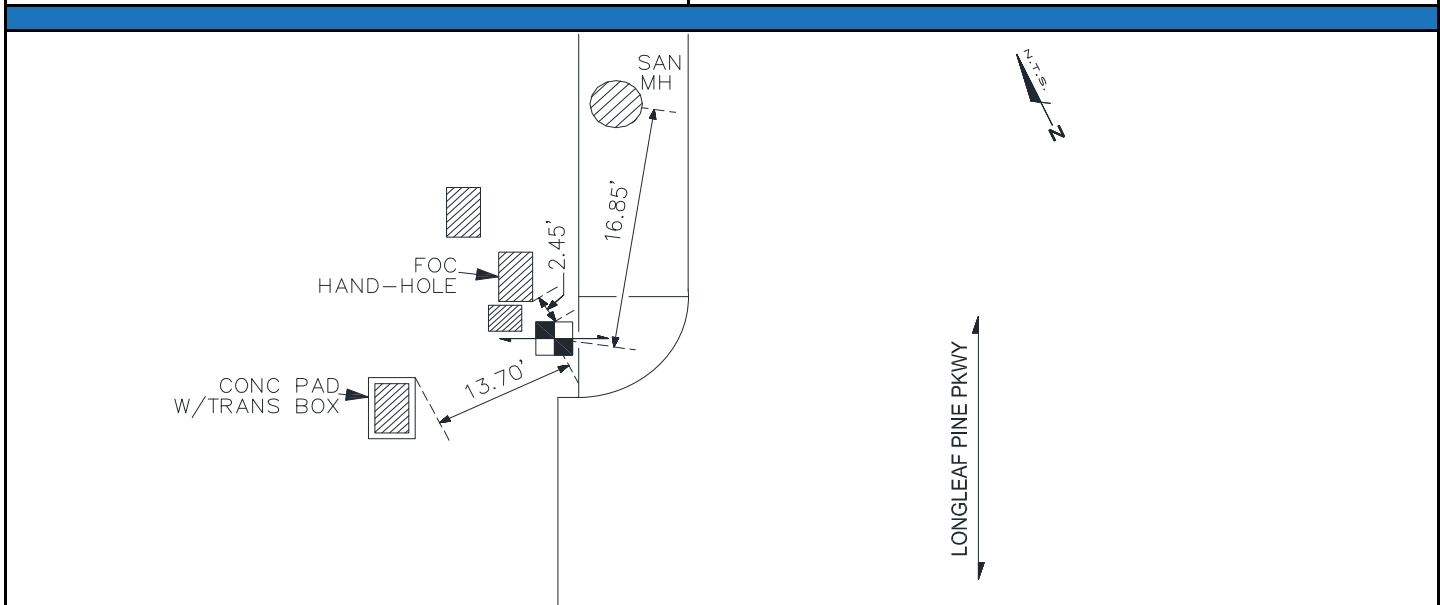
# Vacuum Test Hole Report

FRA Job # 3247  
Work Order 1  
Test Hole # 8  
# of Holes 1  
Date 1/21/2020  
Time N/A

Project Name: JEA Rivertown WTP

Work Order	JEA Rivertown WTP				
Owner	JEA	Client	R.E. Holland & Associates, Inc.		
Contract #	N/A	FPID	N/A		
Utility Owner	JEA WATER & SEWER	Requested Locate	WATER	Located Utility	WATER
Pavement Type	N/A	Pavement Condition	N/A	Soil Condition	SOFT DRY
Material as Found	PVC	Size Expected	20"	Size Found	20"
Utility Condition	GOOD	Ribbon Installed	BLUE	Utility Direction	NW/SE
Proposed	NEW UTILITIES	Installed	HUB	At	CROWN OF UTILITY

<p>Elevation Survey Pin N/A</p> <p>Cover (Top) 8.57'</p> <p>Elevation (Top) N/A</p> <p>Cover (Bottom) 10.24'</p> <p>Elevation (Bottom) N/A</p> <p>Width 1.67'+/-</p> <p>Pavement N/A</p> <p>Sub-Pavement N/A</p>	<p>Survey Pin Located FR Aleman</p> <p>Measurement Type US Feet</p> <p>Northing N/A</p> <p>Easting N/A</p> <p>Station N/A</p> <p>Offset N/A</p> <p>Horizontal Datum N/A</p> <p>Vertical Datum N/A</p> <p>Notes: Find test hole location in sheet no. C-1, Rivertown WTP RAW Water Main Proposed Plan and Profile, provided by client.</p>
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FRA Project Manager	Dennis S.	Form	Chris R.	QA/QC Field	Dailys T.
Assistant	Aaron M.	CAD	Dailys T.	QA/QC Office	Chris R.
Cover	DeShawn R.			QA/QC PM	Dennis S.
Latitude	N/A	Longitude	N/A		



# Vacuum Test Hole Report

FRA Job # 3247  
Work Order 1  
Test Hole # 9  
# of Holes 1  
Date 1/21/2020  
Time N/A

Project Name: JEA Rivertown WTP

Work Order	JEA Rivertown WTP				
Owner	JEA	Client	R.E. Holland & Associates, Inc.		
Contract #	N/A	FPID	N/A		
Utility Owner	JEA WATER & SEWER	Requested Locate	WATER	Located Utility	WATER
Pavement Type	N/A	Pavement Condition	N/A	Soil Condition	SOFT MOIST
Material as Found	PVC	Size Expected	20"	Size Found	20"
Utility Condition	GOOD	Ribbon Installed	BLUE	Utility Direction	NW/SE
Proposed	NEW UTILITIES	Installed	HUB	At	CROWN OF UTILITY

Elevation Survey Pin

N/A

Pavement

N/A

Sub-Pavement

N/A

Cover (Top)

8.57'

Elevation (Top)

N/A

Cover (Bottom)

10.24'

Elevation (Bottom)

