

6. Complete design calculations for tanks, supports, and appropriate accessories.
  7. Tank capacity chart indicating gallons for each inch of depth and cumulative total from bottom.
  8. Fabricator's detailed requirements for tank foundations.
  9. Recommended bolt torques for all bolted FRP connections.
  10. Recommendations for tank material selection and fabrication methods for services indicated on the Tank Data Sheets included at the end of the Detailed Specifications.
  11. ASME RTP-1 certification.
  12. Certified test data on representative samples of standard laminate materials which verify that their physical properties meet the requirements and service conditions specified. Include verification of structural design parameters.
  13. Final Configuration of Tank Appurtenances: The final locations of tank appurtenances including, but not limited to, nozzles, manways, pipe supports, anchor lugs, ladder, and handrail will be confirmed by the Engineer during review of Contractor's drawing submittals.
- B. Samples: Laminate sample representative of production quality of surface finish and visual imperfections.
- C. Quality Control Submittals:
1. Fabricator's Certificate of Compliance with fabrication requirements.
  2. Qualifications of fabricator's Quality Assurance Supervisor.
  3. Copy of the fabricator's Quality Assurance Program.
  4. Certification of Factory Testing. Submit factory test reports to the Engineer.
  5. Certification that the tank supports, and access nozzles have been coordinated with the actual equipment being furnished.
  6. Special shipping, storage and protection, and handling instructions.

7. Fabricator's written/printed installation and tank support instructions.
  8. Manufacturer's Certificate of Proper Installation.
  9. ASME RTP-1 certified.
- D. Contract Closeout submittals: Service records for repairs performed during construction.
- E. Additional Information
1. In the event that it is impossible to conform with certain details of the specifications due to different manufacturing techniques, describe completely all nonconforming aspects.
- F. Operating Instructions
1. Operating and maintenance manuals shall be furnished. 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 operation and maintenance personnel unfamiliar with such equipment. The number and special requirements shall be as specified in Section 01730: Operating and Maintenance Data.
  2. A factory representative of all major component manufacturers, 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. With the Owner's permission, this work may be conducted in conjunction with the inspection of the installation and test run as provided under PART 3-EXECUTION. If there are difficulties in operation of the equipment due to the manufacturer's design or fabrication, additional service shall be provided at no cost to the Owner.

#### 1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. The tanks and components shall be adequately protected during transportation, in storage at the job site, and during subsequent installation and construction activities. Damaged units will be rejected and shall be replaced with undamaged units.

## 1.05 WARRANTY AND GUARANTEES

- A. The tanks shall be warranted for 10 years to be free of defects in material and workmanship.
- B. See Section 01740: Warranties and Bonds.

## PART 2 - PRODUCTS

### 2.01 GENERAL

#### Acceptable Manufacturers

- A. The tanks shall be as manufactured by and established ASME RTP-1 certified manufacturer for fiberglass reinforced polymer vessels. The manufactured tanks shall be stamped with the official symbol for ASME RTP-1 certified vessels, indicating the fabricators full compliance with the design code and standards. The tanks shall be as manufactured by Augusta Fiberglass, Belco Manufacturing Company, Diamond Fiberglass, or equal.

### 2.02 MATERIALS AND EQUIPMENT

- A. Basic materials shall be as follows:

Resin	Vinyl ester resins shall be Hetron 922, or approved equal, suitable for use with the specified chemicals. Use same resin throughout the tank.
Reinforcement	Glass fiber with a suitable coupling agent.
Surfacing Mat	Burlington Formed Fabrics "Nexus Veil", Nicofibers "Surmat 100", or equal.
Plastic Laminate	In conformity with the applicable governing standards.
Exposed Metal	ANSI Type 316 stainless steel, in services other than sodium hypochlorite or fluoride. Hastelloy C in sodium hypochlorite or fluoride service.
Exposed Assembly and Bolts, Nuts, and Washers	ANSI Type 316 stainless steel, in services other than sodium hypochlorite or fluoride. Hastelloy C in sodium hypochlorite or fluoride service.

Protected Metal                      Carbon steel, ASTM A36, with fiberglass reinforced plastic coating.

B. Performance and Design Requirements

1. Conditions of Service: Each tank will normally be used to store the specified chemical at atmospheric pressure. The tanks shall be designed for the storage of the following liquid chemicals:

Tank Number	75-T-1B, 2B, 3B	50-T-1, 2
Chemical	Sodium Hypochlorite	Sodium Hypochlorite
Location	Process Building 75	Process Building 50
Maximum Concentration percent by weight	15	15
Chemical Specific Gravity	1.16	1.16
Max Temp., Degrees F	100	100
Max. Temp., Degrees F	100	100
Min. Temp.		
Tank Contents, Degrees F	Ambient	Ambient

2. Design Criteria:

- a. Each tank shall be designed to withstand the hydrostatic head which would result with the tank and fill line surcharged with the liquid chemical to 6 inches above the top of the tank.
- b. The tanks shall conform to the following requirements:

Tank Number	75-T-1B, 2B, 3B	50-T-1, 2
Service	Sodium Hypochlorite Storage	Sodium Hypochlorite Storage
Orientation	Horizontal	Vertical
Number of Units	3	2
Nominal capacity, measured to invert of overflow pipe, gal	36,000	7,000
Max Diameter, feet	12	10

Length/Height, feet

40<sup>1</sup>

12

Note:

1. Sidewall Length

c. Each tank shall be designed in accordance with the applicable design standards referenced herein. Design calculations shall be provided for each tank and shall be signed and sealed by a professional engineer registered in the State of Florida.

C. Fabrication and Manufacture

1. Vertical Tank:

a. Vertical tanks shall have flat outer bottoms for mounting on a concrete base as indicated on the drawings. Each tank shall be provided with a 24-inch manway with Tank supported access ladder and safety railing around top manway meeting OSHA ladder and railing requirements. Tanks shall be provided with all fittings shown on the drawings.

2. Horizontal Tank:

a. Horizontal tanks shall be constructed for mounting on saddles as indicated on the Drawings. Saddle spacing shall match the existing tanks to allow the tank to be supported by the existing concrete pedestals. Field verify spacing and dimensions of the existing concrete pedestals. Each tank shall be provided with a 24-inch manway and all fittings as shown on the Drawings.

3. Manufacture

a. The tanks shall be hand lay-up, spray-up, or filament wound construction in accordance with the applicable governing standard. All tank shells shall be shop fabricated in a controlled environment by the manufacturer and no vertical seams shall be allowed. The finished laminate shall be constructed using a single generic type of thermoset resin throughout and shall not contain colorants, dyes, fillers, or pigments unless otherwise specified. Ultraviolet absorber shall be added to the resin used in the fabrication of tanks indicated on the drawings or specified to be suitable for installation in exposed, exterior locations. After installation and testing, the tanks shall be painted as specified in Section 09900: Painting, to shield the chemical contents from light.

- b. The inner surface layer of the tanks shall consist of two resin rich layers reinforced with surfacing mat and having a total combined thickness of not less than 110 mils.
- c. Bracketed flat surfaces shall be provided on each tank for the installation of a nameplate, and a certification plate.
- d. Minimum of three lifting lugs shall be provided on each tank as required for handling and installation.
- e. For sodium hypochlorite, the cure system for the corrosion liner shall be BPO/DMA with a four-hour post cure at 180°F. For all other tanks and for structural layers on the sodium hypochlorite tanks, the initiator used shall be of the type, manufacturing origin, and amounts specified by the resin manufacturer. The resins and curing shall comply with FDA regulations 21 CFR 177.2420.
- f. For sodium hypochlorite storage tanks, the inner surface of the tank shall have double nexus veil of 20 mils with ECR banking for the corrosion liner. For all other chemical storage tanks, the inner surface of the tank shall have a single or double nexus veil of 20 mils as a minimum. Material used as reinforcing on the surface exposed to chemical attack shall be commercial grade chemical resistant glass fiber having a coupling agent.
- g. The sodium hypochlorite tank shall be factory air tested to a pressure of 10 psi for a duration of one hour. Any leaks detected during the testing shall be repaired by the manufacturer and the tank retested until no detectable leakage is observed.

3. Concrete Bases:

- a. The concrete bases for the tanks shall be constructed in accordance with the provisions of Section 03300: Cast-in-Place Concrete and shall be level and smooth to the tolerances recommended by the tank fabricator. Existing concrete pedestals for the horizontal tanks shall be reused. Concrete bases and pedestals shall be coated in accordance with Section 09900.

## 2.03 ACCESSORIES

- A. Accessories shall be provided on each tank as indicated on the drawings and as specified herein.

1. Flanged Nozzles:

- a. Nozzles for connecting piping and accessories shall be provided on each tank at the locations and of the sizes indicated on the drawings or specified herein.
- b. Each nozzle shall be flanged, with flange diameter and drilling conforming to ANSI B16.5, Class 150. Nozzles shall extend at least 4 inches from outside face of tank to face of flange.
- c. The level gauge mounting flange shall be above the maximum liquid level recommended by the level sensor manufacturer. The length of the nozzle shall be as recommended by the level sensor manufacturer. The center line of the nozzle shall be at least 24 inches from the tank sidewall, fill nozzle, and other obstructions.
- d. Flanged nozzles shall be fabricated of the same material as the tank and shall be gusseted to the tank or otherwise reinforced in accordance with the governing standard.
- e. Each tank shall be provided with the following flanged nozzles:

<u>Quantity</u>	<u>Connection</u>	<u>Nozzle Size, Inches</u>	<u>Location on Tank</u>
Sodium Hypochlorite Storage Tanks - 75-T-1B, 75-T-2B, 75-T-3B			
1	Fill	3	Top
1	Feed Pump Suction	3	End @ Bottom
1	Overflow	3	End @Top
1	Drain and Pressure/ Level Transducer	2	Bottom
1	Vent	6	Top
1	Vent Return	2	Top
1	Manway	24	Top
1	Site Glass	2	End @ Top and Bottom

Sodium Hypochlorite Storage Tanks - 50-T-1, 50-T-2

1	Fill	2	Top
1	Level Transducer	6	Top
1	Vent	6	Top
1	Feed Pump Suction	2	Side @ Bottom
1	Overflow	3	Side @Top
1	Drain	2	Side @ Bottom

1	Manway	24	Top
1	Site Glass	2	Side @ Top and Bottom

2. **Overflow and Drains:** Chemical tank shall be provided with an overflow and drain line of the size recommended by the manufacturer to provide means for draining the tank and to prevent spills in the event of an overflow.
3. **Level Sight Gauge:** Provide a 2-inch clear PVC graduated level sight gauge where indicated on the Drawings. Sight gauge shall be equipped with PVC isolation ball valves at the top and bottom connection to the tank.
4. **Nameplates:** Each tank shall be provided with a nameplate to identify the use of the tank. The nameplates shall be of orange phenolic material with black engraved lettering one inch high and shall be mounted on the tank at a location acceptable to the Engineer.
5. **Certification Plates:** A stainless steel certification plate shall be installed below each storage tank nameplate. The following data shall be included on the certification plate:
  - a. Name of tank fabricator.
  - b. Date of manufacture.
  - c. Product to be stored
  - d. Maximum allowable concentration, specific gravity and temperature of the specified chemical solution that can be stored safely.
  - e. Mechanical properties of the laminate.
  - f. Resin designation.
  - g. Equipment identification number shown listed herein.
6. **Lifting Lugs:** Provide suitably attached for all tanks weighing over 100 pounds.
7. **Anchor Bolts:** Type 316, stainless steel bolts in services other than fluoride and sodium hypochlorite and Hastelloy-C in fluoride and sodium hypochlorite service, sized by fabricator and at least 1/2-inch in diameter,



or as shown and as specified in Section 05500, Fabricated Metalwork and Castings.

8. Anchor Lugs: Anchor lugs shall be provided and shall be designed to withstand all specified wind load conditions. No less than 8 anchor lugs shall be provided. Details of anchors shall be shown on fabrication Drawings. Anchor lugs shall be Type 316 stainless steel in services other than fluoride and sodium hypochlorite and Hastelloy-C in fluoride and sodium hypochlorite service.
9. Ladders
  - a. Provide ladders for tanks as shown on the drawings. Ladders shall be constructed of FRP. Provide safety cages with ladders. Design ladders to meet OSHA standards: OSHA 2206, 1910.27.
  - b. Attach ladders to the tank to allow for tank expansion and contraction due to temperature and loading changes. The mounting system shall be determined by the ladder material specified and the tank size requested. Connect top ladder mounts to integrally molded-in attachment lugs that allow for tank movement. Ladder mounts may be bolted or banded. Bolted mounts shall consist of a bracket bolted to the tank sidewall with 1/2-inch encapsulated bolts which allows tank movement without tank or ladder damage. The banded mounts shall consist of a bracket banded to the tank sidewall with 2-inch banding material which allows tank movement without tank or ladder damage. Attach metal ladders to the tank at the top ladder mount location only.

#### 2.04 SPARE PARTS (NOT APPLICABLE)

#### 2.05 QUALITY CONTROL

- A. Inspection of all products fabricated to this Specification is required prior to shipment unless specifically waived in writing by the Engineer. This shall include:
  1. Visual inspection to the requirements of ASTM C582-87 and ASTM D2563-87.
  2. Barcol Hardness measurements per ASTM D2583-87.
  3. Acetone sensitivity test for all internal secondary bonds.
  4. Glass content by ignition loss on three cutouts per ASTM D2584.

5. Hydrostatic Leak Test:
  - a. Perform on each tank.
  - b. Fill to top nozzle; allow to stand for 2 hours with no visible leakage.
- B. Repairs authorized by the Engineer shall be reinspected before final acceptance unless specifically waived.
- C. Identify and retain all cutouts. Engineer may select certain cutouts for testing for physical properties of the laminate.
- D. Factory Test Reports: Certify, by signature, results of the following:
  - a. Inspections.
  - b. Results of hydrostatic testing.
  - c. Test reports of physical properties of standard laminates.

## PART 3 - EXECUTION

### 3.01 PREPARATION (NOT APPLICABLE)

### 3.02 INSTALLATION

- A. The tanks shall be installed at the locations as indicated on the drawings. The tanks shall be installed in accordance with the fabricator's recommendations, the requirements of the applicable governing standard, and to the satisfaction of the Engineer, and made ready for the installation of piping and other appurtenances as indicated on the drawings and specified under other sections. Grouting under the tank, if recommended by the tank fabricator, shall be done with nonshrinking grout as specified in Section 03600: Grout.

### 3.03 INSPECTION AND TESTING

- A. After completion of installation, the tanks shall be filled with water to the top access manhole opening and allowed to stand full for a period of not less than 48 hours. During testing, flanged connections may be plugged by the installation of temporary blind flanges on the outside of the tank but shall not be blocked or plugged on the inside. All leaks or indications of leaks shall be repaired by the fabricator and made completely watertight. A leaking tank, upon repair, shall be retested to the satisfaction of the Engineer.

### 3.04 START-UP AND INSTRUCTION

- A. When installation has been completed and all connections have been made, all tank surfaces, interior and exterior, shall be thoroughly cleaned as recommended by the fabricator and to the satisfaction of the Engineer. Abrasive cleaning agents shall not be used. The tank and wetted accessories shall be completely dried before being placed into service.
- B. Provide fabricator's representative at site in accordance with Section 01650: Start-Up for installation assistance, inspection and certification of proper installation and start-up assistance for specified component, subsystem, equipment, or system.
- C. Manufacturer's Authorized Representative: Present at Work site designated by the Contractor for the minimum person-days listed below, travel time excluded.
  - 1. Services to include but may not be limited to:
    - a. 1 person-day for installation assistance, inspection, and certification of installation for each type of tank.
  - 2. Furnish assistance, inspection, and certification services at such times as requested by the Contractor.

END OF SECTION

## SECTION 13300

### INSTRUMENTATION AND CONTROLS

#### PART 1 - GENERAL

##### 1.01 SUMMARY

- A. The Contractor shall furnish, install and place into service operating process instrumentation, control systems and panels including accessories, related to this facility, all as shown on plans and specified herein.
1. Existing plant systems must remain operational during construction. Nighttime and/or other off hours work may be required to support plant operations and shall be included in the contractor's bid.
  2. The instrument contractor is responsible to "As-Built" all existing control panels and to provide all demolition and modification as necessary for the installation of the new I/O in the existing local control panels.
  3. Equipment, wires, and cables rendered obsolete by this construction must be removed from the existing panels. Equipment, wires, and cables previously abandoned must also be removed from the panels. Existing programming associated with obsolete and/or abandoned equipment shall be removed from each PLC's program. Functioning equipment present in these panels must remain functional and will be included on the instrument contractor's "As-Built" drawings. Provide new power supplies, surge suppressors, I/O cards, terminal strips, etc. for new I/O. The instrument contractor is responsible to provide completed panels that are clean, functional and present a professional workman-like appearance. Field devices/equipment shall be provided with sunshields. Sunshields shall be rated for the area in which it will be constructed, unless otherwise noted, sunshields shall be rated NEMA-4X.
  4. All wires in control panels must be permanently tagged and shown on the as-built drawings. This includes all spare wires and cables. Spare cables are to be taped and left coiled in the panels for future use. Cable and wire numbers are to be assigned by the contractor, documented and controlled to prevent duplicate numbers. The contractor shall turn over to the owner, at the project conclusion, a cable and wire list showing assigned numbers and their physical location in the plant.
  5. See electrical drawings and specifications for additional work required of the instrument contractor as part of this project to supply demolition

instructions, relocation and modification instructions for equipment not necessarily shown on the instrument drawings.

6. Contractor shall modify the existing PLC system, SCADA screens, and Report generation requirements at the existing Eastern Regional Water Supply Facility to include all the proposed modifications as part of this project and add Tags to the SCADA system.
  7. Provide and install new PLC control panel for the temporary chemical feed system as described in specification section 11400, Temporary Chemical Feed System. Coordinate all aspects of the PLC control panel with the temporary chemical feed system supplier.
  8. Provide and install new remote I/O panel RIO-5 as indicated on the plans. Provide fiber connection between 50-LCP-5 and RIO-5 and integrate the new RIO-5 panel to the existing process 50 control panel. Modify 50-LCP-5 as required to integrate the new RIO-5 panel.
  9. Contractor shall obtain a copy of the existing PLC programming for panel 50-LCP-5 and 75-LCP-8 from the Owner. Contractor shall rewrite the PLC logic for PLC systems according to the Orange Standard Naming and Tag numbering system. Contractor shall closely coordinate with Owner and Engineer and inform any deviation and get approval from Owner.
  10. Refer to I-drawings for the existing PLC network and associated items to be replaced. All PLC panels shall use I/O scanning for program communication. Program 30 spare addresses into the I/O scanner. The existing 50-LCP-5 and 75-LCP-8 shall be re-programmed with Orange Standard Naming and Tag numbering system.
  11. The existing PLC program in panels 50-LCP-5 and 75-LCP-8 shall be reprogrammed removing any unused tags.
  12. Contractor shall provide and install Hirschmann (or equal) Ethernet Switch in the PLC control panel as shown on instrumentation drawings. Contractor shall obtain and provide onsite training from the Hirschmann system integrator for at least four technicians from the Owner for four hours related to the devices installed. Contact Belden representative to arrange training.
  13. Contractor shall configure the existing iHistorian Server Computer located at the Eastern Regional Water Supply Facility to collect and store the data. Coordinate with Owner and provide for amount of tags that will be collected and stored at Eastern Regional Water Supply Facility.
- B. Work Includes: Engineering, furnishing, installing, calibrating, adjusting, testing, documenting, starting up, and OWNER training for a complete Instrumentation and Control System.

Major parts are:

1. Instrumentation including primary elements, transmitters, and control devices.
  2. Control Panels.
  3. PLC and I/O Rack Control Panels
  4. Software and Licensing
  5. Acceptance Testing, including 30-day system acceptance test.
- C. Instrument and Control (I&C) Supplier work scope:
1. For I&C equipment and ancillaries provide the following:
    - a. Complete detail design.
    - b. Required Submittals.
    - c. Equipment and ancillaries.
    - d. Instructions, details, and recommendations to, and coordination with, Contractor for proper installation.
    - e. Verify readiness for operation.
    - f. Verify the correctness of final power and signal connections.
    - g. Adjusting and calibrating.
    - h. Starting up.
    - i. Testing and coordination of testing.
    - j. Training.
  2. Verify following work not by I&C Supplier is provided:
    - a. Correct type, size, and number of signal wires with their raceways.
    - b. Correct electrical power circuits and raceways.
    - c. Correct size, type, and number of I&C related pipes, valves, fittings, and tubes.
    - d. Correct size, type, materials, and connection of process mechanical piping for in-line primary elements.
  3. For equipment not provided under I&C Supplier, but directly connected to equipment required by I&C Supplier:
    - a. Obtain from Contractor, manufacturer's information on installation, interface, function, and adjustment.
    - b. Coordinate with Contractor to allow required interface and operation with I&C System.
    - c. For operation and control, verify that installations, interfacing signal terminations, and adjustments have been completed with manufacturer's recommendations.
    - d. Test to demonstrate required interface and operation with I&C System.

e. Examples of items in this category, but not limited to the following:

- 1) Valve operators, position switches, and controls.
- 2) Chemical feed pump and feeder speed/stroke controls.
- 3) Automatic samplers.
- 4) Motor control centers.
- 5) Adjustable speed drive systems.

f. Examples of items not in this category:

- 1) Internal portions of equipment provided under Division 16, Electrical, that are not directly connected to equipment under I&C System.
- 2) Internal portions of I&C Systems provided as part of package systems and that are not directly connected to equipment provided under I&C System.

4. Wiring external to equipment provided by I&C Supplier:

a. Special control and communications cable: Provided by I&C Supplier.

D. Software Engineering work scope:

1. Configuration of PLCs, including:

- a. Correct I/O mapping and scaling.
- b. Ladder logic implementing defined control strategies.
- c. SCADA interface mappings.
- d. Specifications/documents including: System External Specification, System Internal Specification, I/O Checklist, Factory Acceptance Test Plan, and Site Acceptance Test Plan.
- e. As-built documentation

2. Start-up support, including system testing.

3. System training.

4. Computer based SCADA system (Proficy HMI/SCADA - iFIX). Coordinate with Owner for County's standard current version and provide accordingly.

## 1.02 SINGLE INSTRUMENT SUPPLIER

- A. The Contractor shall assign to the Single Instrument and Control (I&C) supplier full responsibility for the functional operation of all new and modified instrumentation systems. The Contractor shall have said supplier perform all engineering necessary in order to select, to furnish, to program, to supervise installation, to connect, to calibrate, to place into operation all sensors, instruments, alarm equipment, control panels, accessories, and all other equipment as specified herein.
- B. The single instrument and controls supplier shall demonstrate his ability to successfully complete projects of similar sizes and nature. Provide references (including phone number and contact name) for at least three projects successfully completed in which the following tasks were performed: system engineering, documentation including panel assembly, schematics and wiring diagram, programming, field testing, calibration and start-up, operator instruction and maintenance training.
  - 1. The foregoing shall enable the Contractor and the Owner to be assured that the full responsibility for the requirements of this Section shall reside in an organization which is qualified and experienced in the water management field and its process technology on a functional systems basis.
  - 2. The single I&C supplier shall have a UL approved shop and shall build all panels according to UL 508A.
  - 3. Instrumentation and Controls supplier shall be **Curry Controls Company or Revere Control Systems, Inc.** Instrumentation and Controls supplier (system Integrator) shall be a Schneider Electric Company Certified Alliance Partner.
- C. The single software engineering supplier shall demonstrate his ability to successfully complete projects of similar sizes and nature. Provide references (including phone number and contact name) for at least three projects successfully completed in which the following tasks were performed: ladder logic programming, computer based SCADA system configuration, documentation, field testing, start-up, and operator instruction.

## 1.03 INSTALLATION WORK

- A. Nothing in this part of the Specifications shall be construed as requiring the Contractor to utilize personnel supplied by his assigned instrument manufacturer's organization, or any division thereof, to accomplish the physical installation of any elements, instruments, accessories or assemblies specified herein. However, the Contractor shall employ installers who are skilled and experienced in the installation and connection of all elements, instruments, accessories and



assemblies; portions of their work shall be supervised or checked as specified in Part 3, herein.

#### 1.04 PREPARATION OF SUBMITTAL OF DRAWINGS AND DATA

- A. It is incumbent upon the Contractor to coordinate the work specified in these Sections so that a complete I&C system for the facility shall be provided and shall be supported by accurate Shop and record Drawings. As a part of the responsibility as assigned by the Contractor, the Single I&C supplier shall prepare and submit through the Contractor, complete organized Shop Drawings, as specified in Part 2.02, herein. Interface between instruments, motor starters, etc. shall be included in his Shop Drawing submittal.
- B. During the period of preparation of this submittal, the Contractor shall authorize direct, informal liaison between his Single I&C supplier and the Engineer for exchange of technical information. As a result of this liaison, certain minor refinements and revisions in the systems as specified may be authorized informally by the Engineer, but these shall not alter the scope of work or cause increase or decrease in the Contract Price. During this informal exchange, no oral statement by the Engineer shall be construed to give formal approval of any component or method, nor shall any statement be construed to grant formal exception to, or variation from these Specifications.
- C. In addition, I&C supplier/programmer shall provide a fully documented version of PLC programming and HMI programming on a CD and hard paper copy. The fully documented programs shall include functional descriptions for all areas impacted during construction.

#### 1.05 ADDITIONAL TECHNICAL SERVICES

- A. At no separate additional cost to the Owner, the Contractor shall provide the following services of qualified technical representatives of the Single I&C supplier (See Part 3, herein).
  - 1. To supervise installation and connection of all instruments, elements, and components of every system, including connection of instrument signals to primary measurement elements and to final control elements such as pumps, valves, and chemical feeders;
  - 2. To make all necessary adjustments, calibrations and tests; and
  - 3. To instruct plant operating and maintenance personnel on instrumentation. This time shall be in addition to whatever time is required for other facets of work at the site, and shall be during the Owner's normal working days and hours.

4. To terminate and test all fiber optic cable and affected devices.

#### 1.06 GUARANTEE

- A. The Contractor shall guarantee all equipment and installation, as specified herein, for a period of one (1) year following the date of completion of the work. To fulfill this obligation, the Contractor shall utilize technical service personnel designated by the Single I&C supplier to which the Contractor originally assigned project responsibility for instrumentation. Services shall be performed within two (2) calendar days after notification by the Owner.

#### 1.07 ADDITIONAL PROVISIONS

- A. The applicable provisions of the following Sections under Electrical Work shall apply to work and equipment specified herein, the same as if stated in full, herein:
  1. Codes and Standards
  2. Equipment, Materials and Workmanship
  3. Testing
  4. Grounding
  5. Equipment Anchoring
  6. Conductor and Equipment Identification
  7. Terminal Cabinets and Control Compartments
  8. Process Control Devices

#### 1.08 NEWEST MODEL COMPONENTS

- A. All meters, instruments, and other components shall be the most recent field proven models marketed by their manufacturers at the time of submittal of Shop Drawings unless otherwise specified to match existing equipment. All technical data publications included with submittals shall be the most recent issue.

#### 1.09 INSPECTION OF THE SITE AND EXISTING CONDITIONS

- A. The instrumentation drawings were developed from past record drawings and information supplied by the OWNER.
- B. Before submitting a bid, visit the site and determine conditions at the site and at all existing structures in order to become familiar with all existing conditions and instrumentation and control systems which will, in any way or manner, affect the work required under this Contract. No subsequent increase in Contract cost will be allowed for additional work required because of the CONTRACTOR'S failure to fulfill this requirement.

## 1.10 RELATED WORK

- A. Division 16 - Electrical
- B. Division 11 - Equipment
- C. Division 13 - Special Construction

## PART 2 - PRODUCTS

### 2.01 INSTRUMENTATION CRITERIA

#### A. DESIGNATION OF COMPONENTS:

In these Specifications and on the Drawings, all systems, meters, instruments, and other elements are represented schematically, and are designated by numbers, as derived from criteria in Instrument Society of American Standard ANSI/ISA S5.1-1973. The nomenclature and numbers designated herein and on the Drawings shall be employed exclusively throughout Shop Drawings, data sheets, and similar materials. Any other symbols, designations, and nomenclature unique to the manufacturer's standard methods shall not replace these prescribed above, used herein, and on the Drawings.

#### B. SIGNAL CHARACTERISTICS:

Signals shall be electrical, as indicated herein, and shall vary in direct linear proportion to the measured variable, except as noted. Electrical signals outside control panel(s) shall be 4 to 20 milliamperes DC, except as noted. Signals within enclosures may be 1-5 volts DC.

#### C. MATCHING STYLE, APPEARANCE AND TYPE:

All instruments to be panel mounted at the control panels shall have matching style and general appearance. Instruments performing similar functions shall be of the same type, model, or class, and shall be of one (1) manufacturer.

#### D. ACCURACY AND REPEATABILITY:

The overall accuracy of each instrumentation system or loop shall be as prescribed in the Specifications for that system or loop. Each system's accuracy shall be determined as a probable maximum error; this shall be the square-root of the sum of the squares of certified "accuracy s" of certain designated components in each system, expressed as a percentage of the actual span or value of the measured variable. Each individual electronic instrument shall have a minimum accuracy of  $\pm 0.7$  percent of full scale and a minimum repeatability of  $\pm 0.4$  percent of full scale unless otherwise specified. Instruments which do not conform to or improve upon these criteria are not acceptable.

E. SIGNAL ISOLATORS, CONVERTERS AND POWER SUPPLIES:

Signal isolators shall be furnished and installed in each measurement and control loop, wherever required, to insure adjacent component impedance match or where feedback paths may be generated. Signal converters shall be included where required to resolve any signal level incompatibilities. Signal power supplies shall be included, as required by the manufacturer's instrument load characteristics, to insure sufficient power to each loop component.

F. ALTERNATIVE EQUIPMENT OR METHODS:

Equipment or methods requiring redesign of any project details are not acceptable without prior approval of the Engineer. Any changes inherent to a proposal alternative shall be at no additional cost to the Owner.

The required approval shall be obtained in writing by the I&C Subcontractor through the Contractor prior to submittal of Shop Drawings and data. Any proposal for approval of alternative equipment or methods shall include evidence of improved performance, operational advantage and maintenance enhancement over the equipment or method specified, or shall include evidence that a specified component is not available. Otherwise, alternative equipment (other than direct, equivalent substitutions) and alternative methods shall not be proposed.

2.02 DETAILED SYSTEMS DRAWINGS AND DATA

A. CONTENT:

The Contractor shall submit detailed Shop Drawings and data prepared and organized by the Single I&C supplier in accordance with Division 1, Shop Drawings, Working Drawings, and Samples. These Drawings and data shall be submitted as a complete bound package at one time within 80 calendar days after date of Notice to Proceed and shall include:

1. Drawings showing definite diagrams for every instrumentation loop system. These diagrams shall show and identify each component of each loop or system using legend and symbols from ISA Standard S5.4, each having the format of ISA Standard S5.1 as used on the Project Drawing. (Each system or loop diagram shall be drawn on a separate Drawing sheet.)
2. Data sheets for each component, together with a technical product brochure or bulletin. The data sheets shall show:

- a. Component function description used herein and on the Drawings;
- b. Manufacturer's model number or other product designation;
- c. Project tag number used herein and on the Drawings;
- d. Project system loop of which the component is a part;
- e. Project location or assembly at which the component is to be installed;
- f. Input and output characteristics;
- g. Scale range and units (if any) and multiplier (if any);
- h. Requirements for electric supply (if any);
- i. Requirements for air supply (if any);
- j. Materials of component parts to be in contact with, or otherwise exposed to, process media;
- k. Calibration curves as required.
- l. Special requirements or features.

A complete index shall appear in the front of each bound submittal volume. A separate technical brochure or bulletin shall be included with each instrument data sheet. The data sheets shall be indexed in the submittal by systems or loops, as a separate group for each system or loop.

If, within a single system or loop, a single instrument is employed more than once, one data sheet with one brochure or bulletin may cover all identical uses of that instrument in that system. Each brochure or bulletin shall include a list of tag numbers for which it applies. System groups shall be separated by labeled tags.

3. Drawings showing both schematic and wiring diagrams for control circuits. Complete details on the circuit interrelationship of all devices within and outside each control panel shall be submitted first, using schematic control diagrams. Subsequent to return of this first submittal by the Engineer, piping and wiring diagrams shall be prepared and submitted for review by the Engineer; the diagrams shall consist of component layout Drawings to scale, showing numbered terminals on components together with the unique number of the wire to be connected to each terminal. Piping and wiring diagrams shall show terminal assignments from all primary measurement devices, such as flow meters, and to all final control devices, such as samplers, pumps, valves, and chemical feeders. The Contractor shall furnish all necessary equipment supplier's Shop Drawings to facilitate inclusion of this information by the I&C system supplier.

Schematic and wiring diagram criteria shall be followed as established in NEMA Standards Publication ANSI/NEMA ICS-1-1978, "Industrial Control and Systems."

4. Assembly and construction Drawings for each control panel and for other special enclosed assemblies for field installation. These Drawings shall include dimensions, identification of all components, surface preparation

and finish data, nameplates, and the like. These Drawings also shall include enough other details, including prototype photographs, to define exactly the style and overall appearance of the assembly; a finish treatment sample shall be included.

5. Installation, mounting and anchoring details for all components and assemblies to be field-mounted, including conduit connection or entry details.
6. Complete and detailed bills of materials. A master Bill of Materials listing all field mounted devices, control panels and other equipment that shall be shipped to the job site. A Bill of Materials for each control panel listing all devices within the panel.
7. Modifications to existing equipment. A complete description of all proposed modifications to existing instrumentation equipment, control panels, control devices, cabinets, etc., shall be submitted with the Shop Drawings complete with detailed Drawings of the proposed modifications.

B. ORGANIZATION AND BINDING:

The organization of initial Shop Drawing submittal required above shall be compatible to eventual inclusion with the Technical Manuals submittal and shall include final alterations reflecting "as built" conditions. Accordingly, the initial multiple copy Shop Drawing submittal shall be separately bound in 3-ring binders of the type specified under Part 2.03, herein, for the Technical Manuals.

2.03 TECHNICAL MANUALS

- A. Five (5) final sets of technical manuals shall be supplied for the Owner, and one (1) final set shall be supplied for the Engineer, as a condition of acceptance of the project. Each set shall consist of one (1) or more volumes, each of which shall be bound in a standard size, three-ring, loose-leaf, vinyl plastic hard cover binder suitable for bookshelf storage. Binder ring size shall not exceed 3.0 inches.
- B. Initially, two (2) sets of these manuals shall be submitted to the Engineer for favorable review after return of favorably reviewed Shop Drawings and data required under Part 3, herein. Following the Engineer's review, one (1) set shall be returned to the Contractor with comments. The sets shall be revised and/or amended as required and the requisite final sets shall be submitted to the Engineer fifteen (15) days prior to start-up of systems. The Engineer shall distribute the copies.
- C. In addition to updated Shop Drawing information to reflect actual existing conditions, each set of technical manuals shall include installation, connection,

operating, trouble-shooting, maintenance, and overhaul instructions in complete detail. This shall provide the Owner with comprehensive information on all systems and components to enable operation, service, maintenance, and repair. Exploded or other detailed views of all instruments, assemblies, and accessory components shall be included together with complete parts lists and ordering instructions.

- D. Contractor shall also need to provide all technical manuals and shop drawing information in electronic format (searchable PDF, MS words, AutoCAD, etc.) and combine in a CD or DVD. Provide two copies of CD or DVD with the hard copies as stated above.

#### 2.04 SPARE PARTS

- A. The Contractor shall include, as part of the bid package, a list of recommended spare parts covering items required under Section 13300 except PLC's of these Specifications. The total price of these spare parts shall not be less than \$3,000.00 and this sum shall be a part of the Contractor's total bid price. PLC spare parts are covered in the PLC section of this Specification, and the \$3,000.00 cited above shall be in excess of the PLC spare parts as listed in 2.05 of this specification. The Single I&C Supplier in fact shall be responsible for delivery of the spare parts, as directed by the Owner after plant start-up. Prior to delivery of the spare parts, the Owner shall have the option of adding or exchanging any originally enumerated component based on current list prices for each item. The Contractor shall also submit a list of recommended equipment for maintaining and calibrating equipment furnished under Section 13300.

#### 2.05 CONTROL PANELS

- A. GENERAL:

New control panels shall be furnished and installed under this Contract. They shall house the instrumentation, control devices, LED indicating lights, PLC's, alarm chasses, displays, all necessary accessories, wiring and terminal blocks as necessary and as shown on the Drawings and as described herein. Control panel doors shall be equipped with a door latch kit or a fast operating clamp assembly as applicable. 120 volt AC control voltage in a control panel shall be supplied with a line noise suppressing transformer specified elsewhere in this Section. Each control panel shall be properly grounded and as such be provided with a ground terminal block. Control panels shall be properly sized for installation through new and existing entry ways and custom fit for locations as shown on the drawings.

B. CONSTRUCTION:

1. BUILDING:

Control panels inside a building (not in a control room) shall be NEMA 4X Gasketed, 316 stainless steel 14 gauge construction.

2. OUTDOOR:

All outdoor control panels shall be NEMA 4X with drip shield kit, 3 point latch mechanism and 316 stainless steel 14 gauge construction and painted white.

3. COOLING:

Control panels shall have sufficient cooling and/or ventilation not to exceed the maximum operating temperature of any of the internal components. Ambient temperature limits shall be 90 degrees F for indoor and 100 degrees F for outdoor control panels. Outdoor control panels with electronic equipment shall be furnished with sun shields around and on top of the control panels.

4. UPS:

a. UPS: Control Panels shall be furnished with a UPS to provide power to the PLC microprocessor and all PLC support, interface, and communication equipment for a minimum of 45 minutes. UPS shall be manufactured by APC Smart-UPS SC or Owner approved equal.

b. Each UPS shall be the on-line, double-conversion type with true sine wave output. UPS shall provide power conditioning to the load. UPS shall be externally mounted from the PLC cabinet. UPS shall be installed in either an air conditioned or a ventilated building. Each UPS shall be provided with a bypass switch such that the UPS can be taken out for maintenance without disturbing the devices it protects. Each UPS shall provide auxiliary contact outputs connected to the PLC to monitor UPS alarm, UPS fail, lower battery, main power fail, and UPS bypassed.

C. SIGNAL AND CONTROL CIRCUIT WIRING:

1. WIRE TYPE AND SIZES

Conductors shall be flexible stranded copper wire; these shall be U.L. listed Type XHHW and shall be rated 600 volts. Wire for control signal



circuits and alarm input circuits shall be 14 AWG. All instrumentation cables shall be shielded twisted pair or triad No. 20 AWG with a copper drain wire. Multiconductor control cabling shall not be used. All special instrumentation cable such as between sensor and transmitter shall be supplied by the I&C supplier. Ethernet cable shall be Category 5E (Enhanced). Ethernet cable used for VFDs and power monitoring shall be capable of shielding data from RFI and EMI interference.

## 2. WIRE INSULATION COLORS

Conductors supplying 120 volt AC power on the line side of a disconnecting switch shall have a black insulation for the ungrounded conductor. Grounded circuit conductors shall have white insulation. Insulation for ungrounded 120 volt AC control circuit conductors shall be red. All wires energized by a voltage source external to the control board(s) shall have yellow insulation. Insulation for all DC conductors shall be blue.

## 3. WIRING INSTALLATION

- a. All wires shall be run in plastic wireways except (1) field wiring, (2) wiring run between mating blocks in adjacent sections, (3) wiring run from components on a swing-out panel to components on a part of the fixed structure, and (4) wiring run to panel mounted components. Wiring run from components on a swing-out panels to other components on a fixed panel shall be made up in tied bundles. These shall be tied with nylon wire ties, and shall be secured to panels at both sides of the "hinge loop" so that conductors are not strained at terminals.
- b. Wiring run to control devices on the front panels shall be tied together at short intervals with nylon wire ties and secured to the inside face of the panel using adhesive mounts.
- c. Wiring to rear terminals on panel mount instruments shall be run in plastic wireways secured to horizontal brackets run above or below the instruments in about the same plane as the rear of the instruments.
- d. Shields of shielded instrument cable shall only be grounded on one side of each cable run. The side to be grounded shall always be in the field as applicable.
- e. Care shall be exercised to properly insulate the ungrounded side, to prevent ground loops from occurring.

- f. Conformance to the above wiring installation requirements shall be reflected by details shown on the Shop Drawings for the Engineer's review.

#### 4. WIRE MARKING

Each signal, control, alarm, and indicating circuit conductor connected to a given electrical point shall be designated by a single unique number which shall be shown on all Shop Drawings. These numbers shall be marked on all conductors at every terminal using permanently marked heat-shrink plastic. Instrument signal circuit conductors shall be tagged with unique multiple digit numbers. Black and white wires from the circuit breaker panelboard shall be tagged including the one (1) or two (2) digit number of the branch circuit breaker. Adhesive wire labels are not acceptable.

#### 5. TERMINAL BLOCKS

Terminal blocks shall be molded plastic with barriers and box lug terminals, and shall be rated 15 amperes at 600 volts. White marking strips, fastened securely to the molded sections, shall be provided and wire numbers or circuit identifications shall be marked thereon with permanent marking fluid. Terminal blocks shall be screw-type General Electric Type CR 151A1 with mounting rack, equivalent by Cinch-Jones or equal.

#### 6. TERMINATION OF WIRING

All PLC I/O wiring shall be terminated on removable terminal strips on the individual PLC modules that permit removing I/O modules without disconnecting the wiring. Tag and mark all terminal blocks and individual wiring. All wiring from the field shall terminate on a separate numbered terminal blocks. Separate groups of terminal blocks in discrete inputs, discrete outputs, analog inputs, analog outputs, each different voltages, UPS power, etc. Use different colored wire for all digital inputs and digital outputs to aid in easy identification of signal type.

#### 7. FIBER OPTIC CABLE

New and replaced fiber shall be 12 pair Corning 62.5 multimode fiber optic, or County approved equal. Label each end of the fiber optic cables according with County's standards. All fiber optic cable, including spares, shall be terminated not spliced in fiber optic patch panels. Provide patch cables as required. All patch panel indoors shall be provided with NEMA 12 Gasketed enclosures, all panels outdoors shall be located in NEMA 4X enclosures and shall handle at least 12 pair of fiber. Fiber optic cable manufacturer shall provide a 25 year warranty on fiber cable. Fiber optic

cable shall be installed by a Corning or equal certified I&C installer with a 25 year warranty guarantee for the Owner/County. Maximum acceptable signal loss shall be 10dB through the entire fiber path.

D. PAINTING:

Control panels shall be thoroughly cleaned and sandblasted per SSPC-SP-6 (Commercial Blast) after which surfaces shall receive a prime coat (Amercoat 185, Koppers 622HB, or equal) 3-mils dry, followed by two (2) or more finish coats (Amercoat 5401, Koppers 501, or equal) 3-mils dry, for a total thickness of the complete system of 6 mils. The finished color of the outside surfaces shall be selected by the Engineer. The inside surfaces shall have a white finish coat.

Exterior control panels shall be painted white on the exterior. A durable coating system with a five-year full replacement guarantee shall be used to coat the stainless steel panels. Defects in the coating systems include, but are not limited to, fading, color change, cracking peeling, or otherwise disbonding.

E. PLC CONTROL PANEL REQUIREMENTS

All input/output hardware and interface equipment shall be provided by the computer & PLC system supplier for all specified inputs and outputs. Input/output hardware shall be plug-in modules (or equivalent I/O assembly and associated printed circuit board) in associated I/O rack assemblies.

**Signal and control circuitry to individual input/output modules shall be arranged such that any one module failure shall not disable more than one control loop within any group of controlled equipment (eg. one pump out of a group of three pumps, etc.)**

All analog and discrete inputs and outputs shall be optically or transformer isolated for voltage surge protection and shall meet peak common mode and 3 kV surge to ground withstand capability (SWC) test as specified by ANSI C37.90A-197A (IEEE Standard 472-1974).

In the event a standard manufacturers product does not satisfy the above surge requirements, additional protective circuitry to suppress contact bounce and to protect transients from being recognized as data. Input/output modules shall be configured for ease of wiring and maintenance. The modules shall be connected to wiring arms which are movable to permit removal of a module without disturbing field wiring. Covers shall be provided to prevent operator personnel from inadvertently touching the terminals.

The PLC shall be capable of handling the required number of process inputs and outputs as shown on Instrumentation Drawings, plus 25 percent active spares, plus

capacity to accommodate 25 percent future inputs and outputs by the addition of the required circuit cards. Input/output modules shall have individual indicators that show the on/off status of each input or output device connected to it. Input/output modules shall be configured for ease of wiring and maintenance. The modules shall be connected to wiring arms which are movable to permit removal of a module without disturbing field wiring. Covers shall be provided to prevent operator personnel from inadvertently touching the terminals. Process interface units shall be provided with screw-type terminal blocks with barriers between adjacent terminals for connection of field inputs. Terminals shall be suitable for accepting up to and including No. 14 AWG wire. All terminals shall be provided with unique identification in accordance with approved loop interconnection diagrams. Furnish analog I/O cards that have 8 analog inputs and 8 analog outputs on the card and digital I/O cards that have 16 digital input and 16 digital outputs on the card. The requirements for each type of I/O are:

1. ANALOG INPUT

The analog input subsystem shall accept 4-20 mA (1-5 volts across 250 ohms) signals which shall be multiplexed into one or more amplifiers and ADC's by one or more analog input multiplexers. The analog input multiplexers shall be of the solid state differential type and shall employ successive approximation or dual slope integration to digitize the sampled analog signals into a 12 bit binary value; with an accuracy of  $\pm 0.05\%$  of full scale. Input power supply shall be 24 volts DC from the I/O power supply subsystem where power is not supplied by the associated field instrument. Common mode input protection of 30 VDC minimum shall be provided. Input signal A/D conversion shall be a minimum of 12-bits, with an accuracy of one bit. Isolated DC power for field transmitters shall be provided as required.

a. DISCRETE INPUT

Dry Contact:

The input subsystem shall sense the open or closed status of contacts at each scan interval. Sensing power shall be 24 volts DC from the I/O power supply subsystem. The module inputs shall be optically isolated from the PLC and designed to withstand transients and surges without damage. Input components shall be individually protected to ensure that failure within one component will not interrupt processing of others.

Powered input:

The input subsystem shall sense the status of 120VAC inputs at each scan interval. Power for inputs is derived from the source system or equipment.

### 3. ANALOG OUTPUT

The analog output subsystem shall accept incremental signals from the process controller. A solid state digital to analog converter (DAC) shall be provided for each analog output. The incremental signals from the process controller shall increment or decrement the 4-20 MA output signal from each DAC. A 24 volt DC power supply shall be provided for analog outputs from the I/O power supply subsystem.

The output of each DAC shall be continuously maintained and shall have a drift rate no greater than 2% in 24 hours. Each DAC shall have a 12 bit resolution and an accuracy of  $\pm 0.05\%$  full scale.

### 4. DISCRETE OUTPUT

The discrete output subsystem shall be of the solid state type and shall generate maintained or momentary outputs as required to operate interposing relays provided in related circuitry. Diode protection (in addition to surge protection) shall be provided on all discrete outputs. The output contacts shall be rated 24 VDC/120 VAC, 5A SPDT.

### 5. PLC/RIO SPARE PARTS

- a. 10% spare of each I/O type per control panel including: Analog Input, Analog Output, Digital Input, and Digital Output, with a minimum of two of each Analog type and one of each Digital type.
- b. 10% spare of each type of communication module and cable, with a minimum of one of each type and length.

## 2.06 ACCESSORIES

- A. General purpose relays with LED indication in the control panels shall be plug in type with contacts rated 10 amperes at 120 volts AC. The quantity and type of contacts shall be as shown on the Drawings. Each relay shall be enclosed in a clear plastic heat and shock resistant dust cover. Sockets for relays shall have screw type terminals. Relays shall be Potter and Brumfield Type KRP or KUP, Square-D Type K, or equal.
- B. Time delay relays shall be solid state on-delay or off-delay type with contacts rated 10 amperes at 120VAC. Units shall include adjustable dial with graduated scale or digital switch setting covering the time range in each case. Time delay relays shall be Agastat Series 7000, Omron series H3, SSAC type TDM or approved equal.
- C. Additional slave relays shall be installed when the number or type of contacts shown exceed the contact capacity of the specified relays and timers.