N/A

Width

1.67'+/-



Survey Pin Located FR Aleman

Measurement Type US Feet

Northing N/A

Easting N/A

Station N/A

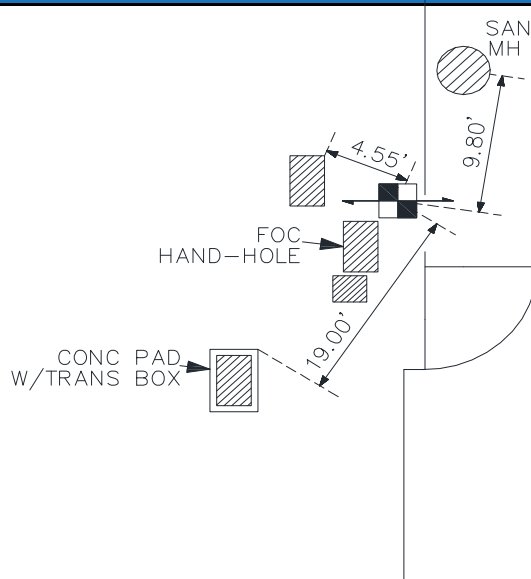
Offset N/A

Horizontal Datum N/A

Vertical Datum N/A

Notes:

Find test hole location in sheet no. C-1, Rivertown WTP RAW Water Main  
Proposed Plan and Profile, provided by client.



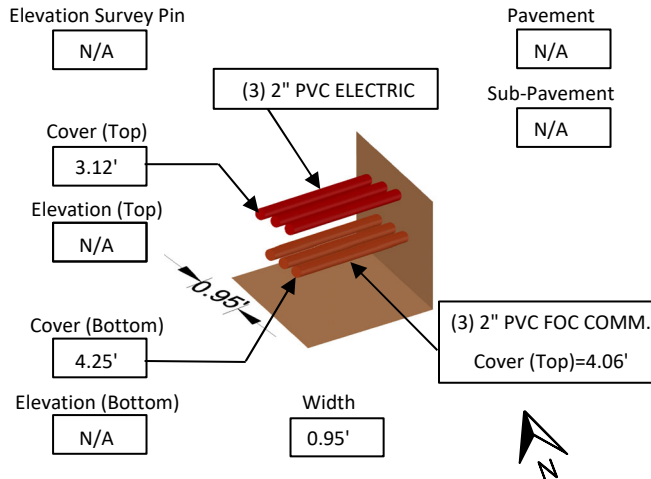
FRA Project Manager	Dennis S.	Form	Chris R.	QA/QC Field	Dailys T.
Assistant	Aaron M.	CAD	Dailys T.	QA/QC Office	Chris R.
Cover	DeShawn R.			QA/QC PM	Dennis S.
Latitude	N/A	Longitude	N/A		

# Vacuum Test Hole Report

FRA Job # 3247  
Work Order 1  
Test Hole # 10  
# of Holes 1  
Date 1/21/2020  
Time N/A

Project Name: JEA Rivertown WTP

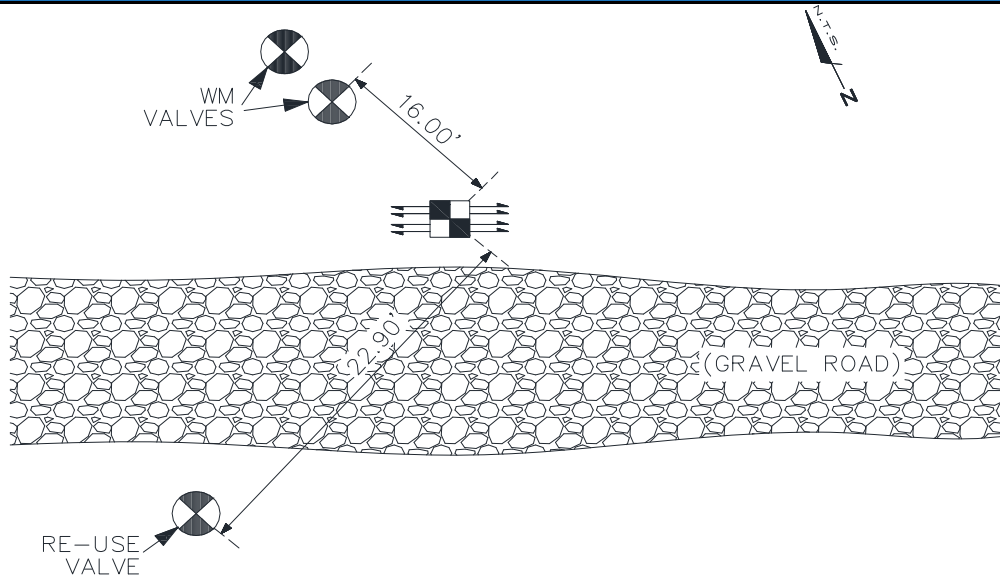
Work Order	JEA Rivertown WTP				
Owner	JEA	Client	R.E. Holland & Associates, Inc.		
Contract #	N/A	FPID	N/A		
Utility Owner	FPL & AT&T	Requested Locate	ELECTRIC & FOC	Located Utility	ELECTRIC & FOC
Pavement Type	N/A	Pavement Condition	N/A	Soil Condition	HARD DRY
Material as Found	PVC	Size Expected	2"	Size Found	(6) 2"
Utility Condition	GOOD	Ribbon Installed	RED	Utility Direction	NW/SE
Proposed	NEW UTILITIES	Installed	HUB	At	EDGE OF UTILITY - S



Survey Pin Located	FR Aleman
Measurement Type	US Feet
Northing	N/A
Easting	N/A
Station	N/A
Offset	N/A
Horizontal Datum	N/A
Vertical Datum	N/A

## Notes:

Find test hole location in sheet no. C-5, Rivertown Water Treatment Plan Project, Yard Piping Plan II, provided by client.