- D. All relays shall be provided with LED indication (Opened & Closed) and a test button to show when relay is energized. Relays shall be mechanically latched type where the service is primarily in the hold open or hold closed position to maintain the operating function. Internal intermittent acting relays may be electrically held. Fail safe conditions may also utilize electrically held relays.
- E. Switches shall be round 30.5mm configuration and LED indicating lights shall be round 16 mm configuration, heavy duty and corrosion resistant. Legend plate shall be standard size square style laminate with white field and black markings as shown.
- F. LED Indicating lights (Pilot lights) shall be rated oil tight/water tight, heavy duty. Miniature type devices are not acceptable. Pilot lights shall be of the transformer type utilizing low voltage lamps. Pilot lights shall be either the push to test type or a common lamp test button type provided on the panel. Pilot lights shall allow for lens and bulb replacement through the front of the unit. Pilot light shall be new LED technology type, no exception. Pushbuttons shall include full guard with flush button and selector switches shall include a black non-illuminated knob on switch, unless otherwise noted. Contact arrangement and configuration shall be as shown on drawings. Devices shall be Cutler Hammer Type E-30, General Electric Type CR104, Square D class 9001 type Sk, Allen Bradley Bulletin 800 or equal.
- G. Selector switches shall be of the rotary type with the number of positions as shown on the Drawings. Color, escutcheon engravings, contact configurations and the like shall be as shown. Devices shall be Cutler Hammer Type E-24, General Electric Type CR104, or equal.
- H. Circuit breakers shall be single pole, 120 volt, 15 ampere rating or as required to protect wires and equipment and mounted inside the panels as shown.
- I. Nameplates shall be supplied for identification of all field mounted elements, including flow meters and their transmitters. These nameplates shall identify the instrument, or meter, descriptively, as to function and system. These nameplates shall be fabricated from black-face, white-center, laminated engraving plastic. A nameplate shall be provided for each signal transducer, signal converter, signal isolator, each electronic trip, and the like, mounted inside the control panels. These shall be descriptive, to define the function and system of such element. Adhesives shall be acceptable for attaching nameplates. Painted surfaces must be prepared to allow permanent bonding of adhesives. Nameplates shall be provided for instruments, function titles for each group of instruments and other components mounted on the front of the control panels as shown. These nameplates and/or individual letters shall be fabricated from VI-LAM, Catalog No. 200, manufactured by N/P Company, or equivalent by Formica, or equal. Colors, lettering, style and sizes shall be as shown or as selected by the Engineer.

- J. Solenoid Valves if not otherwise noted shall be globe valve directly actuated by solenoid and not requiring minimum pressure differential for operation. Materials shall be brass globe valved bodies and Buna-N valve seats. The size shall be 1/4" normally closed. The coil shall be 115 VAC coil, Nema 4 solenoid enclosure. Manufacturer shall be ASCO; Red Hat, or equal.
- K. 4 to 20 mA Loop Indicators: For new supplied instruments, include a local digital readout that is integral with the instrument.
- L. All fuses used in PLC panels and other control panels shall be of the type that indicates a blow fuse condition.

## 2.07 TRANSIENT VOLTAGE SURGE SUPPRESSION (TVSS) PROTECTION

### A. GENERAL:

TVSS protection shall be provided to protect the electronic instrumentation system from induced surges propagating along the signal and power supply lines. 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, and be maintenance free and self-restoring.

Instruments shall be housed in a suitable case, properly grounded. Ground wires for all TVSS shall be connected to a good earth ground and where practical, each ground wire run individually and insulated from each other. These protectors shall be mounted within the instrument enclosure or a separate NEMA 4X junction box coupled to the enclosure.

### B. POWER SUPPLY:

Protection of all 120 VAC instrument power supply lines shall be provided. Control panels shall be protected by line noise suppressing isolation transformers and TVSS. Field instruments shall be protected by TVSS. For control panels, the line noise suppressing isolation transformer shall be Topaz Series 30 Ultra isolators or approved equal. The suppressor shall be Edco HSP-121, Surge Suppression Incorporated, Current Technology, or Joslyn.

### C. ANALOG SIGNALS:

Protection of analog signal lines originating and terminating not in the same building shall be provided by TVSS. For analog signal lines the TVSS shall be Edco PC-642. For field mounted two-wire instruments the TVSS shall be encapsulated in stainless steel pipe nipples, and shall be Edco SS64 series, Phoenix, MTL, or DEHN with a small profile suitable for installation in the RTU's.

For field mounted four-wire 120VAC instruments, the TVSS shall be in a NEMA 4X polycarbonate enclosure, Edco SLAC series, Phoenix, MTL, or DEHN.

## 2.08 INSTRUMENTATION AND CONTROL EQUIPMENT SPECIFICATIONS

### L1: LEVEL ELEMENT AND TRANSMITTER (ULTRA-SONIC)

1. The multi purpose sonic level system shall operate on the principle of ultrasonic sonar reflection in which acoustic impulses emitted from an ultrasonic transducer are reflected back from the material surface and are received by the transducer. The transit time of pulse travel from generation to echo is measured. The elapsed time is proportional to the distance between the transducer face and material surface. Systems shall be designed for automatic self-compensation of signal speed due to temperature, humidity and other atmospheric variations. The system shall be supplied with interconnecting cable between sensor and transmitter.
2. Transmitter Design:
  - a. Microprocessor-based echo-time measuring transmitter with output signal proportional to distance between sensor and surface of media. The controller shall have an EEPROM memory and shall not require a battery to ensure protection of stored data.
  - b. Modular component assembly construction with plug-in electronics for convenient service.
  - c. Power: 120 VAC. 60 Hz, 17-Watt maximum power requirements (36-VA).
  - d. Isolated 4-20 mA DC output signal into 750 ohms
  - e. Operation range and engineering unit selections with local digital display of measured distance shall be able to enter new data via infrared keypad.
  - f. Accuracy: +/- 0.25 percent of full scale.
  - g. Resolution: +/- 0.1 percent of full scale.
  - h. Distance: Maximum allowable distance between sensor and transmitter is 1200 feet.
  - i. Total Beam Angle: 6 degrees or less.
  - j. Maximum Range: 0 to 50 standard feet.
  - k. Process: Level of finished water in storage tank.
  - l. Sensor Location Temperature: -40 to 203 degree F.
  - m. Transmitter Ambient Temperature: -5 to 122 degree F.
1. The multipurpose sonic level system shall have internal self-diagnostics function and 6 alarm relays for lost echo or temperature, rate of change of level, differential level, time sampling, volume sampling, and pump control. Systems shall be furnished complete with flanged transducer, interconnection cable and indicating transmitter.



4. The transmitter shall include an integral LCD type indicator calibrated in engineering units for local indication. LCD display shall be minimum 100 x 40 mm (4 x 1.5") multi-field back lit LCD display with individual alarm status lights on LCD display.
5. Provide a hand held keypad programmer or calibrator for startup.
6. Unless shown otherwise on the instrument schedule, provide NEMA 4X corrosion resistant, oil tight, dust tight, and weatherproof housing for indoor or outdoor locations.
7. Provide all stainless steel mounting hardware for surface, panel or handrail mounting as required by location.
8. Provide front mounted visible data display behind clear, shatterproof viewing cover.
9. Systems shall be manufactured by Siemens-Milltronics Model Hydroranger 200 with an Echomax XPS-15 transducer or equal and shall be compatible with the chemical process environment.

L2: LEVEL SWITCH

Level switches shall consist of a non-mercury type switch element encapsulated in a nominal 5 inch diameter PVC float housing. The switch contact shall be single-pole, double-throw, rated 10 amp at 120 V ac. The float shall be supported from a flexible three-conductor 18 AWG cable that also acts as the float hinge. The cable shall be suitable for fixed mount or weighted suspension type installation as indicated on the drawings or in the device schedule. All necessary mounting hardware shall be provided. The hinge-cable length shall be field adjustable in a manner that allows the deadband to be adjusted between 9 inches and 3 feet. The switch shall be Magnetrol "Series T10" float switch.

A1: CHLORINE ANALYZER: FLUORIDE ANALYZER (NOT USED)

A2: pH SENSOR AND TRANSMITTER (NOT USED)

A3: HYDROGEN SULFIDE ANALYZER AND TRANSMITTER (NOT USED)

F1: FLOW ELEMENT AND TRANSMITTER (MAGNETIC)

Furnish all labor, material, equipment, and incidentals required to install new magnetic flow meters and associated piping and auxiliary equipment as show on the Drawings.

Meter:

All equipment included in the construction of the magnetic flow meters shall be of proven ability for use in measuring total flow and flow rates. The meter shall contain a remote microprocessor based signal converter which will display both rate of flow and total flow using a 4-20 mA DC output signal.

1. General:

- a. Function: Measure, indicate, and transmit the flow of a process liquid in a full pipe.
- b. Type: Electromagnetic flowmeter, with operation based on Faraday's Law, utilizing the pulsed dc type coil excitation principle with high impedance electrodes.
- c. Parts: Flow element, transmitter, interconnecting cables, mounting hardware, and calibrator.

2. Service:

- a. Stream Fluid: As noted.
- b. Flow Stream Descriptions:
  - 1) Sodium Hypochlorite:
    - a) 12.5% Concentration;

The meter shall be of the low frequency electromagnetic induction type and shall produce a pulsed DC signal directly proportional and linear with respect to the liquid flow rate. The output signal from the separately mounted meter electronics shall be 4-20mA DC. The meter shall be designed for operation of a 120 VAC, 60 Hz power consumption of less than 15 watts for sizes through 12-inch, and 5 watts per inch of diameter larger than 12 inches.

The meter shall include a magnetic driver to power the magnetic coils and a signal converter. The metering velocity span shall be continuously adjustable from 0 to 1 and 0 to 33 feet per second, and the meter shall feature complete zero stability. The meter shall be hydraulically calibrated in the United States and the calibration shall be traceable to the National Bureau of Standards.

2. Performance:

- a. Flow Range: As noted.
- b. Accuracy: Plus or minus 1 percent of rate for all flows resulting from pipe velocities of 0 to 100% flow range.
- c. Turndown Ratio: Minimum of 10 to 1 when flow velocity at minimum flow is at least 1 foot per second.

- d. Repeatability:  $\pm 0.1\%$  of full scale.
- e. Ambient Temperature - 20 to 120 °F.
- f. Range full scale from 0 to 33 ft/sec.

3. Features:

- a. Zero stability feature to eliminate the need to stop flow to check zero alignment.
- b. No obstructions to flow.
- c. Very low pressure loss.

4. Process Connection:

- a. Meter Size: As noted.
- b. Connection Type: 150-pound ANSI raised-face flanges or wafer style depending on meter size, unless otherwise noted.
- c. Flange Material: Carbon steel, unless otherwise noted.

5. Signal Interface:

- a. 4 to 20 mA dc for load impedance 0 to 800 ohms minimum for 24V dc supply.

6. Power: 120V ac, 60-Hz, unless otherwise noted.

7. Element:

- a. Meter Tube Material: 304 stainless steel, unless otherwise noted.
- b. Liner Material: NSF approved fusion bonded epoxy liner.
- c. Liner Protectors: Covers on each end to protect liner during shipment.
- d. Electrode Type: non removable 316 stainless steel.
- e. Electrode Material: 316 stainless steel, unless otherwise noted.
- f. Enclosure: NEMA 4, unless otherwise noted.
- g. Grounding Ring/Electrode Material: 316 stainless steel, unless otherwise noted.

8. Transmitter:

- a. Display: Blind or indicating and/or totalizing as noted.
- b. Mounting: Pipe stand, wall, panel, or integral as noted.
- c. Enclosure: NEMA 4X.
- d. Zero and Span: Field adjustable.
- e. Indicator: Digital 16-character display, with scale range as noted.
- f. Totalizer: Digital 16-character display, with totalizer unit digit value as noted.

- g. Terminal Box: NEMA 4X construction mounted on main body of water. Provide splash and dust proof terminal boxes with water cable entrance seals.
9. Cables:
- a. Types: As recommended by manufacturer.
  - b. Lengths: As required to accommodate device locations.
10. Calibration System:
- a. Features:
    - 1) Field programmable electronics.
    - 2) Self-diagnostics with troubleshooting codes.
    - 3) Ability to program electronics with full scale flow, engineering units, meter size, zero flow cutoff, desired signal damping, totalizer unit digit value, etc.
    - 4) Initial flow tube calibration and subsequent calibration checks.
  - b. Equipment:
    - 1) Built-in electronics with each unit provided.
    - 2) Alternatively, one portable calibrator of each type required for the various electromagnetic flowmeters provided on the project.

Provide special tools and spare parts to completely operate and maintain the unit.

Unit shall be factory calibrated and certified. Once installed, unit shall be field calibrated prior to acceptance by the Owner. Calibration check shall be verified by a simple built in signal injection. The meter shall provide for a constant zero output signal during no flow and other conditions of potential false signals. All calibration records shall be provided to Owner at final completion.

Electrical connections shall be 1/2 inch NPT water tight and flush. Manufacturer shall certify the meter is capable of operating under submergence for up to 48 hours in 30 feet of water.

Grounding rings shall be Type 316 stainless steel and placed between the meter and mating flanges at both ends of the meter, or as recommended by the manufacturer.

Meter rangeability shall be 100:1. The output signal scale shall be capable of field adjustment. The unit shall be accurate to  $\pm 1\%$  of rate. The unit shall have standard radio frequency protection.

The meter shall be Mag meter manufactured by Ultramag or Foxboro, or Orange County-approved equal.

Converter:

Microprocessor based signal converter shall accept any linear or squared 4-20 mA DC signal. The unit shall simultaneously display rate of flow and total flow on a half inch (1/2") high liquid crystal display (LCD). The totalizer shall be field programmable for totalization and indicator. The unit shall contain an 8-digit total flow display and be provided with a battery back-up for total flow display, in the event of signal interruption or loss of signal. The total flow display, prior to signal interruption, shall not be lost or zeroed out. Power requirements shall be 120 VAC. The Indication Flow display shall be 3-digit, 1/2 inch high LCD. Converter shall be supplied with empty pipe detection feature.

The accuracy of the Total Display shall be  $\pm 0.5$  percent of rate over the full scale. The accuracy of the rate display shall be  $\pm 0.5$  percent of rate over the full scale.

The housing shall be a fire retardant glass-reinforced polyester plastic with provisions for surface mounting. The case shall be NEMA 4X rated suitable for outdoor installations. The window shall be tempered glass. Provide internal illumination for night reading.

Provide two output signals linear and directly proportional to flow as follows: 4-20mA dc isolated into 0-600 ohms. 0-10 kHz scaled pulse.

Low Flow Cutoff Limit: Drive the output to zero when the measured flow rate is 1-10 percent (adjustable) of full scale and when fully developed flow no longer exists.

High Impedance Sensing: Provide sensing amplifiers with high impedance to minimize effects of deposit build-up on the electrodes.

Interchangeable Electronics: Provide converter/transmitter that is interchangeable with all flow meter sizes of manufacturer's same model.

The converter shall be manufactured by Ultramag, or Foxboro/Flexim, Siemens, or Orange County (Owner) Approved equal.

F2: FLOW ELEMENT AND TRANSMITTER (ULTRASONIC) (NOT USED)

P1: PRESSURE ELEMENT AND TRANSMITTER

Instrument shall utilize a variable capacitance sensor cell to convert process pressure to capacitance with isolating diaphragms to separate the process fluid from the internal fill fluid. The electronic circuit shall convert capacitance change into a proportional 4-20mA output signal. The enclosure shall meet intrinsically safe, explosion proof (NEMA 7) and weatherproof (NEMA 4X) certifications. The operating range shall be configurable with 40:1 rangeability up to 5800 psi. The

accuracy shall be  $\pm 0.1\%$  of span. The output shall be two-wire 4-20mA with superimposed digital communication using HART protocol. Unit shall operate on loop-power from 12 to 45 VDC. The unit shall have configurable 4 ½ digit numerical plus 5-character alphanumeric displays to indicate PV and output in Engineering Units. Configuration shall be performed using digital HART protocol with PC laptop software or using a HART hand-held configurator or through local adjustment. Provide configurator as part of package. Unit shall be Smar LD301 Series or approved equal.

P2: PRESSURE GAUGE

As per specification 15130.

P3: PRESSURE SWITCH (DIAPHRAGM SENSOR)

Pressure switch shall employ a diaphragm sensor and a Belleville disc spring for setpoint stability and vibration resistance. Wetted parts are to be 316SS with BUNA-N "O" rings. Two setpoints shall be adjustable over selected range with an internal slotted adjustment with range scale. The enclosure shall be epoxy painted and meet the requirements of NEMA 4X. Pressure connection shall be ½" x 14 FMPT. Switch contact shall be 10A, 120VAC DPDT implying SPDT for each setpoint. Pressure switch shall be ITT NeoDyn Series 132P or Owner approved equal

P4: DIFFERENTIAL PRESSURE TRANSMITTER (NOT USED)

T1: THERMAL DISPERSION FLOWMETERS (NOT USED)

2.09 LOOP DESCRIPTIONS

A. See I-Drawings.

2.10 CONTROL STRATEGY SCHEDULES

The control strategies are written descriptions of the programming required to implement regulatory and sequential control of the unit processes. Control strategies shall fully reside in the memory of the designated PLC. Coefficients pertaining to control strategies shall be modifiable through the operator interface in the monitoring / control mode.

The I&C supplier shall include an additional 160 hours on-site to fine tune control systems and make minor software modifications in order to resolve any logic discrepancies encountered during start-up, and supply the Owner with a complete functional system. This shall be part of the bid package with no additional cost to the owner.

A. Control Strategy:

See Section 13610 for Control Strategy

2.11 INSTRUMENT LIST

TAG NO.	COMPONENT CODE	COMPONENT TITLE	COMPONENT OPTIONS	REMARKS
50-LE/LIT-1	L1	50-T-1 Tank Level		
50-LE/LIT-2	L1	50-T-2 Tank Level		
75-LE/LIT-1B	P1	75-T-1B Tank Level		
75-LE/LIT-2B	P1	75-T-2B Tank Level		
75-LE/LIT-3B	P1	75-T-3B Tank Level		
50-PE/PIT-1	P1	Hypochlorite High Feed Pressure Transmitter		
75-PE/PIT-1	P1	FDA Cleaning System Hypochlorite High Feed Pressure Transmitter		
75-PE/PIT-2	P1	Transfer Pump Discharge Hypochlorite High Feed Pressure Transmitter		
50-PSH-1	P3	High Service Pump Suction Hypochlorite High Feed Pressure		
75-PSH-1	P3	FDA Cleaning System Hypochlorite High Feed Pressure		
75-PSH-2	P3	Transfer Pump Discharge Hypochlorite High Feed Pressure		
50-FE/FIT-1	F1	Hypochlorite High Feed Flow Transmitter		
75-FE/FIT-1	F1	FDA Cleaning System Hypochlorite High Feed Flow Transmitter		
75-FE/FIT-2	F1	Transfer Pump Discharge Hypochlorite High Feed Flow Transmitter		



1-spare analog input card for each kind,  
1-spare analog output card for each kind,  
1-spare digital input card for each kind,  
1-spare digital output card for each kind,  
1-spare power supply for PLC.  
1-spare Hirschmann 6K8 Ethernet Switch, or equal.

2.12 PROGRAMMING SOFTWARE

The Contractor is responsible for using the ProWorx NXT PLC software that the County is currently using for the PLC type specified under specification 13300. No PLC software license is required for this project for the Owner.

2.13 TAGGING AND NUMBERING SYSTEMS

- A. A consistent tag convention shall be used in the HMI/SCADA database, HMI/SCADA graphics, and PLC programs.
- B. The tag convention shall use the facility code with a user defined abbreviated process, unit identifier, and status for development of the tag name. The user defined abbreviations shall be consistent throughout all facilities.
- C. The description field of the tag should be an English text description that clearly describes the facility, process, instrument type/unit number, and status. For example, Tag Name: EAST\_FLU\_P1\_VENT-ST; this represents facility “EAST”, process “FLU”, pump “P1”, device “VENT”, and status “ST”. All tags developed for this project shall follow this tag convention.

2.14 NEW PLC RACKS AND I/O CARDS

- A. 50-LCP-5 rack layout consists of the following items in addition to items required for the modified hypochlorite feed system. Coordinate with provisions in RIO-5:

Existing 50-LCP-5 16-Slot Rack Layout		
Rack 1	Slot 1	Existing Power Supply
Rack 1	Slot 2	Existing CPU
Rack 1	Slot 3	Existing 16-point relay output isolated module (140 series)
Rack 1	Slot 4	Existing 16-point relay output isolated module (140 series)
Rack 1	Slot 5	Existing 16-point discrete input non-isolated module (140 series)
Rack 1	Slot 6	Existing 16-point discrete input non-isolated module (140 series)
Rack 1	Slot 7	Existing 16-point discrete input non-isolated module (140 series)
Rack 1	Slot 8	Existing 8-point analog output module (140 series)
Rack 1	Slot 9	Existing 16-point discrete input non-isolated module (140 series)
Rack 1	Slot 10	Existing 16-point discrete input non-isolated module (140 series)
Rack 1	Slot 11	Existing 8-point analog input module (140 series)

Rack 1	Slot 12	Existing 8-point analog input module (140 series)
Rack 1	Slot 13	Existing 8-point analog input module (140 series)
Rack 1	Slot 14	Existing 8-point analog output module (140 series)
Rack 1	Slot 15	Existing 8-point analog output module (140 series)
Rack 1	Slot 16	Existing NOE Module

B. RIO-5 rack layout consists of the following items. Coordinate with system manufacturer for exact I/O and provide cards and spares as necessary for a fully functional system:

New RIO-5 16-Slot Rack Layout		
Rack 1	Slot 1	Power Supply
Rack 1	Slot 2	Head Module (140 series)
Rack 1	Slot 3	Adapter Module (140 series)
Rack 1	Slot 4	16-point relay output isolated module (140 series)
Rack 1	Slot 5	16-point relay output isolated module (140 series)
Rack 1	Slot 6	16-point discrete input non-isolated module (140 series)
Rack 1	Slot 7	16-point discrete input non-isolated module (140 series)
Rack 1	Slot 8	8-point analog input module (140 series)
Rack 1	Slot 9	8-point analog input module (140 series)
Rack 1	Slot 10	8-point analog output module (140 series)
Rack 1	Slot 11	8-point analog output module (140 series)
Rack 1	Slot 12	Spare
Rack 1	Slot 13	Spare
Rack 1	Slot 14	Spare
Rack 1	Slot 15	Spare
Rack 1	Slot 16	Spare

C. 75-LCP-8 rack layout consists of the following items:

Existing 75-LCP-8 16-Slot Rack Layout		
Rack 1	Slot 1	Power Supply
Rack 1	Slot 2	CPU
Rack 1	Slot 3	8-point analog input module (140 series)
Rack 1	Slot 4	8-point analog input module (140 series)
Rack 1	Slot 5	8-point analog output module (140 series)
Rack 1	Slot 6	8-point analog output module (140 series)
Rack 1	Slot 7	16-point discrete input non-isolated module (140 series)
Rack 1	Slot 8	16-point discrete input non-isolated module (140 series)
Rack 1	Slot 9	16-point discrete input non-isolated module (140 series)
Rack 1	Slot 10	16-point relay output isolated module (140 series)
Rack 1	Slot 11	16-point relay output isolated module (140 series)
Rack 1	Slot 12	16-point relay output isolated module (140 series)
Rack 1	Slot 13	Spare

Rack 1	Slot 14	Spare
Rack 1	Slot 15	Spare
Rack 1	Slot 16	Spare

D. Temporary Chemical Feed System PLC Panel rack layout consists of the following items Coordinate with system manufacturer for exact I/O and provide cards and spares as necessary for a fully functional system:

Temporary Chemical Feed System PLC Panel 16-Slot Rack Layout		
Rack 1	Slot 1	Power Supply
Rack 1	Slot 2	CPU
Rack 1	Slot 3	16-point relay output isolated module (140 series)
Rack 1	Slot 4	16-point relay output isolated module (140 series)
Rack 1	Slot 5	16-point discrete input non-isolated module (140 series)
Rack 1	Slot 6	16-point discrete input non-isolated module (140 series)
Rack 1	Slot 7	8-point analog input module (140 series)
Rack 1	Slot 8	8-point analog input module (140 series)
Rack 1	Slot 9	8-point analog output module (140 series)
Rack 1	Slot 10	8-point analog output module (140 series)
Rack 1	Slot 11	Spare
Rack 1	Slot 12	Spare
Rack 1	Slot 13	Spare
Rack 1	Slot 14	Spare
Rack 1	Slot 15	Spare
Rack 1	Slot 16	Spare

## PART 3--EXECUTION

### 3.01 INSTALLATION, CALIBRATION, TESTING, START-UP AND INSTRUCTION

#### A. GENERAL:

Under the supervision of the Single I&C supplier, all systems specified in this Section shall be installed, connected, calibrated and tested, and in coordination with the Engineer and the Owner, shall be started to place the processes in operation. This shall include final calibration in concert with equipment specified elsewhere in these Specifications, including pumps, valves, as well as certain existing equipment.