FRA Project Manager	Dennis S.	Form	Chris R.	QA/QC Field	Dailys T.
Assistant	Aaron M.	CAD	Dailys T.	QA/QC Office	Chris R.
Cover	DeShawn R.			QA/QC PM	Dennis S.
Latitude	N/A	Longitude	N/A		

# Vacuum Test Hole Report

FRA Job # 3247  
Work Order 1  
Test Hole # 11  
# of Holes 1  
Date 1/21/2020  
Time N/A

Project Name: JEA Rivertown WTP

Work Order	JEA Rivertown WTP				
Owner	JEA	Client	R.E. Holland & Associates, Inc.		
Contract #	N/A	FPID	N/A		
Utility Owner	JEA WATER & SEWER	Requested Locate	WATER	Located Utility	WATER
Pavement Type	N/A	Pavement Condition	N/A	Soil Condition	SOFT DRY
Material as Found	PVC	Size Expected	20"	Size Found	20"
Utility Condition	GOOD	Ribbon Installed	BLUE	Utility Direction	NW/SE
Proposed	NEW UTILITIES	Installed	HUB	At	CROWN OF UTILITY

Elevation Survey Pin

N/A

Pavement

N/A

Sub-Pavement

N/A

Cover (Top)

8.50'

Elevation (Top)

N/A

Cover (Bottom)

10.17'

Elevation (Bottom)

N/A

Width

1.67+/-



Survey Pin Located FR Aleman

Measurement Type US Feet

Northing N/A

Easting N/A

Station N/A

Offset N/A

Horizontal Datum N/A

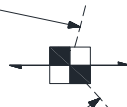
Vertical Datum N/A

Notes:

Find test hole location in sheet no. C-5, Rivertown Water Treatment Plan Project, Yard Piping Plan II, provided by client.



45.60'



(GRAVEL ROAD)



FRA Project Manager	Dennis S.	Form	Chris R.	QA/QC Field	Dailys T.
Assistant	Aaron M.	CAD	Dailys T.	QA/QC Office	Chris R.
Cover	DeShawn R.			QA/QC PM	Dennis S.
Latitude	N/A	Longitude	N/A		

# Vacuum Test Hole Report

FRA Job # 3247  
Work Order 1  
Test Hole # 12  
# of Holes 1  
Date 1/21/2020  
Time N/A

Project Name: JEA Rivertown WTP

Work Order	JEA Rivertown WTP				
Owner	JEA	Client	R.E. Holland & Associates, Inc.		
Contract #	N/A	FPID	N/A		
Utility Owner	JEA WATER & SEWER	Requested Locate	WATER	Located Utility	WATER
Pavement Type	N/A	Pavement Condition	N/A	Soil Condition	SOFT DRY
Material as Found	PVC	Size Expected	20"	Size Found	20"
Utility Condition	GOOD	Ribbon Installed	BLUE	Utility Direction	NW/SE
Proposed	NEW UTILITIES	Installed	HUB	At	CROWN OF UTILITY

Elevation Survey Pin

N/A

Pavement

N/A

Sub-Pavement

N/A

Cover (Top)

8.60'

Elevation (Top)

N/A

Cover (Bottom)

10.27'

Elevation (Bottom)

N/A

Width

1.67+/-



Survey Pin Located FR Aleman

Measurement Type US Feet

Northing N/A

Easting N/A

Station N/A

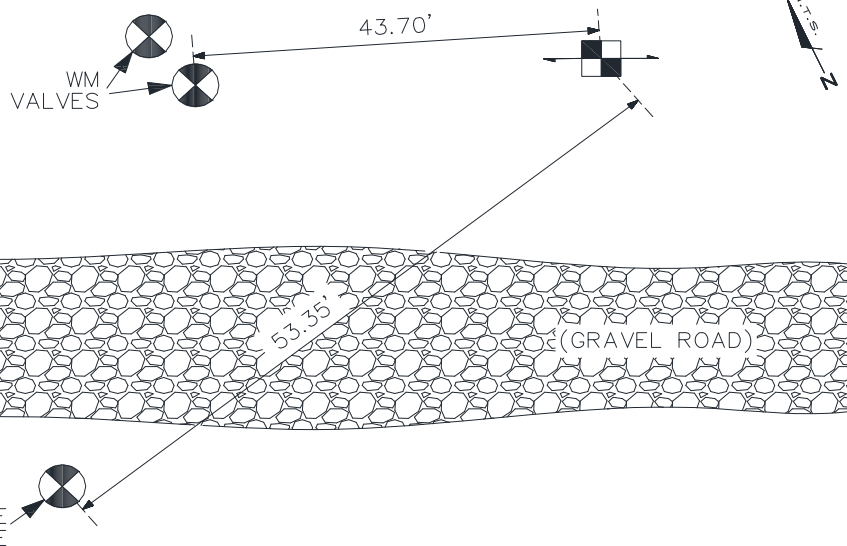
Offset N/A

Horizontal Datum N/A

Vertical Datum N/A

Notes:

Find test hole location in sheet no. C-5, Rivertown Water Treatment Plan Project, Yard Piping Plan II, provided by client.



FRA Project Manager	Dennis S.	Form	Chris R.	QA/QC Field	Dailys T.
Assistant	Aaron M.	CAD	Dailys T.	QA/QC Office	Chris R.
Cover	DeShawn R.			QA/QC PM	Dennis S.
Latitude	N/A	Longitude	N/A		