## B. TESTING

All systems shall be exercised through operational tests in the presence of the Engineer in order to demonstrate achievement of the specified performance. Operational tests depend upon completion of work specified elsewhere in these Specifications. The scheduling of tests shall be coordinated by the Contractor among all parties involved so that the tests may proceed without delays or disruption by incomplete work.

### 1. Unwitnessed Factory Test (UFT)

An unwitnessed factory test shall be conducted to prepare the I&C Supplier to demonstrate compliance with this specification during the Factory Acceptance Test (FAT). The I&C Supplier shall prepare a written procedure detailing every aspect of the UFT. This procedure must be submitted to the ENGINEER for approval prior to the commencement of the UFT. This procedure along with any forms generated during the UFT shall comprise the basis of the FAT.

The I&C Supplier shall inspect and test the Integrated Control System (ICS) to ensure it is ready for the FAT. This test shall take place at the I&C Supplier's factory. It shall consist of interconnecting computers, PLC control panels, communications links, and other new Control Panels (unless specifically excluded below).

All primary element inputs shall be simulated (inputs shall be adjustable by switch, if discrete; by potentiometer or similar device, if analog). Primary outputs shall be monitored via output devices (LED indication lights, for discrete; a meter, digital display (12-bit min. resolution) or other such analog device, if analog output).

During the UFT, the Contractor shall test the communications links and demonstrate error-free communications to and from each node on the fiber optic network. Verify that each I/O point is consistently mapped at the computer node, at the PLC I/O card, in the PLC memory, and at the I/O simulated device according to the database provided by the software engineer. Verify the proper operation of each of the pilot devices on each of the control panels, if any.

Excluded New Panels: None

### 2. Factory Acceptance Test (FAT):

The I&C Supplier shall test the entire control system. The test shall take place at the I&C Supplier's factory. The I&C Supplier shall simulate all inputs and outputs as performed in the UFT. The software engineer shall

load application programs into each PLC. The software engineer shall load the HMI application into the computer. The I&C Supplier shall provide travel and accommodations for Owner and Owner's Consultant to witness the FAT. Provide a minimum of 2 weeks' notice to the Owner/Engineer before conducting testing.

Prior to commencement of the FAT, the I&C Supplier shall furnish the following documentation to the ENGINEER:

- a. All Drawings, Specifications, Addenda, and Change Orders
- b. Master copy of the written FAT procedures
- c. List of equipment to be tested
- d. Shop drawings of equipment to be tested
- e. Preliminary Software documentation submittal

Daily Schedule for FAT:

- a. Begin each day with a meeting to review the day's test schedule
- b. End each day with a meeting to review the day's test results and to review and to revise the next day's test schedule, if required.

The I&C Supplier shall repeat the I/O point mapping consistency check as before, with the addition of verification of mapping on HMI screens. Those variables, which are not I/O but are variables which exist in the PLC and HMI software only (see preliminary software documentation), shall all be checked.

Check the function of each loop, including set points, alarms, displays, and operator interface. Check one loop of each type and 20% (min.) of all loops. Check data logging, alarm logging, and event logging.

Test all non-loop-specific functions including, but not limited to the following:

- a. Demonstrate capacity of system for expansion. Include tests for both storage capacity and processing capacity.
- b. Include tests for timing requirements.
- c. Demonstrate online and offline diagnostic tests, procedures and displays.
- d. Demonstrate Failure Mode and Backup Procedures: Power failure, auto restart, disk backup and reload, retentive outputs.

Correct deficiencies found and complete correction of deficiencies prior to shipment to site.

Failed Tests shall be repeated and witnessed by the OWNER and ENGINEER. With approval of the ENGINEER or OWNER certain tests may be conducted by the I&C Supplier and Witnessed by the OWNER and ENGINEER during START-UP.

See section 3.03 supplements for sample "Loop Status Report" and "Functional Acceptance Test Sheet".

C. INSTALLATION AND CONNECTION:

1. The Contractor shall install and connect all field-mounted components and assemblies under the criteria imposed in Part 1, 1.03, herein. The installation personnel shall be provided with a final reviewed copy of the Shop Drawings and data.
2. The instrument process sensing lines and air signal tubing shall, in general, be installed in a similar manner to the installation of conduit specified under Section 16050. Individual tubes shall be run parallel and near the surfaces from which they are supported.

Supports shall be used at intervals of not more than 3 feet of rigid tubing.

Bends shall be formed with the proper tool and to uniform radii and shall be made without deforming or thinning the walls of the tubing. Plastic clips shall be used to hold individual plastic tubes parallel. Ends of tubing shall be square cut and cleaned before being inserted in the fittings. Bulkhead fittings shall be provided at all panels.

3. The Contractor shall have a technical field representative of the I&C supplier to instruct these installation personnel on any and all installation requirements; thereafter, the technical field representative shall be readily available by telephone to answer questions and supply clarification when needed by the installation personnel.

Where primary elements (supplied by I&C supplier) shall be part of a mechanical system, the I&C supplier shall coordinate the installation of the primary elements with the mechanical system manufacturer.

4. Fiber optic cable shall be furnished by the I&C Supplier and installed by the Corning or equal certified I&C provider with a 25 year warranty guarantee. The I&C Supplier shall provide the services of an experienced fiber optic cable terminator and tester. The I&C Supplier shall supervise the cable installation and shall carry out all terminations at the I/O racks, repeaters, and data concentrators at PLC's and computers. Fiber optic cable termination shall be carried out using the appropriate connectors and

termination kit. All fiber optic system components shall be products of one manufacturer.

Fiber optic cable splicing shall be strictly prohibited. Test all new fiber optic cables with an Optical Time Domain Reflectometer (OTDR) bi-directionally to verify loss does not exceed 0.2 dB. Pull new fiber optic cables which do not conform to Specifications. Provide fiber optic budget loss report for all new fiber optic cables via OTDR test to ENGINEER and OWNER.

After the fiber optic data link is in place, test the attenuation from hub to hub bi-directionally and document test results. Provide a complete fiber optic report showing all losses from newly installed and modified runs. Attenuation in excess of 3.5 dB/km at 850 nm wavelength or 1.0 dB/km at 1300 nm wavelength shall require the I&C supplier to replace the defective sections and retest until the attenuation is below the attenuation allowed per kilometer at the wavelengths cited.

The I&C Supplier is responsible for the satisfactory performance of all fiber optic data links. Demonstrate and document error free bi-directional data files transfer from each host computer to each PLC node.

5. Finally, after all installation and connection work has been completed, the technical field representative shall check it all for correctness, verifying polarity of electric power and signal connections, making sure all process connections are free of leaks, and all such similar details. If the initial inspection finds no deficiencies, the technical field representative shall proceed to the certification to the Contractor. Any completed work that is found to have deficiencies shall have those deficiencies corrected by installation personnel at no additional cost to the Owner. The technical field representative shall then recheck the work after the identified deficiencies are corrected. If the technical field representative finds deficiencies in the follow-up inspection, then remedial action shall be taken by the Contractor at no cost to the Owner. This pattern shall be repeated until the installation is free from defect. The technical field representative shall then certify in writing to the Contractor that for each loop or system that he has inspected is complete and without discrepancies.
6. The field representative of the Single I&C supplier shall coordinate all work required to interface the new equipment and control devices with the existing equipment, including all required modifications to existing equipment and related devices.



#### D. CALIBRATION

1. All instruments and systems shall be calibrated after installation, in conformance with the component manufacturer's written instructions. This shall provide that those components having adjustable features are set carefully for the specific conditions and applications of this installation, and that the components and/or systems are within the specified limits of accuracy. Defective elements which cannot achieve proper calibration or accuracy, either individually or within a system, shall be replaced. This calibration work shall be accomplished by the technical field representatives of the I&C system supplier who shall certify in writing to the Contractor that for each loop or system all calibrations have been made and that all instruments are ready to operate. See section 3.03 supplements for sample "Instrumentation Calibration Sheet".
2. Proof of Conformance - The burden of proof of conformance to specified accuracy and performance is on the Contractor using its designated Single I&C supplier. The Contractor's designer shall supply necessary test equipment and technical personnel if called upon to prove accuracy and/or performance, at no separate additional cost to the Owner, wherever reasonable doubt or evidence of malfunction or poor performance may appear within the guarantee period.

#### E. PRE-COMMISSIONING

The I&C Supplier shall test each loop (discrete and analog) to determine if it is functioning correctly. The I&C Supplier shall furnish a loop sheet for each loop to be tested. The loop sheet shall represent the actual "as-built" condition of the loop. The I&C Supplier shall perform a field functional loop test which shall be witnessed by the ENGINEER and OWNER. If the loop fails the functional test, the I&C Supplier shall coordinate repairs for the CONTRACTOR to correct whatever is wrong with the loop at no additional cost to the OWNER. The I&C Supplier shall retest the loop until it is approved.

Each loop shall be tested and approved by ENGINEER and OWNER until all loops have been approved.

#### F. START-UP AND INSTRUCTION

When all systems are assessed by the Contractor to have been successfully carried through complete operational tests with a minimum of simulation, and the Engineer concurs in this assessment, plant start-up by the Owner's operating personnel can follow. For a minimum of three times for (4) hours prior to start-up, operating and maintenance personnel shall be instructed in the functions and operation of each system and shall be shown the various adjustable and set

point features which may require readjustment, resetting or checking, re-calibration or maintenance by them from time to time. This instruction shall be scheduled at a time arranged with the Owner at least two (2) weeks in advance. Instruction shall be given by qualified persons who have been made familiar in advance with the systems. All equipment shall be checked during the first year of operation at intervals of three months for a period of not less than one day or as may be required to correct any defects to the satisfaction of the Owner.

G. TEMPORARY CHEMICAL FEED SYSTEM

After UFT and FAT, the Contractor shall install and test the temporary chemical feed system control panel as specified herein. The Contractor shall coordinate all required wiring for a fully functional system. Installation and testing shall be fully coordinated with system supplier. After completion of field testing, the temporary chemical feed system shall be placed into service for a seven-day operational test.

During the operational test, the plant operators shall have access to a pushbutton within the SCADA HMI that will take the temporary system offline and will automatically switch back to the existing process 75 system. Both the existing and temporary systems shall be available for service until the seven-day operational test of the temporary system is complete and approved by the County.

The process of a seven-day operational test as described above shall be repeated when placing the new process 75 system in to service. A SCADA HMI pushbutton shall be available to disable the new process 75 system and return to the temporary chemical feed system. Both the new and temporary systems shall be available for service until the seven-day operational test of the temporary system is complete and approved by the County.

At the completion of the project, the temporary system, including all associated code, shall be removed.

H. MODIFICATIONS TO EXISTING FACILITIES

The Contractor shall make all modifications to existing equipment and control devices which are required to successfully install and integrate all new instrumentation equipment. All costs for any required modification and rehabilitation effort shall be included in the Contractor's original bid amount and no additional payment shall be allowed.

I. PLANT SHUTDOWNS

The Single I&C supplier shall carefully examine all work to be performed relative to existing I&C equipment and the installation of new equipment and control devices. Work shall be scheduled to minimize required plant shutdown times. Plant shutdown times shall be scheduled with Owner with a minimum of 2 weeks' notice given to the Owner.

## J. COORDINATION WITH OTHER CONCURRENT PROJECTS

The single I&C supplier shall coordinate extensively with other I&C suppliers of concurrent projects. Some of the equipment shown in this contract as existing might be installed while this contract is underway.

### 3.02 TRAINING

#### A. General:

1. Provide an integrated training program to meet specific needs of Owner's personnel.
2. Provide instruction on one working shift as needed to accommodate the Owner's personnel schedule.
3. Owner reserves the right to make and reuse video tapes of training sessions if applicable.

#### B. Operations and Maintenance Training:

1. Include a review of O&M manuals, expendables, and test equipments.
2. Training session duration shall be minimum 4 hours. Provide training schedule with outlines at least one week before the training to the Owner.
3. Training shall include a minimum understanding of loop functions, loop operation, component calibration, adjustments such as controller tuning, switch trip point, etc., and periodic maintenance.

#### C. Hirschmann (or equal) Technical Factory Level Hand-on Training Class (5-Day Networking Course)

1. Contractor shall pay all travel with per diem and lodging for two individuals from Orlando, Florida to the training site for the duration of the training (Fremont, CA). Belden training location may change and contact Belden representative before bidding.
2. The focus of this training shall include a minimum of technical knowledge and the use and the setup of switches, routers/terminal servers. Confirm with Owner before registering the training class.

#### D. Hirschmann (or equal) Ethernet Switch Onsite Training:

1. In addition to the factory level training, provide an onsite training for the Hirschmann Ethernet switch models that are installed as part of this project. The training shall be by a system integrator (either from Belden or certified by Belden) and shall include a minimum of switch configuration, troubleshooting, connection, etc. as recommended by Belden.

### 3.03 SUPPLEMENTS

- A. Supplements listed below, following "END OF SECTION" are part of this Specification.

1. Instrumentation Calibration Sheet
2. Loop Status Report
3. Functional Acceptance Test Sheet

END OF SECTION

### FUNCTIONAL REQUIREMENTS


#### COMPONENT STATUS

TAG NO.	DELIVERED*	TAG/IDENTIFICATION CHECK*	INSTALLATION CHECK	TERMINATION WIRING*	TERMINATION TUBING*	CALIBRATED*

<b>REMARKS</b>	LOOP READY FOR START-UP
	BY
	DATE

FUNCTIONAL REQUIREMENTS AND SUMMARY OF COMPONENTS:  
(ATTACH XEROX OF LOOP SPECIFICATION FROM THE CONTRACT DOCUMENTS)

VERIFICATION OF LOOP STATUS REPORT AND INSTRUMENT AND VALVE CALIBRATION SHEETS  
BY: \_\_\_\_\_  
DATE: \_\_\_\_\_

DEMONSTRATION TEST(S): FOR EACH FUNCTIONAL REQUIREMENT OF THE LOOP:

REQUIRED PERFORMANCE  
(a) LIST AND NUMBER THE REQUIREMENT (c) CITE THE RESULTS THAT WILL VERIFY THE  
(b) BRIEFLY DESCRIBE THE DEMONSTRATION TEST (d) PROVIDE SPACES FOR INITIAL AND DATE OF TEST WITNESS.

PERFORMED BY:  
WITNESSED BY:  
COMPLETED DATE:

LOOP ACCEPTED BY (OWNER)  
BY  
DATE

CHECK IF REMARKS ON REVERSE SIDE

LOOP NO.

INSTRUMENTATION CALIBRATION SHEET

COMPONENT			MANUFACTURER:				PROJECT					
CODE:			MODEL:				NUMBER:					
NAME:			SERIAL:				NAME:					
<input type="checkbox"/> INDIATE/ RECORD  <input type="checkbox"/> TRANS/ CONVERT	RANGE	VALUE	UNITS	<input type="checkbox"/> COMPUTE FUNCTIONS			<input type="checkbox"/> CONTROL ACTION (DIRECT/REVERSE) MODES (P/I/D)  <input type="checkbox"/> SWITCH UNIT RANGE (VALUE/UNITS)  DIFFERENTIAL (FIXED/ADJUSTABLE) RESET (AUTOMATIC/MANUAL)					
	CHART	_____	_____									
	SCALE	_____	_____									
	INPUT	_____	_____									
OUTPUT	_____	_____										
ANALOG						DISCRETE						
REQUIRED			AS CALIBRATED				REQUIRED			AS CALIBRATED		REMARKS  CODE
IN	SCALE	OUT	SCALE	OUT	SCALE	OUT	NUMBER	TRIP PT	RESET PT	TRIP PT	RESET PT	
C. MODE SETTINGS: P			I				D					
										COMPONENT CALIBRATED AND READY FOR START-UP		
										BY DATE		
										TAG NO.		

## SECTION 13413

### OPTICAL FIBER CABLING SYSTEMS

#### PART 1 - GENERAL

##### 1.01 SUMMARY

A. Section Includes: Product and installation requirements for the following:

1. Fiber-optic (FO) Cables.
2. Fiber-optic Connectors, Couplers, and Patch Panels.

##### 1.02 SUBMITTALS

A. Shop Drawings: Submit in accordance with Section 01340, Shop Drawings covering the items included under this Section. Shop Drawing submittals shall include:

1. Product data for each type of product specified.
2. Product certificates, signed by the communication system manufacturers, certifying that the cables are suitable for the connected equipment as described in "Quality Assurance" Article below.

B. Contract Closeout: Submit in accordance with Section 01700.

##### 1.03 QUALITY ASSURANCE

A. Manufacturers Qualifications: Firms regularly engaged in manufacture of equipment, of types and sizes required, and whose products have been in satisfactory use in similar service for not less than 5 years.

B. Connected Equipment Manufacturer Certifications: Where cables specified in this Section are used to provide signal paths for systems specified in other sections of these Specifications, or for systems furnished under other contracts, obtain review of the cable characteristics and certification for use with the connected system equipment by the connected equipment manufacturers.

C. UL Compliance: For cables that may be run in plenum ceilings or other air-handling spaces, provide cables tested for compliance with applicable requirements of UL Standard 910, "Test Method for Fire and Smoke Characteristics of Electrical and Optical Fiber Cables Used in Air-Handling Spaces." In addition, provide FO cables that have passed the UL VW-1 flame test.



- D. EIA/TIA Compliance: Comply with applicable requirements of EIA Standards, EIA-440, -455, -458, -475, -509, -568-b.3, and 598-a pertaining to optical fiber cable and system component construction and installation. EIA/TIA-455-61, FOTP-61, Measurement of Fiber or Cable Attenuation Using an OTDR.
- E. Fiber Optics Experience: Contractor must be able to prove to the satisfaction of Owner that it has significant experience in the installation of fiber-optics cable systems. Installation must include installation of fiber-optics cable, fiber termination, knowledge of interconnect equipment, and a thorough knowledge of testing procedures.
- F. Labeling: Handwritten labels are not acceptable. All labels shall be machine printed on clear or opaque tape, stenciled onto adhesive labels, or type written onto adhesive labels. The font shall be at least 1/8 inch in height, block characters, and legible. The text shall be of a color contrasting with the label such that it may be easily read. If labeling tape is utilized, the font color shall contrast with the background. Patch panels shall exhibit workstation numbers or some type of location identifier, in sequential order, for all workstations or devices attached. Each fiber-optics cable segment shall be labeled at each end with its respective identifier.
- G. Fiber-Optics Interconnect Equipment (Patch Panels): Interconnect equipment shall be used in all fiber cable installations. Patch panels shall be mounted in the equipment racks or panel mounted. Interconnect equipment mounted in racks shall be affixed to the rack by at least 4 screws. All fiber-optics interconnect devices shall be assembled and installed in accordance with the manufacturer's instructions and recommendations.
- H. Patch Cords: Patch cords shall be provided for each fiber-optic port on the patch panel. Patch cords shall meet or exceed technical specifications of all installed fiber-optic cable. Patch cord connectors shall be matched with patch panel connector type and network fiber module connector type as required.

#### 1.04 COMMISSIONING

- A. Subsequent to hook-ups of FO system to signal sources and destination equipment, operate systems to demonstrate proper functioning. Replace malfunctioning FO cabling system items with new materials, and then retest until satisfactory performance is achieved.

## PART 2 - PRODUCTS

### 2.01 MANUFACTURERS

- A. Subject to compliance with specified requirements, manufacturers offering products which may be incorporated in Work include:
  - 1. FO Cables:
    - a. Corning Infinicor SX+ Optical Fiber, or Equal, for multi-mode applications.
    - b. Corning NexCor Optical Fiber, or Equal, for single-mode applications.
  - 2. FO Connectors and Couplers:
    - a. AMP Netcon.
    - b. AT&T Network Systems.
    - c. Corning.
    - d. Honeywell, Inc.
    - e. ITT Corp.
    - f. Thomas and Betts Corp.
  - 3. FO Patch Panels:
    - a. Panduit.
    - b. Volition.

### 2.02 OPTICAL FIBER CABLING SYSTEMS

- A. Fabricate system using manufacturer's standard materials as indicated by published product information and in sizes, types, and performance characteristics as indicated.
- B. FO Cables: Factory fabricated, single channel, low loss glass type, fiber-optic multimode graded-index cables with the following operational and construction features:
  - 1. Multi-mode Fibers:
    - a. Cable Type shall be Corning FREEDM One Indoor/Outdoor Tight-Buffered Cable.
    - b. Number of Fibers: 6 minimum or as listed on Drawings.
    - c. Core Diameter: 50 microns or as listed on Drawings.
    - d. Cladding Diameter: 125 microns or as listed on Drawings.
    - e. Subunit Size: 2.0 mm or as listed on Drawings.

- f. Maximum Attenuation: Less than 2.5 dB/850 nm.
  - g. Minimum Bandwidth: Greater than 500 MHz-km.
  - h. Minimum Bend Radius (Unloaded): 10 cm (3.1 in).
  - i. Operating Temperature Range: -20 to +70 degrees C.
- C. FO Connectors: Stainless steel, fiber-optic cable connectors, capable of terminating FO glass cables with diameters from 8 through 1,000 microns. Fabricate connectors with optical fiber, self-centering, axial alignment mechanisms. Provide ST style connectors as required or shown on Drawings.

### 2.03 SPARE PARTS

- A. Provide at end of project the following spare parts:
  - 1. Provide twenty (20) Optical Fiber splice pigtails.
  - 2. One (1) optical fiber splice kit including optical fiber tester.

## PART 3 - EXECUTION

### 3.01 EXAMINATION

- A. Examine areas and conditions with the Installer present for compliance with requirements, and other conditions affecting the performance of optical fiber cabling system. Do not proceed with Work until unsatisfactory conditions have been corrected in a manner acceptable to Installer.

### 3.02 INSTALLATION

- A. Install fiber-optic cables and associated equipment and devices in accordance with industry standards and manufacturer's written instructions.
- B. Install fiber-optic cable without damage to fibers, cladding, or jacket. Ensure that media manufacturer's recommended pulling tensions are not exceeded. Do not, at any time, bend cables to smaller radii than minimums recommended by manufacturer.
- C. Install FO cables simultaneously where more than one cable is being installed in same raceway. Use pulling lubricant where necessary; compound used must not deteriorate cable materials. Do not use soap. Use a pulling means, including fish tape, rope, and basket-weave grips, that will not damage media or raceway.
- D. No splices are allowed, except at indicated splice points.

### 3.03 GROUNDING

- A. Provide grounding connections for FO cable and other system components as required by manufacturer's written instructions.

### 3.04 APPLICATIONS

- A. Install optical fiber cabling for project applications as detailed on drawings.