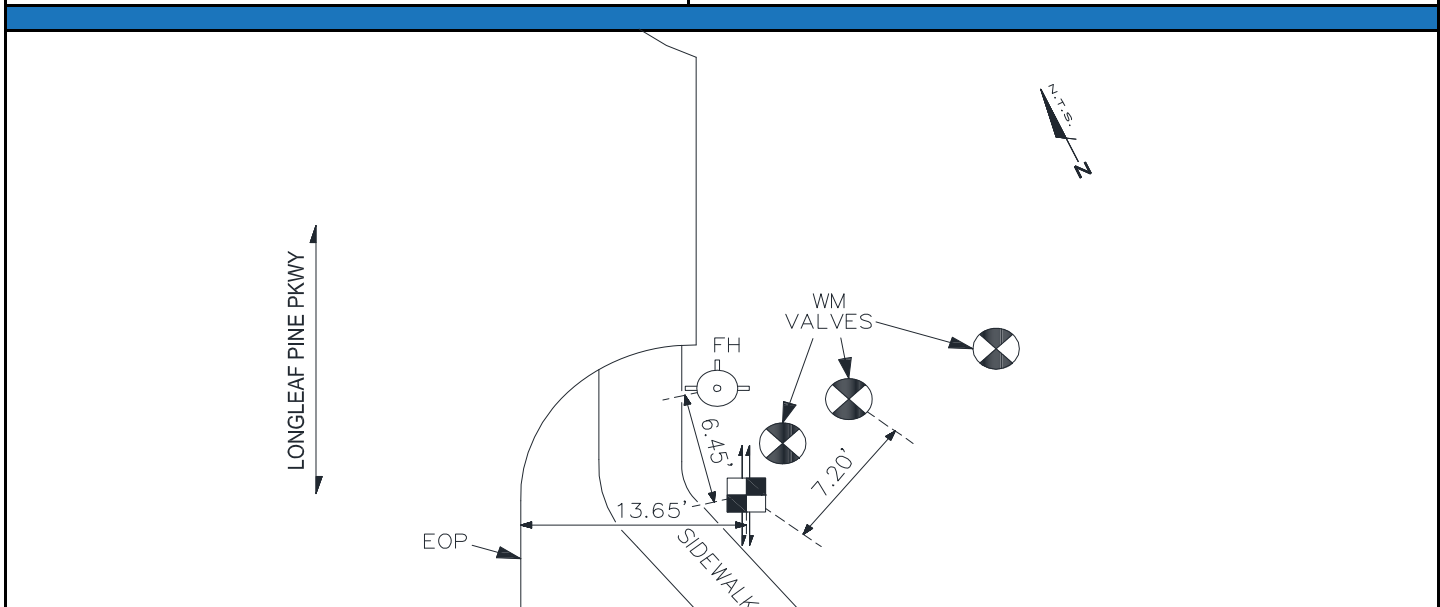
# Vacuum Test Hole Report

FRA Job # 3247  
Work Order 1  
Test Hole # 13  
# of Holes 1  
Date 1/22/2020  
Time N/A

Project Name: JEA Rivertown WTP

Work Order	JEA Rivertown WTP				
Owner	JEA	Client	R.E. Holland & Associates, Inc.		
Contract #	N/A	FPID	N/A		
Utility Owner	TECO PEOPLES GAS	Requested Locate	GAS	Located Utility	GAS & IRRIGATION
Pavement Type	N/A	Pavement Condition	N/A	Soil Condition	SOFT DRY
Material as Found	WRAP-STEEL & PVC	Size Expected	4"	Size Found	(1) 4" & (1) 2"
Utility Condition	GOOD	Ribbon Installed	YELLOW	Utility Direction	NE/SW
Proposed	NEW UTILITIES	Installed	HUB	At	CROWN OF UTILITY

<p>Elevation Survey Pin N/A</p> <p>Cover (Top) 2.76'</p> <p>Elevation (Top) N/A</p> <p>Cover (Bottom) 3.09'</p> <p>Elevation (Bottom) N/A</p> <p>Width 0.33'</p> <p>2" PVC IRRIGATION Cover (Top)=1.63' (FACING N/S)</p> <p>Pavement N/A</p> <p>Sub-Pavement N/A</p> <p>4" WRAP-STEEL GAS MAIN</p>	<p>Survey Pin Located</p> <p>FR Aleman</p> <p>Measurement Type</p> <p>US Feet</p> <p>Northing</p> <p>N/A</p> <p>Easting</p> <p>N/A</p> <p>Station</p> <p>N/A</p> <p>Offset</p> <p>13.65' RT</p> <p>Horizontal Datum</p> <p>N/A</p> <p>Vertical Datum</p> <p>N/A</p> <p>Notes:</p> <p>Find test hole location in sheet no. C-4, Rivertown WTP RAW Water Main Proposed Plan and Profile, provided by client.</p>
--	--



FRA Project Manager	Dennis S.	Form	Chris R.	QA/QC Field	Dailys T.
Assistant	Aaron M.	CAD	Dailys T.	QA/QC Office	Chris R.
Cover	DeShawn R.			QA/QC PM	Dennis S.
Latitude	N/A	Longitude	N/A		

# Vacuum Test Hole Report

FRA Job # 3247  
Work Order 1  
Test Hole # 14  
# of Holes 1  
Date 1/22/2020  
Time N/A

Project Name: JEA Rivertown WTP

Work Order	JEA Rivertown WTP				
Owner	JEA	Client	R.E. Holland & Associates, Inc.		
Contract #	N/A	FPID	N/A		
Utility Owner	AT&T	Requested Locate	TELEPHONE BT	Located Utility	TELEPHONE BT
Pavement Type	N/A	Pavement Condition	N/A	Soil Condition	SOFT DRY
Material as Found	DB CABLE	Size Expected	0.5"	Size Found	0.5"
Utility Condition	GOOD	Ribbon Installed	ORANGE	Utility Direction	NE/SW
Proposed	NEW UTILITIES	Installed	HUB	At	CROWN OF UTILITY

Elevation Survey Pin

N/A

Pavement

N/A

Sub-Pavement

N/A

Cover (Top)

2.35'

Elevation (Top)

N/A

Cover (Bottom)

2.39'

Elevation (Bottom)

N/A

Width

0.04'