### 3.05 FIELD QUALITY CONTROL

- A. Testing: Testing shall be done by Contractor with at least 5 years of experience in testing fiber-optic cabling systems. Contractor shall test each fiber strand. **Owner reserves the right to have representation present during all or a portion of the testing process. Contractor must notify Owner 5 days prior to commencement of testing.** If Owner elects to be present during testing, test results will only be acceptable when conducted in the presence of Owner. Any fiber-optic cable left non-terminated at the discretion of Owner, shall be tested using an adequate light source to determine that all installed strands are not damaged.
- B. Fiber-Optics Cable: Each fiber strand shall undergo bi-directional testing for signal attenuation losses using power meter and light source. Testing shall also include Optical Time Domain Reflectometer (OTDR) at both 850 and 1,300 nanometers for all installed fiber strands.
  - 1. Recommended Test Equipment:
    - a. Multimode: Siecorm OM-100F and OS-100D or equivalent power meter and light source.
    - b. Multimode: Siecorm OTDRPlus with appropriate modules for testing.
  - 2. Tests:
    - a. Multi-mode: Bi-directional signal attenuation at 850 and 1,300 nm.
  - 3. Test Criteria: Signal loss of less than 10 dB through entire fiber path, including cable, couplers and jumpers.
- C. Documentation (Fiber Optic): Contractor shall provide documentation to include test results and as-built Drawings. Fiber Test Results: The results of the fiber testing shall be entered into the form "Fiber Attenuation Tests Results." Handwritten results are acceptable provided the test is neat and legible. Copies of test results are not acceptable. Only original signed copies will be acceptable.

1. Each cable installed shall undergo complete testing in accordance with TIA/EIA TSB-67 to guarantee performance to this standard.
  2. All required documentation shall be submitted within 30 days at conclusion of the project to Owner.
  3. Test Criteria: Pass rate to conform to latest TIA/EIA Standards that incorporate link performance testing through entire path, including cable, couplers, and jumpers.
- D. Acceptance: Acceptance of the Data Communications System, by Owner, shall be based on the results of testing, functionality, and the receipt of documentation.

### 3.06 CLEANING

- A. Clean optical fiber cabling and components of dirt and construction debris upon completion of installation.

### 3.07 WARRANTY

- A. Fiber Optic cable and splices shall be provided with a 20 year full warranty covering material and labor.

END OF SECTION

## SECTION 13610

### DATA ACQUISITION AND PROCESS CONTROL SYSTEM

#### PART 1 - GENERAL

##### 1.01 DESCRIPTION

###### A. Scope of Work:

1. The Primary Instrumentation and Control System Supplier (System Supplier) shall furnish all labor, materials, modifications to existing equipment, programming, services and incidentals required to install and place into operation a digital computer-based data acquisition and process control system (DACS) in a distributed network configuration as specified and shown on the Contract Drawings, Section 13300: Instrumentation and Controls.
2. The System Supplier shall supply all equipment, materials, programming, and services, hereinafter termed the system. The System Supplier shall provide all equipment, materials, programming, software, modifications and interfacing to existing equipment, calibrations and services that are required to successfully interface and interconnect any other control systems and associated equipment that are specified or designated in any drawings or specification provisions in Division 11: Equipment, Division 13: Special Construction, Division 15: Mechanical, and Division 16: Electrical of these Specifications for the purpose of providing a fully integrated and functional control system as specified herein. Successful integration and interconnection of the data acquisition and process control system to any of the areas of interface specified shall require the System Supplier to provide the necessary extension to the existing data highways and I/O capability.
3. The System Supplier shall be responsible for providing accessory devices, revising existing control systems including furnishing and installation of control switches and signal converters and changes to software necessary to perform the intent as shown P&IDs and as specified in the functional process descriptions, providing services to re-calibrate all existing analog transmitters which provide inputs to the system, and services necessary to achieve a fully integrated and operational system as shown on the Contract Drawings, Section 13615 and described hereinafter.

4. The System Supplier shall furnish for installation by the Contractor all cabling and cable accessories, including tools necessary for connecting the control system peripherals.
5. The System Supplier shall furnish startup assistance and operator and maintenance training necessary for successful operation and maintenance of the integrated control system.
6. Upgrade the existing Intellution iFix workstations with the latest version of iHistorian
7. Modify all existing local HMIs to reflect the proposed graphics and control system modifications.

B. Related Work Described Elsewhere:

1. Instrumentation and Controls: Section 13300.
2. Process Instrumentation and Controls - Products: Section 13615
3. Electrical: Division 16.

C. General Description of the System:

1. Contractor shall modify the existing PLC system, SCADA screens, and Report generation requirements at the existing Eastern Regional Water Supply Facility to include all the proposed modifications as part of this project and add Tags to the SCADA system.
2. Provide and install new PLC control panel for the temporary chemical feed system as described in specification section 11400, Temporary Chemical Feed System. Coordinate all aspects of the PLC control panel with the temporary chemical feed system supplier.
3. Provide and install new remote I/O panel RIO-5 as indicated on the plans. Provide fiber connection between 50-LCP-5 and RIO-5 and integrate the new RIO-5 panel to the existing process 50 control panel. Modify 50-LCP-5 as required to integrate the new RIO-5 panel.
4. Contractor shall obtain a copy of the existing PLC programming for panel 50-LCP-5 and 75-LCP-8 from the Owner. Contractor shall rewrite the PLC logic for PLC systems according to the Orange Standard Naming and Tag numbering system. Contractor shall closely coordinate with Owner and Engineer and inform any deviation and get approval from Owner.

1.02 QUALITY ASSURANCE:

- A. Qualification requirements are specified under Section 13300: Instrumentation and Controls.

1.03 SUBMITTALS:

- A. Refer Section 01340 Shop Drawings, Working Drawings and Samples and Section 13300: Instrumentation and Controls.

1.04 DOCUMENTATION:

- A. Refer to Section 13300: Instrumentation and Controls.

1.05 PRODUCT DELIVERY, STORAGE AND HANDLING:

- A. Refer to Section 13300: Instrumentation and Controls.

1.06 WARRANTY AND GUARANTEES: Refer to Section 01740: Warranties and Bonds

- A. All equipment supplied under this section shall be warranted for a period of one (1) year by the System Supplier.
- B. The System Supplier's warranty period shall run concurrently with the Contractor's warranty period. No exception to this provision shall be allowed.

PART 2 - PRODUCTS

2.01 CABLE/MODEM

- A. Fiber-Optic Cable: All fiber-optic connection shall be multi-mode 62.5/125 $\mu$ m gel-filled, armored cable (pre-manufactured by a fiberoptic cable manufacturer) furnished by the electrical contractor.

2.02 SYSTEM SOFTWARE

- A. General Description:
  - 1. The supervisory system shall be an operator interface control system that includes support for process control, data acquisition, alarming, trending, and management reports.



## 2.03 REPORTS

- A. Update all applicable existing Reports per new construction. Create new Reports as required.

## 2.04 FUNCTION DESCRIPTIONS

### A. General Requirements:

1. The Data Acquisition System (DACS) shall perform the following as a minimum:
  - a. Monitor the status of all selector switches in the field.
  - b. Display on each facility screen the run status and totalized run hours of all equipment.
  - c. Display, indicate and record alarm status as required by other divisions of the specification.
  - d. Provide interlocking signals between unit processes.
  - e. Display and configure graphics. Graphics shall include facility structure and major process piping and alarms. The graphics shall include facility name, specific areas, time and date stamp, flow direction arrows, adjacent to and from process icons, valves and equipment tags, each process equipment shall be called-out (i.e. High Pressure Pump No.1 etc.) and equipment status shall be indicated. A color code system shall be submitted for approval.
  - f. Trend all flow, level and analytical signals including min., max., and avg. for each.
  - g. Configure tables of real-time data for access by other users on the network.
  - h. Configure tables of elapsed time of all equipment and relational data as required by the Owner.
  - i. Alarm events shall be tagged to allow the user to mouse click to the alarmed facility.

B. Plant Automation:

1. Sodium Hypochlorite (Process 75).

a. Pre-disinfection: The control system shall automatically control the speed of the pre-disinfection metering pumps based upon the chlorine residual and/or the flow rate. There shall be an option to control pump stroke based on chlorine residual.

1. The pre-disinfection control sequence shall be as follows:

a.) The operator selects the sodium hypochlorite metering pumps for service. (75-MP-1, 75-MP-2, 75-MP-3, 75-MP-4).

b.) The operator adjusts the desired chlorine set point via a control matrix CRT.

c.) The operator selects either MANUAL or AUTO for control of each sodium hypochlorite metering pump speed.

d.) The operator selects MANUAL or AUTO for the control of each sodium hypochlorite meter pump stroke.

d.) The control system will start the sodium hypochlorite metering pumps in software and field AUTO as required based upon the transfer pump station discharge flow and chlorine residual. The PLC logic shall have a trimming option based on the chlorine measurement. Pre-disinfection is active only when the transfer pumps are running.

2. Pump ready signal shall be generated when the field HOA is in auto position.

3. Pump failure signal shall be generated based upon the lack of chlorine residual, SCR failure, or excessive discharge pressure.

2. Sodium Hypochlorite (Forced Draft Aerator).

a. Forced Draft Aerator: The control system shall control the speed of the metering pump based upon operator input.

1. The FDA cleaning pump control sequence shall be as follows:
  - a.) The operator selects the desired speed. (75-MP-5)
  - b.) The operator selects the desired run time.
  - c.) The control system will start the sodium hypochlorite metering pump in software and field AUTO. The metering pump shall run for the selected duration then stop.
2. Pump ready signal shall be generated when the field HOA is in auto position.
3. Pump failure signal shall be generated based upon excessive discharge pressure.

3. Sodium Hypochlorite (Process 50).

- a. Post Disinfection: The control system shall automatically control the speed of the post-disinfection metering pumps based upon the chlorine residual and/or the total flow rate. There shall be an option to control pump stroke based on chlorine residual.

1. The post disinfection control sequence shall be as follows:
  - a.) The operator selects the sodium hypochlorite metering pumps for service. (50-MP-1, 50-MP-2 and 50-MP-3).
  - b.) The operator adjusts the desired chlorine set point via a control matrix CRT.
  - c.) The operator selects either MANUAL or AUTO for control of each sodium hypochlorite metering pump.
  - d.) The control system will start the sodium hypochlorite metering pumps in software and field AUTO as required based upon the high service pump discharge flow and chlorine residual, the PLC logic shall have trimming option based on the chlorine measurement.

Post disinfection is active only when the high service pumps are running.

2. Pump ready signal shall be generated when the field HOA is in auto position.
3. Pump failure signal shall be generated based upon the lack of chlorine residual, SCR failure or excessive discharge pressure.

## PART 3 - EXECUTION

### 3.01 GENERAL INSTALLATION

- A. The computer system, peripherals, and accessory equipment shall be installed in accordance with the requirements set forth under Section 13300: Instrumentation and Controls.

### 3.02 TESTS AND ACCEPTANCE

- A. Field and system tests, and acceptance requirements are specified under Section 13300: Instrumentation and Controls.

### 3.03 MAINTENANCE CONTRACT

- A. Maintenance contract requirements are specified under Section 13300: Instrumentation and Controls.

### 3.04 WARRANTY

- A. Provide a system warranty in accordance with the requirements of Section 01740: Warranties and Bonds.

### 3.05 INSTRUCTION

- A. Personnel training requirements are specified under Section 13300: Instrumentation and Controls.

END OF SECTION

## SECTION 13615

### PROCESS INSTRUMENTATION AND CONTROLS - PRODUCTS

#### PART 1 - GENERAL

##### 1.01 SCOPE OF WORK

- A. Attention is drawn to the requirement that all instrumentation and control equipment specified herein shall be furnished by the same System Supplier who shall provide all other related equipment as specified in Section 13300 and 13610.
- B. System Supplier shall furnish all labor, materials, equipment, and services required to install and place into operation the field instrumentation and controls specified herein and as shown on the Contract Drawings.
- C. Any auxiliary devices such as lightning/surge protectors, relays, timers, isolators, signal boosters, etc., which are necessary for complete operation of the system, or to perform the functions specified, shall be included whether or not they are specifically shown on the drawings.
- D. System Supplier shall coordinate programming of the programmable logic controllers with the membrane supplier, chemical feed pump supplier, motor control center supplier and all other related equipment supplied by other vendor.

##### 1.02 RELATED WORK

- A. System Supplier shall be responsible for supplying and installing all equipment as defined in this section and the following related sections:
  - 1. Section 13300 - Instrumentation and Controls
  - 2. Section 13610 - Data Acquisition and Process Control System
- B. System Supplier shall be responsible for coordinating with the work to be performed as defined in section 13300.

##### 1.03 QUALIFICATIONS

- A. All System Suppliers shall comply fully with the qualification requirements stated in specification section 13300.

#### 1.04 SUBMITTAL REQUIREMENTS

- A. Refer to Section 13300 - Instrumentation and Controls

#### 1.05 FINAL DOCUMENTATION

- A. Final Documentation requirements are defined in specification Section 13300.

#### 1.06 QUALITY CONTROL

- A. Quality Control requirements are defined in specification Section 13300.

#### 1.07 PRODUCT HANDLING

- A. Product handling requirements are defined in specification Section 13300.

#### 1.08 TOOLS AND TEST EQUIPMENT

- A. In addition to the general tools and test equipment defined in specification section 13300, the System Supplier shall provide any items, such as calibration fixtures, patch cables, test leads, etc. necessary for properly checking field operation of equipment supplied under this section.

#### 1.09 SPARE PARTS

- A. Spare parts shall be provided for all field replaceable components so there is one spare for every five like items or part thereof.
- B. All spares shall be packed in a manner suitable for long-term storage and shall be adequately protected against corrosion, humidity and temperature.
- C. Storage and handling instructions shall be provided with each spare part.

### PART 2 - PRODUCTS

#### 2.01 FIELD MOUNTED INSTRUMENTS

See Section 13300

#### 2.02 OTHER FIELD EQUIPMENT

- A. Intrinsic Safety Barriers
  - 1. 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.

2. Unit shall be Factory mutual approved and certified for use in accordance with National Fire Protection Association (NFPA 493 of 1978).
3. Unit shall be as manufactured by R. Stahl, Inc. or approved equal.

## 2.03 CONTROL PANELS

### A. Components

#### 1. General

- a. Panel shall be completely fabricated, instruments installed, wired, and plumbed at the factory.
- b. Panel shall be free standing with concrete housekeeping pad, single or double door, of sufficient size to adequately enclose all instruments plus 25 percent ample interior clearance to allow for installation, general servicing, future additions, and maintenance of the instruments. Weight of instruments shall be supported by channel supports where required. (See Indoor Panel Construction this section)
- c. Circuit Protection
  1. Main Circuit Breakers – This breaker shall control the supplied 115 VAC primary power to all branch circuits within the panel.
  2. Utilities Circuit Breakers – This breaker shall control the supplied 115 VAC power to the service outlet, internal lamp and light switch.
  3. UPS Power Supply Branch Circuit Breaker. This breaker shall control the supplied 115 VAC power to the UPS power supply.
  4. PLC Power Supply Branch Circuit Breaker. This breaker shall control the supplied 115 VAC UPS supplied power to the PLC 24Vdc power supply.
  5. I/O and Control Branch Circuit Breaker. This breaker shall control the supplied 115 VAC UPS supplied power to the dedicated PLC I/O and control additional 24V power sources.

d. Panel Mounting

1. Panel Component Arrangements

- a. Panel face mounted equipment shall consist of pilot lights, pushbuttons, selector switches, meters, indicating timers, etc. Spacing between horizontal rows of components shall be 1-1/2 inches center-to-center minimum; spacing between vertical columns of components shall be 1-7/8 inches center-to-center minimum.
- b. The distance from the bottom row of components to the floor shall be not less than 36-inches. The top row of recording and indicating instruments shall be centered approximately 60 inches above the floor. In general, all indicating lights, pushbuttons, etc. shall be mounted in accordance with the sequence of operation from left to right and top to bottom.

2. Rear of Panel Component Arrangements

- a. All relays, timers, etc. installed on each panel sub plate, shall be provided with a minimum spacing between the component and the wire duct of 1-1/2 inches above and one inch below. Minimum spacing between adjacent components shall be 1/4-inch.
- b. A minimum of 2-inches shall be provided between terminal strips and wire ducts or terminal strips and terminal strips. In general, terminal strips shall be mounted vertically near the outer edges of the sub plate.
- c. Sub plates shall have a minimum of 25% spare mounting space, and terminal strips shall have a minimum of 20% installed spare terminal blocks.

B. Indoor Panel Construction:

- 1. Floor Mount panels shall be provided with welded floor stands/legs, Free Standing Panels with 4-6" concrete house keeping pad and adequate internal bracing to support the weight of all instruments and wiring.



Internal bracing shall permit panel lifting without racking or distortion. Panel shall be NEMA 4X rated. All doors shall be rubber gasketed.

2. Removable lifting rings designed to facilitate simple, safe rigging and lifting of the panel during installation shall be provided. Plugs shall be provided to fill the lifting ring holes after installation and shall match the panel color.
3. When applicable, floor standing cabinets shall match adjacent floor standing cabinets in height, depth, general access, and color, unless otherwise noted. Panels shall not require any additional external supports or bracing to maintain freestanding integrity.
4. All installation details shall be verified by the Contractor/System Supplier. Unless otherwise noted, all panels including full range of door swing(s) shall be properly sized to fit in the allotted spaces as noted or shown in the Contract Drawings.
5. The panels shall be so constructed that no seams or bolt heads are visible when viewed from the front. Panel cutouts for instruments and other devices (e.g., lights and switches) shall be punched, or drilled and smoothly finished with rounded edges.
6. Provide steel angle and/or plate stiffeners 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 steel 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 panel during installation. Where two or more panels are shown mounted immediately adjacent to one another, they shall be securely bolted together with their front faces parallel. All internal components shall be mounted on removable sub pans and not directly to the enclosures. Sub pans shall be painted with white enamel. Additional print storage pockets shall be provided on the inside of each panel. Its size shall be sufficient to hold all of the prints required servicing the equipment. All control operations and overload reset shall be accessible without opening panel.
7. Each enclosure shall be provided with full height, fully gasketed access doors where shown. Doors shall be provided with three-point latches. Handles shall be stainless steel lever, quarter turn type. All panel access doors shall be provided with full length, continuous, piano type, and steel hinges with steel pins.

8. Panels shall be internally lighted by LED lights, provided with protective shields and a switch box mounted control switch. LED lights shall be capable of illuminating all areas within the control panel. LED light output shall be equivalent to one (1) 30W fluorescent lamp mounted every four (4) feet of panel width.
9. Each panel shall be provided with one 15-amp ground fault protected, duplex service outlet. One outlet shall be provided for every 3.0 feet of panel width and mounted to the panel subplate or deadfront.
10. Service lights and/or receptacles shall be wired to a separate main disconnect circuit breaker and connected to the 120-volt, 60-hertz, single-phase supply. Receptacles shall be labeled as "Service Outlet"
11. Provide single steel handle, 3-point latch lock option on panel door(s).
12. Panel shall be manufactured by Hoffman, Hammond, Electromate, Saginaw or approved equal.
13. Panel finish, in addition to manufacturer's finish, all surfaces shall be painted with no less than three (3) coats of industrial type gloss polyurethane enamel paint light gray in color on exterior and gloss white on interior and back panel.
14. Panel shall be secured to concrete floor with no less than six (6) 3/8" stainless steel wedge anchors.

D. Panel Grounding

1. Contractor shall exercise care and furnish additional grounding to insure good ground continuity in particular with equipment surge protection devices located within panel and to meet or exceed surge equipment manufacturers recommendations. See section 16450 Grounding Systems.

E. Uninterruptible Power Supply

1. The control panel shall operate from an On-line Uninterruptible Power Supply (UPS). Battery-supplied power shall be provided to operate the system for at least 45 minutes. The UPS shall utilize low maintenance, rechargeable, sealed batteries, maintained at a float charge during normal power conditions. The UPS shall output a synchronized 60 Hz sine-wave output, in phase with the commercial line power sine wave. The sine-wave output shall be synchronized during switching from commercial AC power source to battery source and during switching from battery source back to commercial AC power source. The UPS shall switch to and from

battery in less than 4 milliseconds. The UPS shall visually indicate its current mode of operation. The UPS shall provide silencing audible and visible alarms indicating commercial AC line power failure and low battery. The UPS shall support a serial port interface to communicate with the central site computer. This interface shall provide information to programmable controller to alert the utility staff in case of a power or UPS alarm or failure. The UPS shall be located within the control panel and supported by a sturdy rack.

2. The load center and UPS shall be protected by an Adaptive Surge Filter Model OM-20-120-LB as manufactured by Zero Surge, or equal.

F. Details:

1. General

- a. All components and circuits used shall be subject to review and approval by the Owner. All switching circuits shall be checked and verified for specified performance by testing before shipment. All wiring shall comply with the latest applicable local and N.E.C. codes. Non-conforming circuits shall be corrected and re-tested.
- b. Each device requiring power shall be wired so that when wires are removed from any one device, power will not be disrupted to any other device.
- c. One isolated, N.O. spare contact shall be provided on each relay.
- d. Control device contacts going to high voltage equipment for motor control shall be rated 240 V ac/125 V dc at 10 amps. The contacts shall handle 50 amps inrush on "make" at 120 V ac and one amp on "break" at 125 V dc.
- e. Fuses shall not be allowed where protection by circuit breakers will not void the warranty of the device.
- f. Fuse holders shall be lever operator terminal block type with blown fuse indicator model M4/8.SFL for 110VAC and M4/8.SFD for 24VDC manufactured by Entrelec, Square D or equal.
- g. Nameplates shall be plastic engraved type white in color with black letters.

2. Signal Distribution within Panels:

- a. All signals shall be 24 VDC 4 to 20 mA signals.
  - b. Signals distributed outside panels shall be isolated 4 to 20 mA signals.
  - b. All signal wiring shall be twisted pairs.
  - c. All field 4-20mA dc signals shall be isolated with a din rail mount isolator, as manufactured by Moore Industries model SCX or M-Systems model M2VS.
  - e. All field 4-20mA dc signal isolators shall be protected with a surge protector, as manufactured by MTL, Phoenix or OWNER approved equal.
3. Signal Switching:
- a. Signals shall be switched by dry circuit type relays or switches.
  - b. 4 to 20 mA loops shall not be interrupted during switching.
  - c. Switching transients in any associated signal circuit shall not exceed  $\pm 0.2$  mA or  $\pm 0.05$  V depending on the signal type.
4. Discrete Control Distribution within Panels:
- a. All discrete I/O control points shall be 120VAC power.
  - b. All discrete field I/O control points entering panel shall be protected with a surge protection unit, as manufactured by MTL model SD150X, MTL model MA15, Edco model HSP121BT-1RU, Phoenix model 1414064, or OWNER approved equal.
  - c. Programmable Logic Controller (PLC)
    - 1. General:
      - a. The programmable logic controller (PLC), as specified herein, shall be provided under this section and located within the control panel. RAM capacity shall be determined by size of project.
    - 2. Programmable Controller:

- a. The plant shall be automatically controlled by a Modicon Quantum programmable logic controller (PLC) 140CPU43412A, 486, 800 Kb, 2 Modbus Ports, 1 Modbus Plus, Key Switch to Start/Memory Protect/ Start Controller.
- b. Each discrete input module shall accept up to sixteen (16) 120Vac input signals received from devices such as pushbuttons, selector switches, pressure switches, temperature switches, or limit switches and converts them into voltage logic levels that can be processed by the controller. Input signals shall be wired in two (2) groups of eight signals per module. Each group of eight points shall be protected by a .16 amp external indicating fuse block. Each input shall be optically isolated and protected with a red LED to indicate the presence of the 24Vdc power (circuit closed indication). A green LED shall be provided to indicate the presence of the I/O module supply voltage of each group. Discrete input modules shall be as manufactured by Modicon
- c. Each discrete output module shall provide sixteen (16), relay switched, 120Vac output signals that can drive loads up to 1 amp such as relays, starters, and solenoid valves. The outputs shall be optically isolated from the system. Output signals shall be field wired in two (2) groups of eight signals per module. Each group of four points shall be protected by an external .16A indicating fuse block. Each output shall be isolated and provided with a red LED to indicate the output is turned "on". A green LED shall be provided to indicate the presence of the required 24Vdc supply voltage. External, panel mounted, 10Amp, interposing relays shall be provided for interfacing to control devices that are external to the local control panel or to devices that exceed the rating of the output module. Where LED type status indicators are used, a loading resistor shall be installed to prevent leakage current from keeping the lamps falsely lit. Discrete input modules shall be as manufactured by Modicon.