Survey Pin Located FR Aleman

Measurement Type US Feet

Northing N/A

Easting N/A

Station N/A

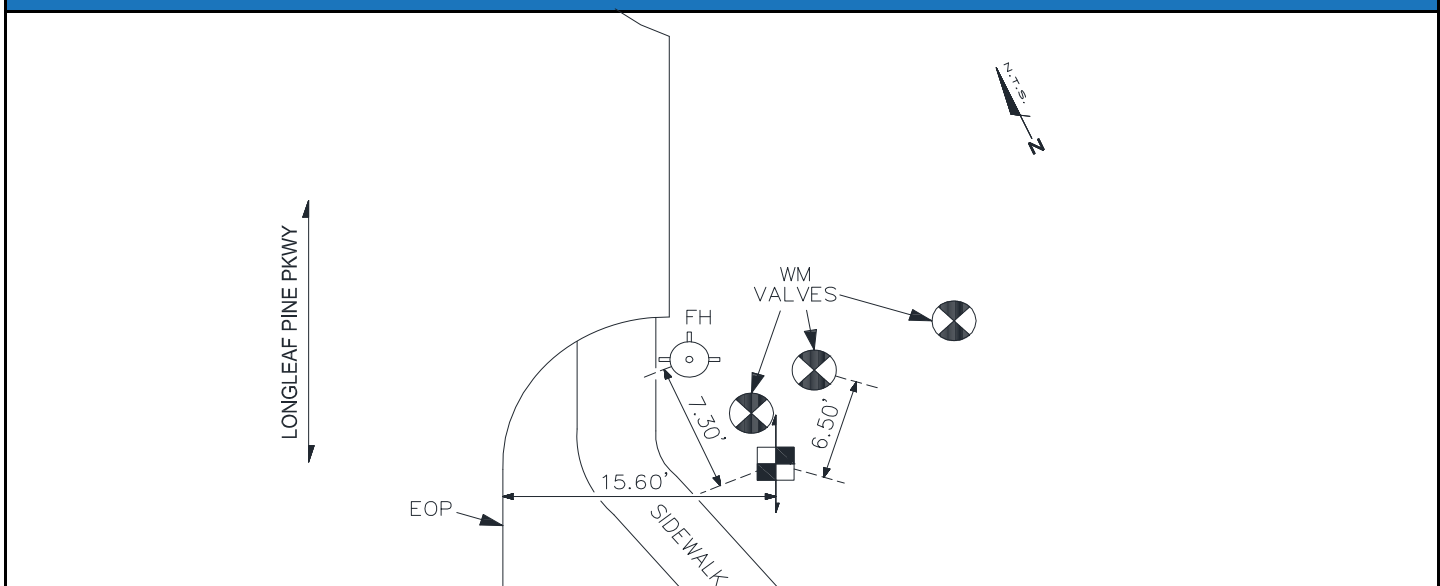
Offset 15.60' RT

Horizontal Datum N/A

Vertical Datum N/A

## Notes:

Find test hole location in sheet no. C-4, Rivertown WTP RAW Water Main  
Proposed Plan and Profile, provided by client.



FRA Project Manager	Dennis S.	Form	Chris R.	QA/QC Field	Dailys T.
Assistant	Aaron M.	CAD	Dailys T.	QA/QC Office	Chris R.
Cover	DeShawn R.			QA/QC PM	Dennis S.
Latitude	N/A	Longitude	N/A		

# Vacuum Test Hole Report

FRA Job # 3247  
Work Order 1  
Test Hole # 15  
# of Holes 1  
Date 1/22/2020  
Time N/A

Project Name: JEA Rivertown WTP

Work Order	JEA Rivertown WTP				
Owner	JEA	Client	R.E. Holland & Associates, Inc.		
Contract #	N/A	FPID	N/A		
Utility Owner	FPL	Requested Locate	ELECTRIC	Located Utility	ELECTRIC
Pavement Type	N/A	Pavement Condition	N/A	Soil Condition	SOFT DRY
Material as Found	HDPE	Size Expected	6"	Size Found	6"
Utility Condition	GOOD	Ribbon Installed	RED	Utility Direction	NE/SW
Proposed	NEW UTILITIES	Installed	HUB	At	CROWN OF UTILITY

Elevation Survey Pin

N/A

Pavement

N/A

Sub-Pavement

N/A

Cover (Top)

1.65'

Elevation (Top)

N/A

Cover (Bottom)

2.21'

Elevation (Bottom)

N/A

Width

0.56'



Survey Pin Located FR Aleman

Measurement Type US Feet

Northing N/A

Easting N/A

Station N/A

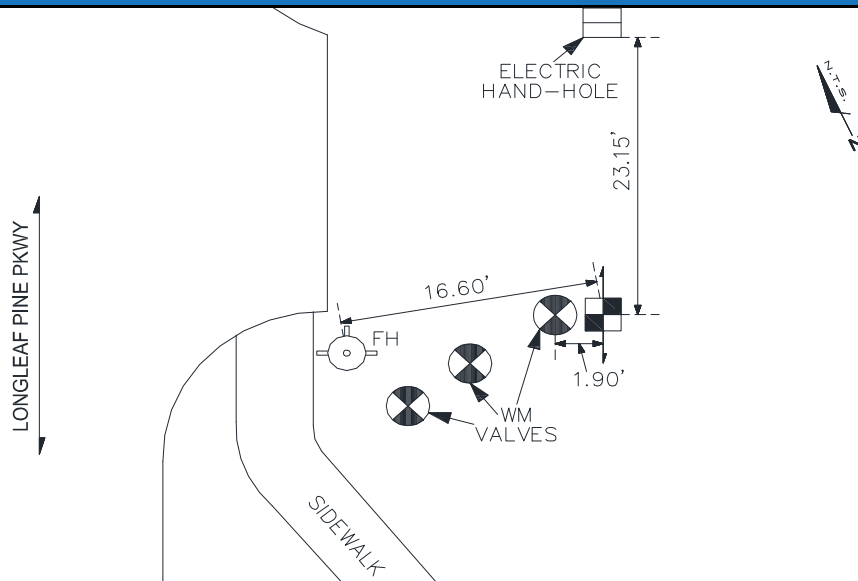
Offset N/A

Horizontal Datum N/A

Vertical Datum N/A

Notes:

Find test hole location in sheet no. C-4, Rivertown WTP RAW Water Main  
Proposed Plan and Profile, provided by client.



FRA Project Manager	Dennis S.	Form	Chris R.	QA/QC Field	Dailys T.
Assistant	Aaron M.	CAD	Dailys T.	QA/QC Office	Chris R.
Cover	DeShawn R.			QA/QC PM	Dennis S.
Latitude	N/A	Longitude	N/A		