- d. Analog input modules shall be eight channels with opto-isolation. Inputs shall accept 4-20mA DC signals. Input shall be set for Unipolar with Offset and Extended Resolution mode to detect loss of signal or low input indication. Resolution shall be 11 bit plus sign with a 10 ms conversion time. The four points shall be protected by an external .16A indicating fuse block. A green LED shall be provided to indicate the presence of the required 24Vdc supply voltage. A second green LED shall be provided to indicate the module is healthy. Removal of any panel-mounted devices shall not interrupt the input signals to the PLC. Analog values shall continue to function properly. Inputs shall be provided for Flow and Level. Analog input modules shall be as manufactured by Modicon.
- e. Analog Output Module shall be eight channels with opto-isolation. Outputs shall drive 4-20mA DC signals. Output shall be set for Unipolar with Offset and Extended Resolution mode to detect loss of signal or low input indication. Resolution shall be 11 bit plus sign with a 10 ms conversion time. The four points shall be protected by an external .16A indicating fuse block. A green LED shall be provided to indicate the presence of the required 24Vdc supply voltage. A second green LED shall be provided to indicate the module is healthy. Removal of any panel-mounted devices shall not interrupt the input signals to the PLC. Analog values shall continue to function properly. Outputs shall be provided for VFD speed pacing. Analog output modules shall be as manufactured by Modicon
- f. Power supply Modules shall be sum able, rack mounted and provide DC power to CPU. Power supply modules shall be as manufactured by Modicon
- g. Operation of the PLC processor shall be continuously monitored, and in the event the controller should stop functioning, or the branch circuit breaker is opened, the pumps shall

automatically revert to ultrasonic control or float as required.

- h. Battery-backed memory shall be protected by a 3.6V Lithium battery with the battery status monitored by the PLC. When the battery needs replacement, as indicated by the "Low Battery" status lamp on the processor or "PM required" lamp on the front of the local panel, a remote alarm will be initiated and sent to the PLC.
- j. Serial Port surge protection shall be used on all Serial, Modbus, and Modbus Ethernet ports. Serial Port surge protection shall be manufactured by APC, Model PS9-DCE or approved equal.

### 3. PLC Ladder Logic Software

- a. The System Integrator shall program PLC to perform, and warrant proper system operation as described in this document.
- b. The Owner shall be sole owner of all programming software described in this contract, the use of any proprietary software other than described in this contract will not be accepted.
- c. All points used in Ladder logic shall be documented and labeled so Owners personnel can identify each point and its function.
- d. Control (Command) points shall be programmed such that control can be performed from HAND field devices (such as a selector switch) or from REMOTE by operator interface or MMI SCADA system, as described in contract. In some applications this will require that OR logic be in the program. The control description shall include how the MMI software should handle the commands.
- e. PLC Command points shall be "SET" from MMI or Remote SCADA system. Command example: To start Pump #1, the MMI system shall set the bit to a 1 at address 02001 and to stop the pump the MMI

shall set the same bit to a 0 (zero) at the same address 02001.

- f. Programmer shall keep the amount of points needed to control equipment to a minimum necessary.
- g. Provide a Device Specific, Control Description in one (1) document. The document shall provide all information about controlling each specific device in the same area of the document. This prevents the user from looking in four (4) different places for information on one (1) device.
- h. All descriptions shall be grouped by piece of equipment, functional description and address in the PLC. The documentation shall be created in a Excel spreadsheet format on CD and 8.5x11 printout.

EXAMPLE:

<u>Device</u>	<u>Description</u>	<u>0 State</u>	<u>Address</u>
<b>Pump 101</b>	Run Status	Stopped	10001
<b>Pump 101</b>	Failed Status	OK	10022

- i. All Analog values in the PLC ladder logic program documentation shall include scaling values and engineering units. The documentation shall be in a Excel spreadsheet format on CD and 8.5x11 printout.

EXAMPLE:

<u>Description</u>	<u>Address</u>	<u>Data Type</u>	<u>Raw Zero</u>	<u>Raw Full Scale</u>	<u>Eng Units Zero</u>	<u>Eng Units Full Scale</u>	<u>Units</u>
<b>Flow</b>	300010	INT	0	4095	0	300	GPM

- j. Documentation shall also state any special conditions that must be met to control a piece of equipment. For example if a pump must be in manual for the MMI system to turn the pump on or off this shall be documented. (i.e. Pump 101 can only be directly controlled by the MMI system if it is in the manual condition).



- k. Provide documentation and CD for all PLC logic.
- l. All PLC logic instructions (all coils, contacts and registers), shall be programmed and labeled using “Modicon, ProWORKS - NxT”, PLC programming software.
- m. System Integrator shall furnish the Owner’s Technician with Basic PLC Operation training.
- n. All Data to be exchanged with the MMI SCADA system shall be “Block Moved” to a contiguous group of “Super blocks” that contain contiguous registers for the purpose of read write routine polling efficiency. Furnish 25 percent spare “Super blocks” in-group for future additions.

**EXAMPLE:**

40206 shall contain 16 discrete inputs  
40207 shall contain 16 discrete outputs  
40208 shall contain 1 analog input  
40209 shall contain 1 analog output

- o. All “Super block” register used shall contain the prefix “MMI” in its description label for ease of identifying in its logic.
- p. All analog I/O programming shall be based on a range of 0 to 4095 bits.
- q. To simplify program troubleshooting, PLC ladder logic program shall be written in a segment specific format as logic relates to field device control loops. (i.e. “For Example only”: Ladder logic written for chlorine pacing system shall be contained in segment 07, logic to start and stop constant speed transfer pumps shall be contained in segment 08, etc.). Furnish ladder logic segment table of contents document listing segment numbers and control loop descriptions.

d. Relays:

- 1. Relays shall be provided as necessary to perform switching functions required of control panels and other control

circuits. All relays shall have screw type terminal interface. Terminals shall have a permanent, legible identification. Relays shall be mounted such that the terminal identifications are clearly visible and all terminals are readily accessible. Relays shall be equipped with LED indication.

2. General-purpose relays shall be used for logic and switching power to external loads and shall be DIN rail mounted, general purpose, medium power, and industrial type. Minimum mechanical life expectancy shall be 10,000,000 operations and electrical life expectancy of 100,000 operations at rated load. They shall be of the dust cover enclosed, plug-in type, with 8 or 11 pin, screw terminal, snap-on sockets. Relays shall have a maximum of three form C contacts rated for 10 amperes at 120V ac and be equipped with coil status indicator lamps and hold down springs. Relays shall be as manufactured by Potter-Brumfield series KRPA, KUP, or Omron Type G2R or approved equal.

e. Power Supplies:

1. Provide dc power supplies as required to power instruments requiring external dc power, including two-wire transmitters, dc relays.
2. Power supplies shall convert 120V ac, 60-Hz power to dc power of the appropriate voltage(s) with sufficient voltage regulation and ripple control to assure that the instruments being supplied can operate within their required tolerances.
3. Output over voltage and over current protective devices shall be provided with the power supply to protect the instruments from damage due to power supply failure and to protect the power supply from damage due to external failure. Provide NEMA 1 enclosure for all power supplies. Power supplies shall be DIN rail mounted such that dissipated heat does not adversely affect other components.
4. Power supplies shall be manufactured by Phoenix Contact.

f. Internal Panel Lights and Service Outlets:

1. Panels shall be internally lighted by LED lights, provided with protective shields and a switch box mounted control switch. LED lights shall be capable of illuminating all areas within the control panel. LED light output shall be equivalent to one (1) 30W fluorescent lamp mounted every four (4) feet of panel width.
  2. Panels shall be provided with a 15-amp, 120-volt, service outlet circuit within the back-of-panel area. The circuit shall be provided with three-wire, 120-volt, 15-ampere, duplex receptacles, one for every 4 feet of panel width (two minimum per panel) and spaced evenly along the back-of-panel area.
- g. Wiring: Wiring within panels, consoles, racks, and cabinets shall meet the following requirements:
1. AC power wiring shall be 600 VAC, 12 AWG tinned stranded unless otherwise noted.
  2. All Discrete Output control wiring to be orange in color, 300 VAC no less than, 16 AWG, Tinned Stranded Copper type B/N 16/19 or Belden 8500 or XHHW, insulated wire or equal.
  3. All Discrete Input control wiring to be red in color, 300 VAC no less than, 16 AWG, Tinned Stranded Copper type B/N 16/19 or Belden 8500 or XHHW, insulated wire or equal.
  4. Control wiring routed to MCC and field shall be no less than 14 AWG multi-conductor Tray Cable, Stranded Copper type PVC, THWN or XHHW, insulated wire or equal.
  5. All internal analog wiring, (PLC to field terminal), shall be properly labeled and color coded Black for positive and White for negative polarity, no less than 18 AWG, Shielded Tinned Stranded Copper type Belden or equal.
  6. All analog field signal cable exiting enclosure, outer jacket shall be labeled with dot matrix printed shrink tube type wire labels. All shield drain wire shall be insulated and properly terminated per ISA and OEM standards. Labels shall identify terminal number, PLC logic reference number

and affiliated process variable, properly color coded Black for positive and White for negative polarity, no less than 16 AWG, Shielded Stranded Tinned Copper Signal type wire, Belden # 8719 or equal.

7. Wiring shall be numbered and tagged at each termination. Heat shrunk dot matrix wire markers shall be provided at each wire termination point internal and external to each panel(s). Wire tags shall be marked with legible machine printed markings and numbers. Adhesive or taped on tags will not be accepted. Each wire shall have a unique tag number assigned and be clearly identified on the approved shop drawings. Tagging scheme shall identify the designated component tag and terminal number destination (e.g. DO-00001, DI-10001, AI-30001, & AO-40001).
8. Wiring for special signals such as communications, digital data, and multiplexed signals shall be labeled and use manufacturer's standard cables.
9. All wires to internal components shall be connected to the "inside" of the field interface terminal strip. All wires to external components shall be connected to the "outside" of the field interface terminal strip. No more than two wires shall be connected to any one terminal point.
10. All panel wiring not run in wire ducts shall be bundled and tied.
11. Wiring shall not be spliced or tapped except at device terminals or terminal blocks.
12. Control and signal wiring shall be restrained by plastic ties or ducts. Hinge wiring shall be secured at each end so that any bending or twisting will be around the longitudinal axis of the wire and the bend area shall be protected with a sleeve.
13. Where panel components are provided for future equipment, wiring from the components to the panel terminal blocks shall be provided.

h. Wire Color Coding

1. Power Wiring: Phase A shall be black with brown phasing tape, Phase B black with orange tape, and Phase C black with yellow tape.
2. Internally powered AC Control Wiring: Control panel wiring associated with control circuits that are de-energized when the main panel disconnect is opened shall be color coded "Red".
3. Externally powered AC Control Wiring: Control panel wiring associated with control circuits that remain "Hot" when the main panel disconnect is opened shall be color coded "Yellow".
4. All yellow wiring leaving panels shall be brought to an isolated set of terminal blocks.
5. Low voltage, DC Wiring: Blue (DC+); White with Blue or White with red and black -tracer (DC-).
6. DC Control Wiring: Dark Blue (+) and White with Blue tracer (-).
7. Neutral: White  
  
Exception: Where prefabricated wire bundles are used, it is permissible to identify the neutral at every termination with a white shrink tube at least 12 inches long.
8. Ground: Green
9. Field interface wiring shall be black and white pairs unless otherwise noted or required by the National Electrical Code.
10. Intrinsically safe Light Blue
11. 24 VAC power wire shall be orange and brown.

j. Wire Duct

1. Panel wire duct shall be provided between each row of components and adjacent to each terminal strip. Wire ducts

shall be a minimum of one inch wide and three inches deep with removable snap-on covers and perforated walls for easy wire entrance. Wire ducts shall be constructed of non-metallic materials with voltage insulation in excess of the maximum voltage carried therein.

2. Empty panel wire duct shall be provided for all field connections to the terminal blocks.
  3. A minimum of two inches shall be provided between wire duct and terminal block assemblies
  4. Wiring duct shall not be filled to more than 60% visible fill.
- k. Wiring Interface: All wiring including spares entering or leaving each panel, console, rack or cabinet shall be terminated and identified as follows:
1. Analog and discrete signal wiring shall be terminated at numbered terminal blocks. All wire shall be labeled with terminal number and PLC logic reference number.
  2. Wiring for special signals such as communications, digital data, and multiplexed signals may be terminated at manufacturer's standard connectors.
- l. Terminal Blocks: Terminal blocks for panels, consoles, racks, and cabinets shall meet the following requirements:
1. All terminal blocks shall be 600-volt rated and shall be provided for termination of all circuits entering or leaving all panels. Terminal blocks shall have screw clamp compression, dead front barriers with current bar providing direct contact with wire between the compression screw and yoke. Yoke, current bar, and clamping screw shall be constructed of high strength and high conductivity metal. Yoke assembly shall guide all strands of wire into the terminal. Current bar shall provide dependable vibration-proof connections. Terminals shall be constructed to allow connection of wires without any special preparation other than stripping. Individual terminals shall be rail mounted to create a complete assembly such that jumpers can be installed with no loss of space on terminal or rail.

2. Terminal block components shall be sized to allow insertion of all necessary wire sizes and types. Legible, factory machine printed markings and numbers shall be provided for terminal block identifications on both the inside and outside tracks of the terminal block assembly. Terminal blocks shall be numbered in numerical order.
  3. Sufficient terminal blocks shall be provided to terminate all wires routed to the panel, all spare points and spare conductors. In addition, the greatest of 20 percent or four unused spare terminals shall be provided
  4. All connections for future functions shall be wired to numbered terminal blocks, grouped separate from the terminal blocks in use. Terminal blocks shall be grouped to keep 120V ac circuits separate from the 24V dc circuits.
  5. Terminal blocks shall be CSA certified and UL approved.
  6. Control type terminal blocks shall be as manufactured by WAGO, Entrelec, SQ-D or Owner approved equal. Analog signals (4-20 mA dc) shall be connected to knife type disconnect terminal. Shields required to be grounded shall be terminated. Signal shields shall be grounded at only point within a loop. Use blocks when passing the shields through.
- m. Grounding: Panels, consoles, racks and cabinets shall be provided with an isolated tinned copper grounding bus and lugs for all signal and shield ground connections. This ground bus shall be grounded at a common signal ground point. The signal grounding system shall meet National Electrical Code requirements. (See section 16450 Grounding System)
1. Each analog loop shall be grounded at a single point for the loop. This single point shall be at location of the dc power supply for the loop. Keep all in separate conduit away from parallel runs or AC wiring.
  2. Each analog loop shall have its wire shields connected to ground at a single point for the loop. Shields shall be grouped and connected to ground at the same point as the analog signal ground.

- n. Analog Signal Isolators and Surge Protectors: Instruments on different panels, cabinets, or enclosures shall not be wired in series. Provide din rail mount analog signal isolators as manufactured by Moore Industries model SCX or M-Systems model M2VS, for analog signals that are sent from one panel or cabinet to another. All analog signals entering or leaving the control system shall be protected at both ends of loop by a surge arrester as manufactured by MTL Surge arresters shall be labeled.

## 2.04 TRANSFER METERING SYSTEM

- 1. Enclosure:
  - a. Free-standing panels shall be provided with adequate internal bracing to support the weight of all instruments and wiring. Internal bracing shall permit panel lifting without racking or distortion. Panel shall be NEMA 4X 316 stainless steel, R-6 insulated rated. All doors shall be rubber gasketed.
  - b. Removable lifting rings designed to facilitate simple, safe rigging and lifting of the panel during installation shall be provided. Plugs shall be provided to fill the lifting ring holes after installation and shall match the panel color.
  - c. When applicable, free-standing cabinets shall match adjacent free-standing cabinets in height, depth, general access, and color, unless otherwise noted. Panels shall not require any additional external supports or bracing to maintain freestanding integrity.
  - d. All installation details shall be verified by the Contractor/Supplier. Unless otherwise noted, all panels shall be properly sized to fit in the allotted spaces as noted or shown in the Contract Drawings.
  - e. The panels shall be so constructed that no seams or bolt heads are visible when viewed from the front. Panel cutouts for instruments and other devices (e.g., lights and switches) shall be punched, or drilled and smoothly finished with rounded edges.
  - f. Provide steel angle and/or plate stiffeners 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 steel 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 panel during



installation. Where two or more panels are shown mounted immediately adjacent to one another, they shall be securely bolted together with their front faces parallel. All internal components shall be mounted on removable subpanels and not directly to the enclosures. Subpanels shall be painted with a white enamel. Print storage pockets shall be provided on the inside of each panel. Its size shall be sufficient to hold all of the prints required to service the equipment. All control operations and overload reset shall be accessible without opening panel.

- g. Each panel shall be provided with full height, fully gasketed access doors where shown. Doors shall be provided with three-point latches. Handles shall be "D" ring, foldable type. All panel access doors shall be provided with full length, continuous, piano type, steel hinges with steel pins.
- h. Freestanding panels shall be internally lighted by 30-watt min fluorescent lamps, provided with protective shields and a switch box mounted control switch. One light shall be provided for every 3.0 feet of panel width.
- i. Panel shall permit continuous operation of all components with external ambient temperatures of up to 100° F. The supplier shall submit to the Owner a heat dissipation summary with calculations for each panel furnished to support the fact that the panel and internal components have been designed to operate properly in the exposed environment. Heat dissipation shall be maximums and shall be given in BTU/Hr. Internal panel temperatures shall be maintained below 85° F.
- j. Panels shall be provided with external conditioners as required to prevent excessive temperature buildup as manufactured by Mclean Midwest "Slimboy" series with coated coils or equal. All temperature control equipment shall be controlled by a thermostat. Panels that are located outdoors shall not have vents open to the atmosphere. Hardware shall be corrosion resistant for outdoor environments.
- i. Panels shall be manufactured by Henessy Type TD or Equal.

## PART 3 - EXECUTION

### 3.01 GENERAL

- A. Instrumentation and accessory equipment shall be installed in accordance with specification section 13300 and as specified herein.
- B. Unless specifically shown otherwise in the Drawings, direct reading or electrical transmitting instrumentation shall not be mounted on process piping. Instrumentation shall be mounted on instrument racks or stands as detailed on the installation detail drawings. All instrumentation connections shall be provided with shutoff and drain valves. For differential pressure transmitters, three-way valve manifolds shall also be provided. For slurries, chemical or corrosive fluids, diaphragm seals with flushing connections shall be provided.
- C. All piping to and from field instrumentation shall be provided with necessary unions, test tees, couplings, adapters, and shut-off valves.
- D. Field instruments requiring power supplies shall be provided with local electrical shut-offs and fuses as required.
- E. The shield on each process instrumentation cable shall be continuous from source to destination and be grounded as directed by the manufacturer of the instrumentation equipment, but in no case shall more than one ground point be employed for each shield.
- F. Lifting rings shall be removed from all panels and assemblies once in position. Plugs of the same color as the panel shall then be installed in the holes.
- G. System Supplier shall coordinate the installation, placing and location of system components, their connections to the process equipment panels, cabinets and devices, subject to the Engineer's approval.
- H. System Supplier shall ensure that all field wiring for power and signal circuits are in accordance with best industry practice, and provide for all necessary system grounding to insure a satisfactory functioning installation.

END OF SECTION

**DIVISION 14**

**NOT USED**

**DIVISION 15**  
**MECHANICAL**

SECTION 15000  
MECHANICAL-GENERAL  
REQUIREMENTS

PART 1 - GENERAL

1.01 DESCRIPTION

A. Scope of Work:

1. All equipment furnished and installed under this contract shall conform to the general stipulations set forth in this section except as otherwise specified in other sections.
2. Contractor shall coordinate all details of equipment with other related parts of the Work, including verification that all structures, piping, wiring, and equipment components are compatible. Contractor shall be responsible for all structural and other alternations in the Work required to accommodate equipment differing in dimensions or other characteristics from that contemplated in the Contract Drawings or Specifications.

B. Related Work Described Elsewhere:

1. General Requirements: Division 1
2. Concrete: Division 3
3. Metals: Division 5
4. Painting: Division 9
5. Equipment: Division 11
6. Special Construction: Division 13
7. Electrical: Division 16

C. General Design:

1. Contract Drawings and Specifications: The Contract Drawings and Specifications shall be considered as complementary, one to the other,

so that materials and work indicated, called for, or implied by the one and not by the other shall be supplied and installed as though specifically called for by both. The Contract Drawings are to be considered diagrammatic, not necessarily showing in detail or to scale all of the equipment or minor items. In the event of discrepancies between the Contract Drawings and Specifications, or between either of these and any regulations or ordinances governing work of these specifications, the bidder shall notify the Engineer in ample time to permit revisions.

## 1.02 QUALITY ASSURANCE

- A. **Materials and Equipment:** Unless otherwise specified, all materials and equipment furnished for permanent installation in the work shall conform to applicable standards and specifications and shall be new, unused, and undamaged when installed or otherwise incorporated in the work. No such material or equipment shall be used by the Contractor for any purpose other than that intended or specified, unless such use is specifically authorized in writing by the Owner. No material shall be delivered to the work site prior acceptance of drawings and data by the Engineer.
- B. Where applicable, Manufacturers shall be selected from one of the specified "Manufacturers" in the Orange County Utilities "List of Materials and Approved Manufacturers" as presented in an appendix to these technical specifications.
- C. **Equivalent Materials and Equipment:**
  - 1. Whenever a material or article is specified or described by using the name of a proprietary product or the name of a particular manufacturer or vendor, the specific item mentioned shall be understood as establishing the type, function, and quality desired. Other manufacturers' products will be accepted provided sufficient information is submitted to allow the Engineer to determine that the products proposed are equivalent to those named. Such items shall be submitted for review in accordance with Section 01340: Shop Drawings, Working Drawings, and Samples.
  - 2. Requests for review of equivalency will not be accepted from anyone except the Contractor and such requests will not be considered until after the contract has been awarded.
- D. **Governing Standards:** Equipment and appurtenances shall be designed in conformity with ANSI, ASME, ASTM, IEEE, NEMA, OSHA, AGMA, and other generally accepted applicable standards. They shall be of rugged

construction and of sufficient strength to withstand all stresses which may occur during fabrication, testing, transportation, installation, and all conditions or operations. All bearings and moving parts shall be adequately protected against wear by bushings or other acceptable means. Provisions shall be made for adequate lubrication with readily accessible means.

- E. Tolerances: Machinery parts shall conform to the dimensions indicated on the drawings within allowable tolerances. Protruding members such as joints, corners, and gear covers shall be finished in appearance. All exposed welds shall be ground smooth and the corners of structural shapes shall be rounded or chamfered.
- F. Clearances: Ample clearances shall be provided for inspection and adjustment. All equipment shall fit the allotted space and shall leave reasonable access room for servicing and repairs. Greater space and room required by substituted equipment shall be provided by the Contractor and at his expense.
- G. Testing:
  - 1. When the equipment is specified to be factory tested, the results of the tests shall be submitted to the Engineer and approval of the test results shall be obtained before shipment of the equipment.
  - 2. When an item of equipment, including controls and instrumentation, has been completely erected, the Contractor shall notify the Engineer, who will designate a time to make such tests as required, and operate the item to the satisfaction of the Contractor. All testing shall be done in the presence of the Contractor. "Completely erected" shall mean that the installation is erected, all necessary adjustments have been made, all required utility connections have been made, required lubricants and hydraulic fluid have been added and the unit has been cleaned and painted.
- H. Pressure Test:
  - 1. After installation, all piping shall be pressure tested. Piping shall be tested in accordance with Section 15044.
  - 2. All tests shall be made in the presence of and to the satisfaction of the Owner and also, to the satisfaction of any local or state inspector having jurisdiction.
    - a. Provide not less than three days' notice to the Construction Manager and the authority having jurisdiction when it is proposed to make the tests.