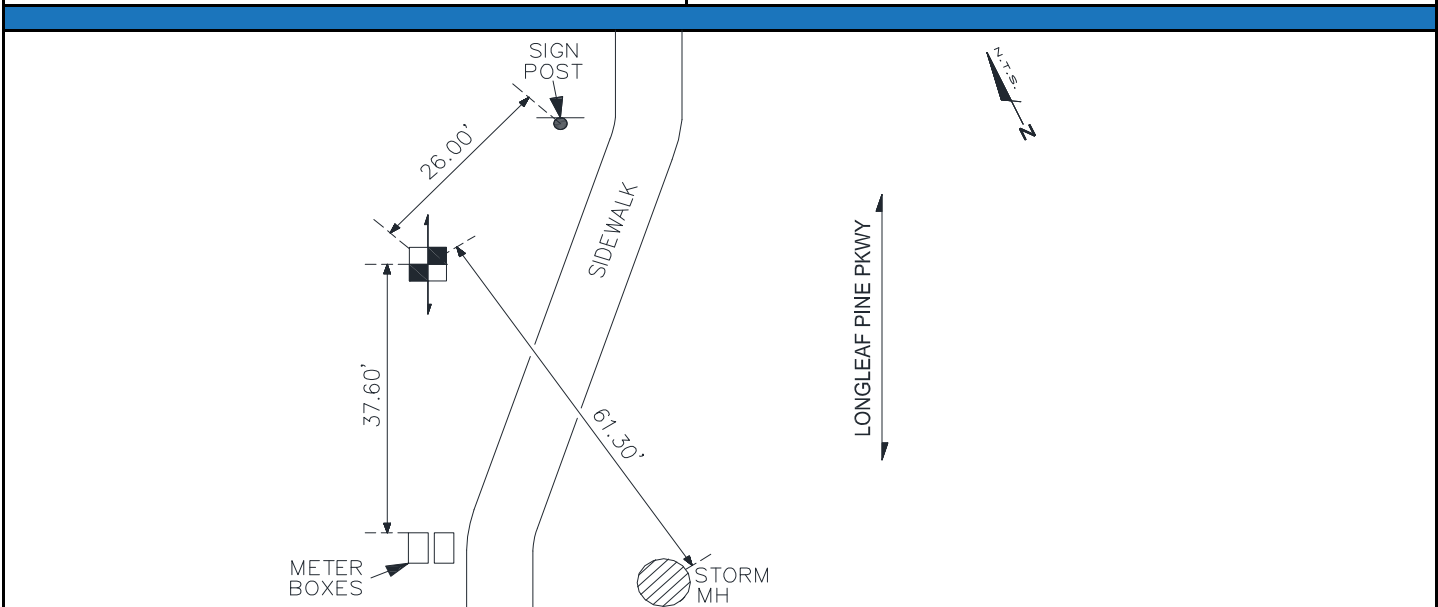
# Vacuum Test Hole Report

FRA Job # 3247  
Work Order 1  
Test Hole # 16  
# of Holes 1  
Date 1/22/2020  
Time N/A

Project Name: JEA Rivertown WTP

Work Order	JEA Rivertown WTP				
Owner	JEA	Client	R.E. Holland & Associates, Inc.		
Contract #	N/A	FPID	N/A		
Utility Owner	JEA WATER & SEWER	Requested Locate	FORCE MAIN	Located Utility	FORCE MAIN
Pavement Type	N/A	Pavement Condition	N/A	Soil Condition	SOFT DRY
Material as Found	PVC	Size Expected	16"	Size Found	16"
Utility Condition	GOOD	Ribbon Installed	GREEN	Utility Direction	NE/SW
Proposed	NEW UTILITIES	Installed	HUB	At	CROWN OF UTILITY

<p>Elevation Survey Pin N/A</p> <p>Cover (Top) 4.52'</p> <p>Elevation (Top) N/A</p> <p>Cover (Bottom) 6.09'</p> <p>Elevation (Bottom) N/A</p> <p>Width 1.57'</p> <p>Pavement N/A</p> <p>Sub-Pavement N/A</p> <p>North Arrow</p>	<p>Survey Pin Located FR Aleman</p> <p>Measurement Type US Feet</p> <p>Northing N/A</p> <p>Easting N/A</p> <p>Station N/A</p> <p>Offset N/A</p> <p>Horizontal Datum N/A</p> <p>Vertical Datum N/A</p> <p>Notes: No comments</p> <p>Find test hole location in sheet no. C-3, Rivertown WTP RAW Water Main</p> <p>Proposed Plan and Profile, provided by client.</p>
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FRA Project Manager	Dennis S.	Form	Chris R.	QA/QC Field	Dailys T.
Assistant	Aaron M.	CAD	Dailys T.	QA/QC Office	Chris R.
Cover	DeShawn R.			QA/QC PM	Dennis S.
Latitude	N/A	Longitude	N/A		



# Vacuum Test Hole Report

FRA Job # 3247  
Work Order 1  
Test Hole # 17  
# of Holes 1  
Date 1/22/2020  
Time N/A

Project Name: JEA Rivertown WTP

Work Order	JEA Rivertown WTP				
Owner	JEA	Client	R.E. Holland & Associates, Inc.		
Contract #	N/A	FPID	N/A		
Utility Owner	JEA WATER & SEWER	Requested Locate	RE-CLAIM WM	Located Utility	RE-CLAIM WM
Pavement Type	N/A	Pavement Condition	N/A	Soil Condition	SOFT DRY
Material as Found	PVC	Size Expected	20"	Size Found	20"
Utility Condition	GOOD	Ribbon Installed	PURPLE	Utility Direction	NE/SW
Proposed	NEW UTILITIES	Installed	HUB	At	CROWN OF UTILITY

Elevation Survey Pin

N/A

Pavement

N/A

Sub-Pavement

N/A

Cover (Top)

4.57'

Elevation (Top)

N/A

Cover (Bottom)

6.24'

Elevation (Bottom)

N/A

Width

1.67+/-



Survey Pin Located FR Aleman

Measurement Type US Feet

Northing N/A

Easting N/A

Station N/A

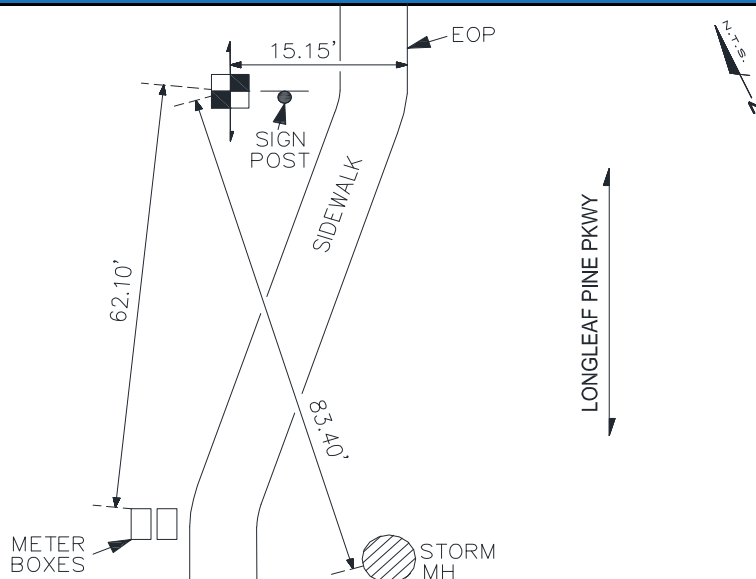
Offset 15.15' LT

Horizontal Datum N/A

Vertical Datum N/A

## Notes:

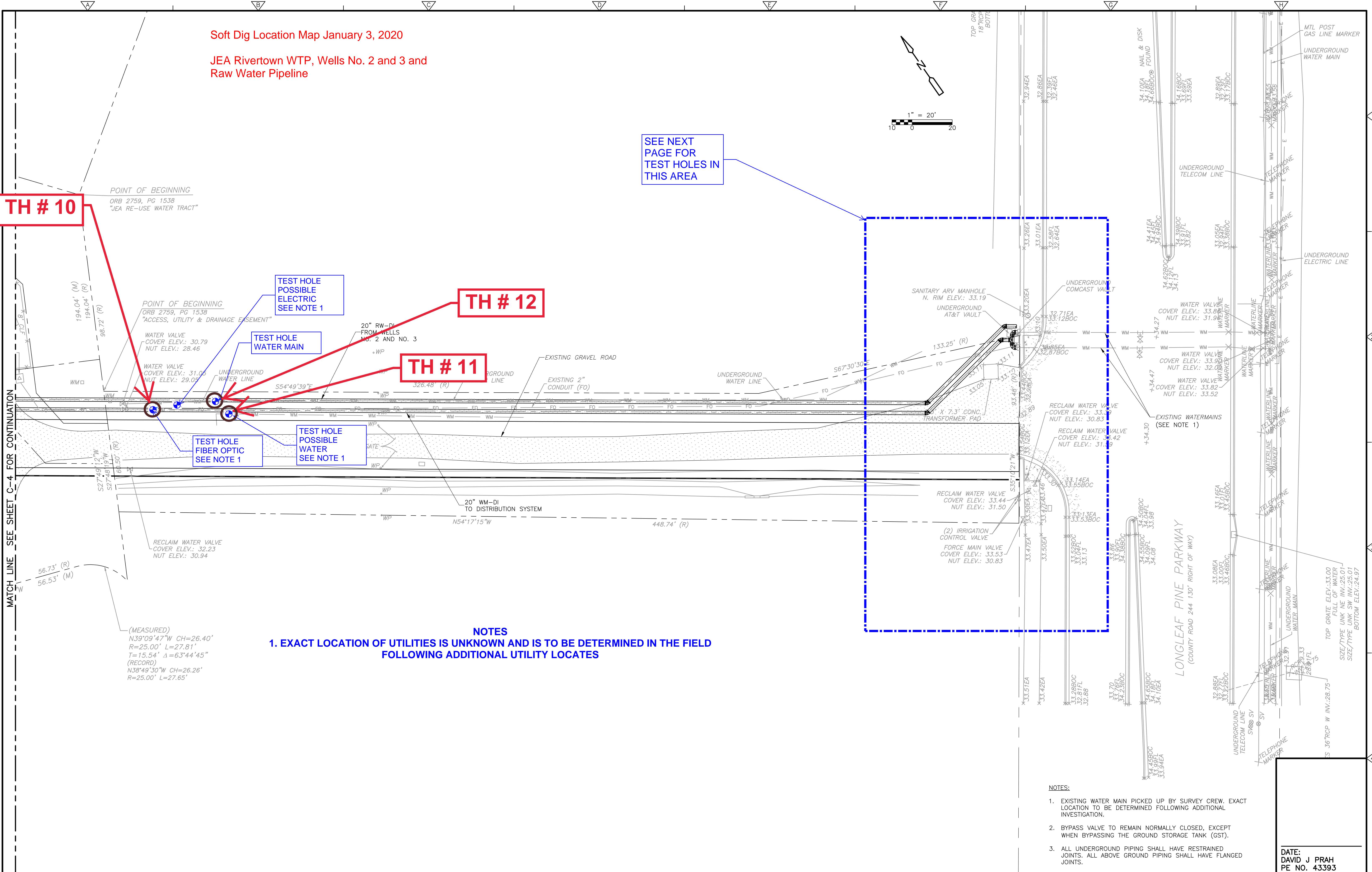
Find test hole location in sheet no. C-3, Rivertown WTP RAW Water Main  
Proposed Plan and Profile, provided by client.



FRA Project Manager	Dennis S.	Form	Chris R.	QA/QC Field	Dailys T.
Assistant	Aaron M.	CAD	Dailys T.	QA/QC Office	Chris R.
Cover	DeShawn R.			QA/QC PM	Dennis S.
Latitude	N/A	Longitude	N/A		