- b. Any piping or equipment that has been left unprotected and subject to mechanical or other injury in the opinion of the Construction Manager shall be retested in part or in whole as directed by the Construction Manager.
    - c. The piping systems may be tested in sections as the work progresses by no joint or portion of the system shall be left untested.
  3. All elements within the system that may be damaged by the testing operation shall be removed or otherwise protected during the operation.
  4. All defects and leaks observed during the tests shall be corrected and made tight in an approved manner and the tests repeated until the system is proven tight.
  5. Repair all damage done to existing or adjacent work or materials due to or on account of the tests.
  6. Provide test pumps, gauges, or other instruments and equipment required for the performance of all tests. Provide all temporary bracing, test plugs, additional restraint, and thrust blocking which may be required for test pressures above normal working pressures.
  7. All tests shall be maintained for as long a time as required to detect all defects and leaks but not less than the duration specified for each type of pipe or piping system in this Division.

I. Failure of Test:

1. Defects: Any defects in the equipment, or deviations from the guarantees or requirements of the Specifications, shall be promptly corrected by the Contractor by replacements or otherwise. The decision of the Engineer as to whether or not the Contractor has fulfilled his obligations under the Contract shall be final and conclusive. If the Contractor fails to correct any defects or deviations, or if the replaced equipment when tested shall fail again to meet the guarantees or specified requirements, the Owner, notwithstanding his having made partial payment for work and materials which have entered into the manufacturer for such equipment, may reject that equipment and order the Contractor to remove it from the premises at the Contractor's expense.
2. Rejection of Equipment: In case the Owner rejects a particular item of equipment, then the Contractor hereby agrees to repay to the Owner all



sums of money paid to him to deliver to the Contractor a bill of sale of all his rights, title, and interest in and to the rejected equipment provided, however that the equipment shall not be removed from the premises until the Owner obtains from other sources other equipment to take the place of that rejected. The bill of sale shall not abrogate the Owner's right to recover damages for delays, losses or other conditions arising out of the basic Contract. The Owner hereby agrees to obtain the alternate equipment within a reasonable time and the Contractor agrees that the Owner may use the original equipment furnished by him without rental or other charge until the other equipment is obtained.

J. Responsibility During Tests: The Contractor shall be fully responsible for the proper operation of equipment during tests and instruction periods and shall neither have nor make any claim for damage which may occur to equipment prior to the time when the Owner formally takes over the operation thereof.

K. Acceptance of Materials:

1. Only new materials and equipment shall be incorporated in the work. All materials and equipment furnished by the Contractor shall be subject to the inspection and acceptance of the Owner. No material shall be delivered to the work without prior submittal approval of the Engineer.
2. The Contractor shall submit to the Engineer data relating to materials and equipment he proposes to furnish for the work. Such data shall be in sufficient detail to enable the Engineer to identify the particular product and to form an opinion as to its conformity to the specifications.
3. Facilities and labor for handling and inspection of all materials and equipment shall be furnished by the Contractor. If the Engineer requires, either prior to beginning or during the progress of the work, the Contractor shall submit samples of materials for such special test as may be necessary to demonstrate that they conform to the specification. Such sample shall be furnished, stored, packed, and shipped as directed at the Contractor's expense. Except as otherwise noted, the Owner will make arrangements for and pay for tests.
4. The Contractor shall submit data and samples sufficiently early to permit consideration and acceptance before materials are necessary for incorporation in the work.

L. Safety Requirements:

1. In addition to the components shown and specified, all machinery and equipment shall be safeguarded in accordance with the safety features

required by the current codes and regulations of ANSI, OSHA, and local industrial codes.

2. The Contractor shall provide for each V-belt drive or rotating shaft a protective guard which shall be securely bolted to the floor or apparatus. The guard shall completely enclose drives and pulleys and be constructed to comply with all safety requirements.
3. For double inlet fans, the belt guard shall be arranged so as not to restrict the air flow into the fan inlet. Guards shall not interfere with lubrication of equipment.

#### 1.03 SUBMITTALS (SEE SECTION 01340: SHOP DRAWINGS, WORKING DRAWINGS AND SAMPLES)

#### 1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Packaging: All equipment shall be suitably packaged to facilitate handling and protect against damage during transit and storage. All equipment shall be boxed, crated, or otherwise completely enclosed and protected during shipment, handling, and storage. All equipment shall be protected from exposure to the elements and shall be kept thoroughly dry at all times.
- B. Protection: All machined surfaces and shafting shall be cleaned and protected from corrosion by the proper type and amount of coating necessary to assure protection during shipment and prior to installation. Painted surfaces shall be protected against impact, abrasion, discoloration, and other damage as specified in Sections 09900 and 09905. All painted surfaces which are damaged prior to acceptance of equipment shall be repainted to the satisfaction of Engineer.
- C. Lubrication: Grease and lubricating oil shall be applied to all bearings and similar items as necessary to prevent damage during shipment and storage.
- D. Marking: Each item of equipment shall be tagged or marked as identified in the delivery schedule or on the Shop Drawings. Complete packing lists and bills of material shall be included with each shipment.
- E. Fabricated sub-assemblies, if any, shall be shipped in convenient sections as permitted by carrier regulations and shall be properly match-marked for ease of field erection.
- F. Responsibility:
  1. The Contractor shall be responsible for all material, equipment, and

supplies sold and delivered to the site under this Contract until final inspection of the work and acceptance thereof by the Owner. In the event any such material, equipment, and supplies are lost, stolen, damaged, or destroyed prior to final inspection and acceptance, the Contractor shall replace same without additional cost to the Owner.

2. Should the Contractor fail to take proper action on storage and handling of equipment supplied under this Contract within seven days after written notice to do so has been given, the Owner retains the right to correct all deficiencies noted in previously transmitted written notice and deduct the cost associated with these corrections from the Contractor's Contract. These costs may be comprised of expenditures for labor, equipment usage, administrative, clerical, engineering, and any other costs associated with making the necessary corrections.

G. Delivery: The Contractor shall arrange deliveries of products in accordance with construction schedules and coordinate to avoid conflict with work and condition at the site.

1. The Contractor shall deliver products in undamaged condition, in manufacturer's original containers or packaging, with identifying labels intact and legible.
2. Immediately on delivery, the Contractor shall inspect shipments to assure compliance with requirements of Contract Documents and accepted submittals, and that products are properly protected and undamaged.
3. Under no circumstances shall the Contractor deliver equipment to the site more than one month prior to installation without written authorization from the Construction Manager. Operation and maintenance data shall be submitted to the Engineer for review prior to shipment of equipment as described in Section 01730: Operating and Maintenance Data.

H. Storage and Protection of Products:

1. The Contractor shall furnish a covered, weather-protected storage structure providing a clean, dry noncorrosive environment for all mechanical equipment, valves, architectural items, electrical and instrumentation equipment, and special equipment to be incorporated into this project. Storage of equipment shall be in strict accordance with the "Instructions for Storage" of each equipment supplier and manufacturer including connection of space heaters and placing of storage lubricants in equipment. Corroded, damaged, or deteriorated equipment and parts shall be replaced before

acceptance of the project. Equipment and materials not properly stored will not be included in a payment estimate.

- a. The Contractor shall store products subject to damage by the elements in weathertight enclosures.
  - b. The Contractor shall maintain temperature and humidity within the ranges required by manufacturer's instructions.
  - c. The Contractor shall store fabricated products above the ground, on blocking or skids, to prevent soiling or staining. The Contractor shall cover products which are subject to deterioration with impervious sheet coverings and provide adequate ventilation to avoid condensation.
  - d. The Contractor shall store loose granular materials in a well-drained area on solid surfaces to prevent mixing with foreign matter.
2. All materials and equipment to be incorporated in the work shall be handled and stored by the Contractor before, during, and after shipment in a manner to prevent warping, twisting, bending, breaking, chipping, rusting, and any injury, theft, or damage of any kind whatsoever to the material or equipment.
  3. Cement, sand, lime shall be stored under a roof and off the ground and shall be kept completely dry at all times. All structural and miscellaneous steel and reinforcing steel shall be stored off the ground or otherwise to prevent accumulations of dirt, or grease, and in a position to prevent accumulations of standing water, staining, chipping, or cracking. Brick, block, and similar masonry products shall be handled and stored in a manner to reduce breakage, chipping, cracking and peeling to a minimum.
  4. All materials which, in the opinion of the Construction Manager, have become damaged and are unfit for the use intended or specified, shall be promptly removed from the site of the work, and the Contractor shall receive no compensation for the damaged material or its removal.
  5. The Contractor shall arrange storage in a manner to provide easy access for inspection. The Contractor shall make periodic inspections of stored products to assure products are maintained under specified conditions, and free from damage or deterioration.
  6. Protection After Installation: The Contractor shall provide substantial coverings as necessary to protect installed products from damage from

traffic and subsequent construction operations. The Contractor shall remove covering when no longer needed.

- I. Extended Storage Requirements for Equipment: Because of the long period allowed for construction, special attention shall be given to extended storage and handling of equipment onsite. As a minimum, the procedure specified herein shall be followed:
  1. If equipment will be stored onsite for more than one month prior to incorporation into the Work, the Contractor shall submit a written request to the Construction Manager outlining any special provision to be made to protect and maintain the equipment while it is being stored. All such provisions shall be acceptable to the Construction Manager. No equipment shall be stored onsite for more than one month without prior written authorization from the Construction Manager.
  2. All equipment having moving parts including gears, electric motors, and/or instruments shall be stored in a temperature and humidity controlled building accepted by the Construction Manager, until such time as the equipment is to be installed.
  3. All equipment shall be stored fully lubricated with oil and grease unless otherwise instructed by the manufacturer.
  4. Manufacturer's storage instructions shall be carefully studied by the Contractor and reviewed by him with the Construction Manager. These instructions shall be carefully followed and a written record of this review kept by the Contractor.
  5. Moving parts shall be rotated a minimum of once weekly to ensure proper lubrication and to avoid metal-to-metal "welding". Upon installation of the equipment, the Contractor shall start the equipment, and operate loaded when possible, weekly for an adequate period of time to ensure that the equipment does not deteriorate from lack of use.
  6. Lubricants shall be changed upon completion of installation and as frequently as required thereafter during the period between installation and acceptance. Mechanical equipment to be used in the work, if stored for longer than ninety days, shall have the bearings cleaned, flushed, and lubricated prior to testing and startup, at no extra cost to the Owner.
  7. Prior to acceptance of the equipment, the Contractor shall have the manufacturer inspect the equipment and certify that its condition has not been detrimentally affected by the long storage period. Such certifications by the manufacturer shall be deemed to mean that the equipment is judged by

the manufacturer to be in a condition equal to that of equipment that has been shipped, installed, tested, and accepted in a minimum time period. As such, the manufacturer will guarantee the equipment equally in both instances. If such a certification is not given, the equipment shall be judged to be defective, and it shall be removed and replaced at the Contractor's expense.

8. A maintenance log shall be maintained by the Contractor outlining the schedule of maintenance required for each piece of equipment as well as the date on which the maintenance was actually performed and the initials of the individual performing the work. Submit a copy of the maintenance log monthly with the progress pay application.

#### 1.05 WARRANTY AND GUARANTEES

- A. The manufacturer's written warranty shall be submitted for all pieces of equipment, as specified in Section 01740: Warranties and Bonds. The manufacturer's warranty period shall be concurrent with the Contractor's correction period for one year after the time of completion and acceptance.

### PART 2 - PRODUCTS

#### 2.01 GENERAL

- A. All materials that come into contact with the water being treated or the finished water shall be on either the EPA or NSF lists of products approved for use in contact with potable water. Manufacturers shall submit an affidavit with the shop drawings indicating approval by the EPA or NSF for the materials used in products that come into contact with the water, in accordance with Rule 62-555.320(3) Florida Administrative Code.
- B. All copper and brass piping, fittings, valves and appurtenances shall be lead free.

#### 2.02 MATERIALS AND EQUIPMENT

- A. Fabrication and

Manufacture:

1. Workmanship and Materials:

- a. Contractor shall guarantee all equipment against faulty or inadequate design, improper assembly or erection, defective workmanship or materials, and leakage, breakage or other failure. Materials shall be suitable for service conditions.
- b. All equipment shall be designed, fabricated, and assembled in accordance with recognized and acceptable engineering and shop practice. Individual parts shall be manufactured to standard sizes and gages so that repair parts, furnished at a time, can be installed in the field. Like parts of duplicate units shall be interchangeable. Equipment shall not have been in service at any time prior to delivery, except as required by tests.
- c. Except where otherwise specified, structural and miscellaneous fabricated steel used in equipment shall conform to AISC standards. All structural members shall be designed for shock or vibratory loads. Unless otherwise specified, all steel which will be submerged, all or in part, during normal operation of the equipment shall be at least 1/4 inch thick.

2. Lubrication:

- a. Equipment shall be adequately lubricated by systems which require attention no more frequently than weekly during continuous operation. Lubrication systems shall not require attention during startup or shutdown and shall not waste lubricants.
- b. Lubricants of the type recommended by the equipment manufacturer shall be furnished by the Contractor in sufficient quantity to fill all lubricant reservoirs and to replace all consumption during testing, startup, and operation prior to acceptance of equipment by Owner. Unless otherwise specified or permitted, the use of synthetic lubricants will not be acceptable.
- c. Lubrication facilities shall be convenient and accessible. Oil drains and fill openings shall be easily accessible from the normal operating area or platform. Drains shall allow for convenient collection of waste oil in containers from the normal operating area or platform without removing the unit from its normal installed position.

3. Safety Guards: All belt or chain drives, fan blades, couplings, and other moving or rotating parts shall be covered on all sides by a safety guard. Safety guards shall be fabricated from 16 USS gage or heavier galvanized or aluminum-clad sheet steel or 1/2-inch mesh galvanized expanded metal. Each guard shall be designed for easy installation and removal. All necessary

supports and accessories shall be provided for each guard. Supports and accessories, including bolts, shall be galvanized. All safety guards in outdoor locations shall be designed to prevent the entrance of rain and dripping water.

4. Equipment Foundation Supports:

- a. All foundations, platforms and hangers required for the proper installation of equipment shall be furnished and installed by the Contractor.
- b. Unless otherwise indicated or specified, all equipment shall be installed on reinforced concrete bases at least 6 inches high and shall conform to Section 03300. Cast iron or welded steel baseplates shall be provided for pumps, compressors, and other equipment. Each unit and its drive assembly shall be supported on a single baseplate of neat design. Baseplates shall have pads for anchoring all components and adequate grout holes. Baseplates for pumps shall have a means for collecting leakage and a threaded drain connection. Baseplates shall be anchored to the concrete base with suitable anchor bolts and the space beneath filled with grout as specified in Section 03600: Grout. All open equipment bases shall be filled with nonshrinking grout sloped to drain to the perimeter of the base.
- c. The Contractor shall furnish, install and protect all necessary guides, bearing plates, anchor and attachment bolts, and all other appurtenances required for the installation of equipment. These shall be of ample size and strength for the purpose intended.
- d. Equipment suppliers shall furnish suitable anchor bolts for each item of equipment. Anchor bolts, together with templates or setting drawings, shall be delivered sufficiently early to permit setting the anchor bolts when the structural concrete is placed. Anchor bolts shall comply with Section 05500: Miscellaneous Metals and, unless otherwise specified, shall have a minimum diameter of 3/4 inch. Unless otherwise indicated or specified, anchor bolts for items of equipment mounted on baseplates shall be long enough to permit 1-1/2 inches of grout beneath the baseplate and to provide adequate anchorage into structural concrete.
- e. Structural steel supports and miscellaneous steel required for supporting and/or hanging equipment and piping furnished under this Division shall be provided and installed by Contractor.



- f. All foundations, anchor pads, piers, thrust blocks, inertia blocks and structural steel supports shall be built to template and reinforced as required for loads imposed on them.
  - g. The Contractor shall assume all responsibility for sizes, locations and design of all foundations, anchor pads, pier, thrust blocks, inertia blocks, curbs and structural steel supports.
5. Shop Painting:
- a. All steel and iron surfaces shall be protected by suitable paint or coatings applied in the shop. Surfaces which will be inaccessible after assembly shall be protected for the life of the equipment. Exposed surfaces shall be finished smooth, thoroughly cleaned, and filled as necessary to provide a smooth uniform base for painting. Electric motors, speed reducers, starters, and other self-contained or enclosed components shall be shop primed or finished with a high-grade oil resistant enamel suitable for coating in the field with an alkyd enamel. Coatings shall be suitable for the environment where the equipment is installed.
  - b. Surfaces to be painted after installation shall be prepared for painting as recommended by the paint manufacturer for the intended service, and then shop painted with one or more coats of the specified primer. Unless otherwise specified, the shop primer for steel and iron surfaces shall be Cook "391-N-167 Barrier Coat", Koppers "No. 10 Inhibitive Primer", or equal.
  - c. Machined, polished, and nonferrous surfaces which are not to be painted shall be coated with rust-preventive compound, Houghton "Rust Veto 344", Rust-Oleum "R-9", or equal.
6. Nameplates: Contractor shall provide equipment identification nameplates for each item of equipment. Nameplates shall be 1/8-inch Type 304 stainless steel and shall be permanently fastened. Plates shall be fastened using round head metallic drive screws, or where metallic drive screws are impractical, with stainless steel pop rivets. Metallic drive screws shall be brass or stainless steel, Type V and No. 8 by 3/8-inch long. Names and/or equipment designations shall be engraved on the plates and the engraving painted with a primer and black paint system compatible with stainless steel. Contractor shall submit a list of proposed names and designations for review prior to fabrication of nameplates. At a minimum, each nameplate shall include equipment manufacturers name, year of manufacture, serial number and principal rating data.

7. Pipe Identification:

- a. All pipe (except underground) shall have code letters and flow arrows painted as per specification Section 09905. The contractor shall ensure that the pipes are properly marked.
- b. Underground pipe and tube: Pipe and tube shall be located by laying 2-inch wide plastic tape continuously along the run of pipe or tube. Where possible, color of tape shall be consistent with the color of bands on interior pipe and as approved by the Engineer or shall bear an imprinted identification of the line.
  - i. Location: Tape shall be laid approximately 12 inches below ground surface and directly over pipe location.
  - ii. Manufacturer: Tape shall be as specified in Section 09905.
- c. All pipe shall require insulated locating wire (10 gauge solid copper) capable of detection by cable locator and shall be wrapped with nylon straps to the centerline of the pipe.

8. Valve Identification: On all valves, except shut-off valves located at a fixture or piece of equipment, the Contractor shall provide a coded and numbered tag attached with brass chain and/or brass "S" hooks. Underground valves shall be provided with a brass plate glued onto the valve pad.

- a. Tag Types:
  - i. Tags for valves on pipe and tube lines conducting hot medium (steam, condensate, hot water, etc.) shall be brass or anodized aluminum.
  - ii. Tags for all other valves shall be Type 304 stainless steel.
  - iii. Square tags shall be used to indicate normally closed valves and round tags shall indicate normally open valves.
- b. Coding: In addition to the color coding, each tag shall be stamped or engraved with wording or abbreviations to indicate the line service. All color and letter coding shall be approved by the Engineer.
- c. Valve Schedule: The Contractor shall provide a typewritten list of all tagged valves giving tag shape, letter code and number, the valve size, type, number of turns, and general location within building.

9. Fire Hazard Rating:

- a. All piping, duct work, and equipment insulation, fastener, and jacketing materials shall have a fire hazard rating not to exceed 25 for flame spread, 50 for fuel contributed, and 50 for smoke developed. Rating shall be determined by ASTM Designation E84, "Surface Burning Characteristics of Building Materials". Corresponding ratings determined by Underwriters' Laboratories, Inc., UL-723, "Test Method for Fire Hazard Classification of Building Materials", will also be acceptable.
- b. Flame proofing treatments will not be acceptable.

10. Heating, Ventilation and Domestic Plumbing Equipment:

- a. Interchangeability: In all design and purchasing, interchangeability of items of equipment, subassemblies, parts, motors, starters, relays, and other items is essential. All similar items shall be of the same manufacturer, type, model, and dimensions.

## 2.03 ACCESSORIES

- A. Special Tools and Accessories: Equipment requiring periodic repair and adjustment shall be furnished complete with all special tools, instruments, and accessories required for proper maintenance. Equipment requiring special devices for lifting or handling shall be furnished complete with those devices.

## 2.04 SPARE PARTS

- A. Spare parts for certain equipment provided under Divisions 11, 13, 14, 15, and 16 have been specified in the pertinent sections of the specifications. The Contractor shall collect and store all spare parts in an area to be designated by the Engineer. In addition, the Contractor shall furnish to the Engineer an inventory listing of all spare part, the equipment they are associated with, and the name and address of the supplier.
- B. Maintenance Materials:
  1. All grease, oil, and fuel required for testing of equipment shall be furnished with the respective equipment. The Owner shall be furnished with a year's supply of required lubricants including grease and oil of the type recommended by the manufacturer with each item of equipment supplied.

2. The Contractor shall be responsible for changing the oil in all drives and intermediate drives of each mechanical equipment after initial break-in of the equipment, which in no event shall be any longer than three weeks of operation.

## 2.05 QUALITY CONTROL

- A. Contractor shall follow Manufacturer's and Supplier's recommended product quality control specifics as required for project.

## PART 3 - EXECUTION

### 3.01 PREPARATION (Not Applicable)

### 3.02 INSTALLATION

- A. Installation: Equipment shall not be installed or operated except by, or with the guidance of, qualified personnel having the knowledge and experience necessary for proper results. When so specified, or when employees of Contractor or his subcontractors are not qualified, such personnel shall be field representatives of the manufacturer of the equipment or materials being installed.
  1. The Contractor shall have on site sufficient proper construction equipment and machinery of ample capacity to facilitate the work and to handle all emergencies normally encountered in work of this character. To minimize field erection problems, mechanical units shall be factory assembled when practical.
  2. Equipment shall be erected in a neat and workmanlike manner on the foundations and supports at the locations and elevations shown on the Drawings, unless otherwise directed by the Engineer during installation.
  3. All equipment shall be installed in such a manner as to provide access for routine maintenance including lubrication.
  4. For equipment such as pumping units, which require field alignment and connections, the Contractor shall provide the services of the equipment manufacturer's qualified mechanic, millwright, machinist, or authorized representative, to align the pump and motor prior to making piping connections or anchoring the pump base.
  5. Equipment of a portable nature which require no installation shall be delivered to a location designated by the Owner.

- B. Tolerances: Precision gauges and levels shall be used in setting all equipment. All piping and equipment shall be perfectly aligned, horizontally and vertically. Tolerances for piping and equipment installation shall be 1/2 inch to 30 ft horizontal and vertically. All valves and operators shall be installed in the position shown on the Contract Drawings or as directed by the Engineer, if not shown.
- C. Alignment and Level: The equipment shall be brought to proper level by shims (1/4 inch maximum). After the machine has been leveled and aligned, the nuts on the anchor bolts shall be tightened to bind the machine firmly into place against the wedges or shims. Grouting shall be as specified in Section 03600: Grout.
- D. Grouting: The grout shall be tamped into position with a board, steel bar, or other tool. Tamping should not be so hard as to raise or otherwise displace the plate.
- E. Contact of Dissimilar Metals: Where the contact of dissimilar metal may cause electrolysis and where aluminum will contact concrete, mortar, or plaster, the contact surface of the metals shall be separated using not less than one coat of zinc chromate primer and one heavy coat of aluminum pigmented asphalt paint on each surface.
- F. Cutting and Patching: All cutting and patching necessary for the work shall be performed by the Contractor.
- G. Operation: All equipment installed under this Contract, including that furnished by Owner or others under separate contract, shall be placed into successful operation according to the written instructions of the manufacturer or the instructions of the manufacturer's field representative. All required adjustments, tests, operation checks, and other startup activity shall be provided.

### 3.03 INSPECTION AND TESTING

- A. Where the specifications require observation of performance tests by the Construction Manager, such tests shall comply with the quality assurance paragraph in this section.

### 3.04 START-UP AND INSTRUCTION

- A. Services Furnished Under This Contract:
  - 1. An experienced, competent, and authorized representative of the manufacturer of each item of equipment shall visit the site of the Work

and inspect, check, adjust if necessary, and approve the equipment installation. In each case, the manufacturer's representative shall be present when the equipment is placed in operation. The manufacturer's representative shall revisit the jobsite as often as necessary until all trouble is corrected and the equipment installation and operation are satisfactory in the opinion of Construction Manager.