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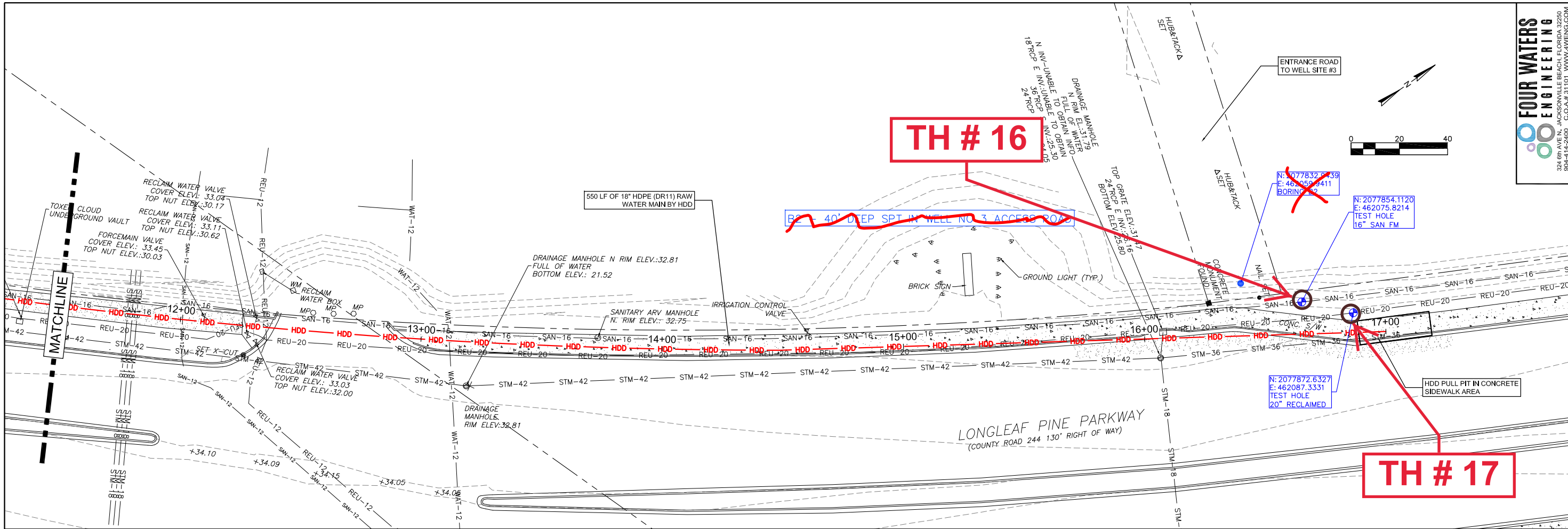


						DESIGNED BY: C. GERRETA	 4651 Salisbury Road, Suite 420 Jacksonville, FL 32256 Tel: (904) 731-7109 FL COA No. EB-0000020	JEA	RIVERTOWN WATER TREATMENT PLANT PROJECT	YARD PIPING PLAN II	PROJECT NO. 6103-237938
						DRAWN BY: C. SCOTT					FILE NAME: C005YPPL.DWG
						SHEET CHK'D BY: B. WILLIAMS					SHEET NO.
						CROSS CHK'D BY: D. PRAH					C-5
						APPROVED BY: I. POLEMATIDIS					
REV.	DATE	DRWN	CHKD		REMARKS	DATE: DECEMBER 2019					

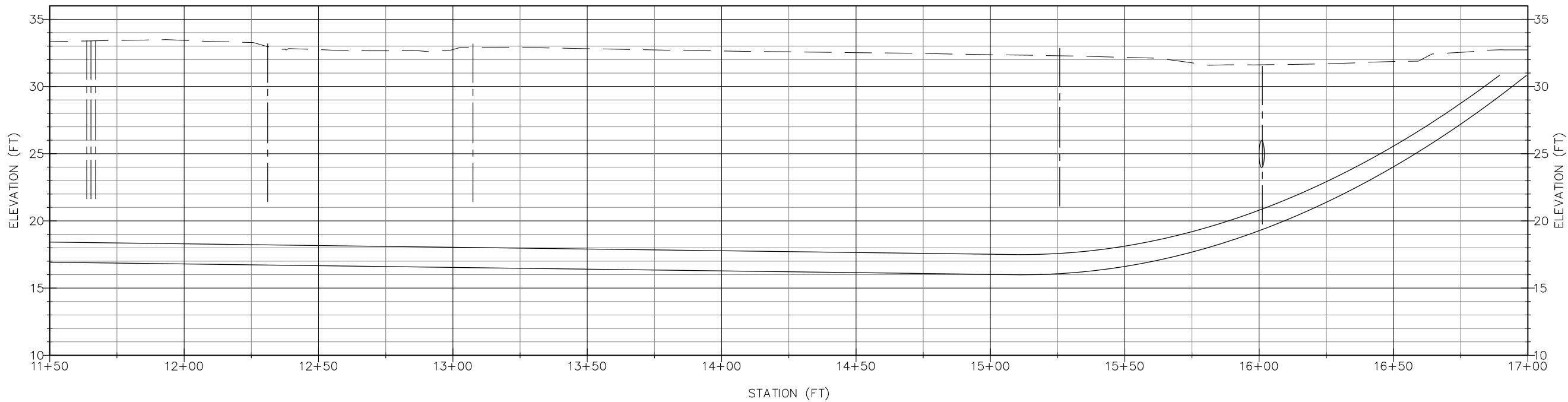








MAIN RUN PROFILE  
FROM 11+50.00 TO 17+00.00



FOUR WATERS  
ENGINEERING

324 8th AVE N. JACKSONVILLE BEACH, FLORIDA 32250  
904-114-2400 CADD 31101 WWW.FWENG.COM

DATE: \_\_\_\_\_

BY: \_\_\_\_\_

NO.: \_\_\_\_\_

DESIGN ENGINEER: \_\_\_\_\_

DESIGNER: \_\_\_\_\_

DATE: \_\_\_\_\_

CHECKED BY: \_\_\_\_\_

DATE: \_\_\_\_\_

REVISIONS

DATE: \_\_\_\_\_

BY: \_\_\_\_\_

NO.: \_\_\_\_\_

DESIGN ENGINEER: \_\_\_\_\_

DESIGNER: \_\_\_\_\_

DATE: \_\_\_\_\_

CHECKED BY: \_\_\_\_\_

DATE: \_\_\_\_\_

PROJECT NO. 19-1019

SHEET NO. \_\_\_\_\_

DRAWING NO. C-3

DATE: NOV-2019

SCALE: AS SHOWN

RIVERTOWN WTP  
RAW WATER MAIN  
PROPOSED PLAN AND PROFILE

DATE: \_\_\_\_\_

BY: \_\_\_\_\_

NO.: \_\_\_\_\_

DESIGN ENGINEER: \_\_\_\_\_

DESIGNER: \_\_\_\_\_

DATE: \_\_\_\_\_

CHECKED BY: \_\_\_\_\_

DATE: \_\_\_\_\_

TH #16

TH #17

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