2. Each manufacturer's representative shall furnish to Owner, Construction Manager, a letter of certification stating that the equipment has been properly installed and lubricated; is in accurate alignment; is free from any undue stress imposed by connecting piping or anchor bolts; and has been operated under full load conditions and that it operated satisfactorily.
3. All costs for field services shall be included in the contract amount.

END OF SECTION

## SECTION 15044

### PRESSURE TESTING OF PIPING

#### PART 1 - GENERAL

##### 1.01 DESCRIPTION

- A. Scope of Work: This section specifies the leakage testing requirements for plant piping.
- B. Related Work Described Elsewhere:
  - 1. Section 15070: Schedule 80 Polyvinyl Chloride (PVC) and Chlorinated Polyvinyl Chloride (CPVC) Pipe, Fittings and Valves.
  - 2. Section 15076: PVC and CPVC Double Wall Containment Piping.
  - 2. Section 15090: Chemical Feed System Piping.
- C. General Design (not applicable)

##### 1.02 QUALITY ASSURANCE

- A. Test Pressures: Test pressures for the various services and types of piping shall be as shown in the drawings and at a minimum shall be 1.5 times the working pressure.

##### 1.03 SUBMITTALS

- A. Materials and Shop Drawings (Not Applicable)
- B. Additional Information:
  - 1. Testing Plan: Submit prior to testing and include at least the information that follows:
    - a. Testing dates.
    - b. Piping systems and section(s) to be tested.
    - c. Test type.
    - d. Method of isolation.

- e. Calculation of maximum allowable leakage for piping section(s) to be tested.
- 2. Certifications of Calibration: Testing equipment.
  - 3. Certified Test Report.
  - 4. Testing Records:
    - a. Provide a record of each piping installation during the testing. These records shall include:
      - i. Date of test.
      - ii. Identification of pipeline tested or retested.
      - iii. Identification of pipeline material.
      - iv. Identification of pipe specification.
      - v. Test fluid.
      - vi. Test pressure.
      - vii. Remarks: Leaks identified (type and location), types of repairs, or corrections made.
      - viii. Certification by Contractor that the leakage rate measured conformed to the specifications.
      - ix. Signature of Owner's representative witnessing pipe test.
    - b. Submit five (5) copies of the test records to the Engineer's representative upon completion of the testing.

## PART 2 - PRODUCTS

### 2.01 GENERAL

- A. Testing fluid shall be clean water for all piping except air service and shall be of such quality to prevent corrosion of materials in piping system for all hydrostatic tests. Air piping shall be tested using compressed air.



## 2.02 MATERIALS AND EQUIPMENT

- A. Provide pressure gauges, necessary bracing and restraint, test plugs, pipes, bulkheads, pumps, and meters to perform the hydrostatic and pneumatic testing.

## PART 3 - EXECUTION

### 3.01 PREPARATION

- A. Pipes shall be in place and anchored before commencing pressure testing.
- B. Conduct hydrostatic and pneumatic tests on exposed and aboveground piping after the piping has been installed and attached to the pipe supports, hangers, anchors, expansion joints, valves, and meters.
- C. Before conducting hydrostatic tests, flush pipes with water to remove dirt and debris. For pneumatic tests, blow air through the pipes.
- D. Test new pipelines which are to be connected to existing pipelines by isolating the new line from the existing line by means of pipe caps, special flanges, or blind flanges. After the new line has been successfully tested, remove caps or flanges and connect to the existing piping.
- E. Conduct hydrostatic tests on buried pipe after the trench has been completely backfilled. The pipe may be partially backfilled and the joints left exposed for inspection for an initial leakage test. Perform the final test, however, after completely backfilling and compacting the trench.
- F. Chlorine Piping: Test, dry, and clean in accordance with requirements of Chlorine Institute Pamphlet 6.
- G. New Piping Connected to Existing Piping: Isolate new piping with grooved-end pipe caps, spectacle blinds, blind flanges, or as acceptable to ENGINEER.
- H. Items that do not require testing include: Piping between wet wells and wet well isolation valves, equipment seal drains, tank overflows to atmospheric vented drains, and tank atmospheric vents.
- I. Gravity Piping:
  - 1. Perform testing after service connections, manholes, and backfilling have been completed between stations to be tested.

2. Determine groundwater level at time of testing by exploratory holes or other method acceptable to ENGINEER.

J. Pressure Test:

1. All tests shall be made in the presence of and to the satisfaction of the Owner or Engineer and also, to the satisfaction of any local or state inspector having jurisdiction.
  - a. Provide not less than three (3) days notice to the Owner, Engineer, and the authority having jurisdiction when it is proposed to make the tests.
  - b. Any piping or equipment that has been left unprotected and subject to mechanical or other injury in the opinion of the Engineer shall be retested in part or in whole as directed by the Engineer.
  - c. The piping systems may be tested in sections as the work progresses, but no joint or portion of the system shall be left untested.
2. All elements within the system that may be damaged by the testing operation shall be removed or otherwise protected during the operation.
3. Repair all damage done to existing or adjacent work or materials due to or on account of the tests.

3.02 INSTALLATION (Not Applicable)

3.03 INSPECTION AND TESTING

- A. Hydrostatic Testing of Aboveground or Exposed Piping: The maximum filling velocity shall be 0.25 feet per second, applied over full area of pipe. Open vents at high points of the piping system to purge air while the pipe is being filled. Subject the piping system to the test pressure indicated. Maintain the test pressure for a minimum of four (4) hours. Examine joints, fittings, valves, and connections for leaks. The piping system shall show no leakage or weeping. Correct leaks and retest until no leakage is obtained.
- B. Hydrostatic Testing of Buried Piping:
  1. Test after backfilling has been completed. Expel air from piping system during filling.

2. Where any section of the piping contains concrete thrust blocks or encasement, do not make the pressure test until at least 10 days after the concrete has been poured. When testing mortar-lined piping, fill the pipe to be tested with water and allow it to soak for at least 48 hours to absorb water before conducting the pressure test.
3. Apply and maintain the test pressure by means of a hydraulic force pump. Maintain the test pressure for a minimum duration of four (4) hours. After the test pressure is reached, use a meter to measure the additional water added to maintain the pressure during the four hours. This amount of water is the loss due to leakage in the piping system. The allowable leakage rate is defined by the formula.

$$L = \frac{SD(P)^{1/2}}{148,000}$$

in which:

- |   |   |  |
|---|---|--|
| L | = | allowable leakage (gallons/hour) during the test period. |
| S | = | length of pipe, in feet                                  |
| D | = | nominal diameter of the pipe (inches)                    |
| P | = | average test pressure during leakage test (psig)         |

3. Repair and retest any pipes showing leakage rates greater than that allowed.

C. Pneumatic Test for Pressure Piping:

1. Do not perform on PVC or CPVC pipe.
2. Fluid: Oil-free, dry air.
3. Procedure:
  - a. Apply preliminary pneumatic test pressure of 25 psig maximum to piping system prior to final leak testing, to locate visible leaks. Apply soap bubble mixture to joints and connections, examine for leakage.
  - b. Correct visible leaks and repeat preliminary test until visible leaks are corrected.
  - c. Gradually increase pressure in system to half of specified test pressure. Thereafter, increase pressure in steps of approximately

one-tenth of specified test pressure until required test pressure is reached.

- d. Maintain pneumatic test pressure continuously for minimum of 10 minutes and for such additional time as necessary to conduct soap bubble examination for leakage.
  - e. Correct visible leakage and retest as specified.
- 4. Allowable Leakage: Piping system, exclusive of possible localized instances at pump or valve packing, shall show no visual evidence of leakage.
  - 5. After testing and final cleaning, purge with nitrogen those lines that will carry flammable gases to assure no explosive mixtures will be present in system during filling process.

D. Hydrostatic Test for Gravity Piping:

- 1. Testing Equipment Accuracy: Plus or minus 1/2 gallon of water leakage under specified conditions.
- 2. Maximum Allowable Leakage: 0.16 gallon per hour per inch diameter per 100 feet. Include service connection footage in test section, subjected to minimum head specified.
- 3. Gravity Sanitary and Roof Drain Piping: Test with 15 feet of water to include highest horizontal vent in filled piping. Where vertical drain and vent systems exceed 15 feet in height, test systems in 15-foot vertical sections as piping is installed.
- 4. Exfiltration Test:
  - a. Hydrostatic Head:
    - i. At least 6 feet above maximum estimated groundwater level in section being tested.
    - ii. No less than 6 feet above inside top of highest section of pipe in test section, including service connections.
- 5. Infiltration Test:
  - a. Groundwater Level: At least 6 feet above inside top of highest section of pipe in test section, including service connections.

6. Piping with groundwater infiltration rate greater than allowable leakage rate for exfiltration will be considered defective even if pipe previously passed a pressure test.
  7. Defective Piping Sections: Replace or test and seal individual joints, and retest as specified.
- E. Test Pressure:
1. All pipe shall be tested at pressures shown in the Drawings and at a minimum shall be 1.5 times the normal working pressure of the pipe.

### 3.04 START-UP AND INSTRUCTION (Not Applicable)

END OF SECTION

SECTION 15062

DUCTILE IRON PIPE AND FITTINGS

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Scope of Work: Furnish all labor, materials, equipment and incidentals required and install, in the locations inside, and under buildings and structures as shown on the Drawings, all ductile iron piping, cast or ductile iron fittings, and appurtenances as specified herein.
  
- B. Related Work Specified Elsewhere:
  - 1. Pressure Testing of Piping: Section 15044.
  - 2. Valves and Appurtenances: Section 15100.
  - 3. Pipe hangers and supports: Section 15126.
  - 4. Couplings and Connectors: Section 15129.
  
- C. General Design: The equipment and materials specified herein is intended to be standard types of ductile iron pipe and cast or ductile iron fittings for use in transporting sewage, sludges, and water. All materials that contact drinking water or drinking water chemicals shall comply with AWWA Standards and NSF Standard 61.

1.02 QUALITY ASSURANCE

- A. Qualifications: All of the ductile iron pipe and cast or ductile iron fittings shall be furnished by manufacturers who are fully experienced, reputable, and qualified in the manufacture of the materials to be furnished. The pipe and fittings shall be designed, constructed, installed in accordance with the best practices and methods and shall comply with these specifications as applicable.
  
- B. Standards

1.	Ductile Iron Pipe Thickness: ANSI A 21.50/AWWA C150	5.	Ductile Iron Compact Fittings for Water Service: ANSI A-21.53/AWWA C153
2.	Ductile Iron Pipe Centrifugally Cast: ANSI A-21.51/AWWA C151	6.	Polyethylene Encasement for Ductile Iron Pipe: ANSI A-21.5/AWWA C105
3.	Cement Mortar Lining for Water: ANSI A-21.4/AWWA C104	7.	Installation of Ductile Iron Water Mains: AWWA C600
4.	Cast and Ductile Iron Fittings: ANSI A-21.10/AWWA C110	8.	Disinfection of Water Mains: AWWA C651

- C. Factory Tests: The manufacturer shall perform the factory tests described in ANSI A-21.51/AWWA C151.
- D. Quality Control
  - 1. The manufacturer shall establish the necessary quality control and inspection practice to ensure compliance with the referenced standards.
  - 2. In addition to the manufacturer's quality control procedures, the Owner may select an independent testing laboratory to inspect the material at the foundry for compliance with these specifications. The cost of foundry inspection requested by the Owner will be paid for by the Owner.
- E. Manufacturers: Manufacturers shall be selected from one of the specified "Manufacturers" in the Orange County Utilities "List of Materials and Approved Manufacturers" as presented in an appendix of these technical specifications.

### 1.03 SUBMITTALS

- A. Materials and Shop Drawings
  - 1. Submit shop drawings, including pipeline layouts, within and under buildings and structures. Shop drawings shall include dimensioning, methods and locations of supports and all other pertinent technical specifications. Shop drawings shall be prepared by the pipe manufacturer. Shop drawings for piping within and under buildings and structures shall be submitted within 30 days of Execution of Contract.
  - 2. For all pipes in contact with potable or raw water, submit certification that pipe and fittings meet the requirements of NSF 61.
- B. Operating Instructions: Submit Operation and Maintenance Manuals in accordance with Section 01730. Pipe dimensions and liner thickness shall be provided in the Operation and Maintenance Manuals.
- C. Manufacturer's Certification: Submit certification of compliance with the following, sworn by a corporate officer of the manufacturer and witnessed by a notary:
  - 1. Factory tests and results
  - 2. Dimensions and weights of fittings per respective AWWA Standard.

## 1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Delivery and Storage: Delivery and storage of the materials shall be in accordance with the manufacturer's recommendations.
- B. Handling: Care shall be taken in loading, transporting and unloading to prevent damage to the pipe or fittings and their respective coatings. Pipe or fittings shall not be rolled off the carrier or dropped. Unloading shall be done by lifting with a forklift or crane. All pipe or fittings shall be examined before laying, and no piece shall be installed which is found to be defective.

## PART 2 - PRODUCTS

### 2.01 MATERIALS

#### A. Ductile Iron Pipe

1. Standards: ANSI A-21.50, AWWA C150 and ANSI A-21.51, AWWA C151

2. Thickness

a. Below ground piping: Pipes shall be the following minimum thickness class unless otherwise noted or specified.

- |                                |           |
|--------------------------------|-----------|
| 1) 4 through 12-inch diameter  | Class 350 |
| 2) 14 through 24-inch diameter | Class 250 |
| 3) 30 through 64-inch diameter | Class 200 |

b. Above Ground Piping

- 1) Flanged, Class 53 (Minimum)

3. Joints

a. Push-on or Mechanical Joints (below ground piping):

- 1) Standards: ANSI A21.11/AWWA C111
- 2) Class: The working pressure of the joint shall be equal to or exceed the rated working pressure of the pipe.
- 3) Gaskets: SBR (Styrene Butadiene Rubber)

b. Flanged (above ground or inside below ground vaults):

- 1) Standards: ANSI A21.15, ANSI B16.1



- 2) Class: 125 lb factory applied screwed long hub flanges, plain faced without projection.
- 3) Gaskets
  - (a) Spans less than 10 feet: full face 1/8-inch thick neoprene rubber
  - (b) Spans greater than 10 feet: Toroseal gaskets as manufactured by American Cast Iron Pipe or equal.
- c. Restrained Joints
  - 1) Restrained joints shall be selected from one of the specified "Manufacturers" and types specified in the Orange County Utilities "List of Materials and Approved Manufacturers" as presented in an appendix of these technical specifications, or approved equal.
  - 2) Class: 250 psi (minimum) design pressure rating
  - 3) Standard mechanical joint retainer glands will not be acceptable.
- d. Joint Accessories
  - 1) Mechanical joint bolts, washers and nuts: Ductile iron or Corten steel.
  - 2) Flanged joint bolts, washers and nuts:
    - (a) Above Ground: Hot dipped galvanized, Grade B, ASTM A-307
    - (b) Below Ground: 304 stainless steel
- e. Pipe Length (below ground installation): 20 feet maximum nominal length.

## B. Fittings

1. Materials: Ductile iron or grey cast iron, AWWA C 110
2. Pressure Class
  - a. Mechanical Joint, Restrained Joint
    - 1) 4-inch through 48-inch minimum 250 psi pressure rating
    - 2) 54-inch through 64-inch minimum 150 psi pressure rating
  - b. Flanged Joint: Class 125, plain

3. Compact Fittings:
  - a. Mechanical Joint, restrained joint 4-inch through 64-inch: ANSI/AWWA A21.53/C153
  - b. Flanged Joint 4-inch through 48-inch: ANSI/AWWA C110/A21.10
  - c. Flanged Joints 54-inch through 64-inch: ANSI/AWWA A21.53/C153
4. Manufacturers: Manufacturers shall be selected from one of the specified "Manufacturers" in the Orange County Utilities "List of Materials and Approved Manufacturers" as presented in an appendix of these technical specifications, or approved equal.

#### C. Wall Penetrations

1. Wall Pipes
  - a. Material: Ductile iron or cast iron
  - b. Type: Welded-on wall collar/water stop located in the center of the wall.
  - c. Design: Full thrust at 250 psi transmitted to the structure wall. Tapped mechanical joint wall pipes may be used to facilitate concrete form work.
2. Wall Sleeves
  - a. Material: Galvanized Schedule 40 Steel Pipe, ASTM A120
  - b. Design: as manufactured by Thunderline Corporation, "Link Seal" or equal.

## 2.02 COATINGS, MARKINGS AND LININGS

### A. Exterior Coatings

1. Below ground or in a casing pipe
  - a. Type: Asphaltic coating, 1.0 mil DFT
  - b. Markings: (continuous 2-inch wide stripe within top 90 degrees of pipe - min. drying time 30 minutes before backfill). All ductile iron pipe shall be marked with a continuous stripe located within the top 90 degrees of the pipe. Said stripe shall be a minimum 2 inches in width and shall be oil based paint, blue in color for potable water, green for wastewater and purple for reuse. Backfill shall not be placed for 30 minutes following paint application. At the

Contractor's option, the pipe may be stripe marked prior to pipe installation as follows:

Up to 8-inch diameter:	(2) 2-inch wide @ 180°
10 to 16-inch diameter:	(3) 2-inch wide @ 120°
18 to 24-inch diameter:	(4) 2-inch wide @ 90°
30 to 54-inch diameter:	(6) 2-inch wide @ 60°

Alternately, all ductile iron pipe may be marked along the crown of the pipe with an adhesive Underground Utility marking tape. Said tape shall be a minimum 6 inches width with a minimum 4.0 mil overall thickness inert plastic film formulated for extended use underground. Tape shall be specified and supplied in accordance with the A.P.W.A. national color code and shall be imprinted with the appropriate legend to define the type of utility line it protects.

c. Color: Potable Water:	blue
Wastewater:	green

2. Above Ground

- a. Not subject to non-potable water submergence or splashing: See Division 9.
- b. Subject to non-potable water submergence or splashing: See Division 9.
- c. Color: See Division 9.

B. Interior Lining (Applied by pipe manufacturer)

- 1. Potable Water: Cement-mortar lining for ductile iron pipe and ductile and gray iron fittings for water service is in accordance with ANSI/AWWA C104/A21.4, and is listed by ANSI/NSF Standard 61 for potable water contact.

C. Polyethylene Encasement (required for all below ground piping, fittings and appurtenances located less than 10 feet from a gas main and as indicated on the Drawings):

- 1. Standard: ANSI A 21.5/AWWA C105, 8 mil minimum thickness.
- 2. Color: Color coded per paragraph A.1. above.

## PART 3 - EXECUTION

### 3.01 INSTALLATION

#### A. Standards: AWWA C600-05

#### B. Underground Ductile Iron Pipe and Fittings

1. Bedding for Ductile Iron Pipe: Minimum bedding requirements shall be Type 4 as defined in ANSI/AWWA C600, latest revision. Provide proper bedding required, in accordance with thickness class of pipe being laid and depth of cover. Property pipe laying conditions shall be in accordance with ANSI/AWWA C150 and C151, latest revisions, and ANSI/AWWA C600, latest revision.
2. Placement
  - a. Alignment: In accordance with lines and grades shown on the Drawings. Deflection of joints shall not exceed 75 percent of that recommended by the manufacturer.
  - b. Polyethylene encasement: Provide polyethylene wrap around piping, fittings and appurtenances located less than 10 feet from a gas main and as indicated on the Drawings.
3. Cutting: When required, cutting shall be done by machine, leaving a smooth cut at right angles to the axis of the pipe. Cut ends of the pipe to be used with a push-on bell shall be beveled. All cut ends shall be coated with manufacturer's coating system.
4. Joints
  - a. Joint Placement
    - 1) Push on joints: Pipe shall be laid with the bell ends facing upstream. The gasket shall be inserted and the joint surfaces cleaned and lubricated prior to placement of the pipe. After joining the pipe, a metal feeler shall be used to verify that the gasket is correctly located.
    - 2) Mechanical Joints: Pipe and fittings shall be installed in accordance with the "Notes on Method of Installation" under ANSI A21.11/AWWA C111. The gasket shall be inserted and the joint surfaces cleaned and lubricated with soapy water before tightening the bolts to the specified torque.
    - 3) All piping joints shall be mechanically restrained. Bells shall be painted red.

C. Above ground and interior ductile iron pipe and fittings

1. Pipe Supports

- a. General: All piping shall be properly supported with hangers, supports, base elbows and tees, concrete piers and pads as shown on the Drawings and specified in Section 15126: Hangers and Supports and herein. All pipe and appurtenances connected to equipment shall be supported to prevent any strain from being imposed on the equipment.
- b. Support spacing: 8 feet on centers and at each fitting and where shown on the Drawings.
- c. Hangers for Horizontal Piping
  - 1) Material: Heavy malleable iron
  - 2) Type: Adjustable, swivel, split ring or adjustable swivel, pipe-roll
- d. Hangers for vertical piping
  - 1) Material: Wrought Iron
  - 2) Type: Clamp

2. Placement

- a. Alignment: In accordance with lines and grades shown on the Drawings. Each section of pipe shall be cleaned thoroughly prior to installation.

3. Flanged Joints: Joints shall be fitted so that the contact faces bear uniformly on the gasket.

D. Thrust Restraint

- 1. General: Thrust restraint shall be accomplished by restrained joints.
- 2. Length of Restrained Joints: Restrained joints shall be provided for all buried piping systems as indicated on the Drawings to restrain system thrust. It is intended that all buried joints be restrained.

- E. At times when pipe laying is not in progress, the open ends of the pipe shall be closed by a watertight plug or by other means approved by Utilities to ensure absolute cleanliness inside the pipe.

### 3.02 CLEANING

- A. General: At the conclusion of the work, the Contractor shall thoroughly clean the new pipe lines by flushing with water or other means to remove all dirt, stones or other material which may have entered the line during the construction period.
- B. Correction of Non-Conforming Work: All non-conforming work shall be repaired or replaced by the Contractor at no additional expense to the Owner. Non-conforming work shall be defined as failure to adhere to any specific or implied directive of this Project Manual and/or the drawings, including but not limited to pipe not laid straight, true to the lines and grades as shown on the drawings, damaged or unacceptable materials, misalignment or diameter ring deflection in pipe due to bedding or backfilling, visible or detectable leakage and failure to pass any specified test or inspection.

### 3.03 INSPECTION AND TESTING

- A. All pipe shall be inspected and tested at the Foundry.
- B. The Owner shall have the right to have any or all piping, fittings or special castings inspected and tested by an independent testing agency at the foundry or elsewhere. Such inspections and testing will be at the Owner's expense.
- C. Mark as rejected and immediately remove from the job site, all pipe lengths showing a crack, damaged lining or receiving a severe blow that may cause an incipient fracture, even though no such fracture can be seen.
- D. Removal of Cracked Portions
  - 1. Any pipe showing a distinct crack, but no incipient fracture beyond the limits of the visible crack, may be cut off and the sound portion installed. Cut the pipe at least 12-inches from the visible limits of the crack. Cutting of pipe shall be done by skilled workmen, and in such a manner as to not damage the pipe. Every cut shall be square and smooth, with no damage to the pipe lining. Cut surfaces shall be recoated as specified for the pipe.
  - 2. Cutting and installing cracked pipe shall only be performed when approved by the Engineer, and shall be at the expense of the Contractor.
- E. Carefully inspect and hammer test all pipe and fittings prior to installation.

F. Hydrostatic Testing: Test in accordance with Section 15044: Pressure Testing of Pipe. Test pressures are shown in the Piping Pressure Test Schedule, Table 15044-A of Section 15044.

3.04 DISINFECTION (See Section 15041 – Disinfection of Piping and Structures)

END OF SECTION

## SECTION 15070

### SCHEDULE 80 POLYVINYL CHLORIDE (PVC) AND CHLORINATED POLYVINYL CHLORIDE (CPVC) PIPE, FITTINGS, AND VALVES

#### PART 1 - GENERAL

##### 1.01 DESCRIPTION

###### A. Scope of Work:

1. Furnish all labor, materials, equipment and incidentals required, and install and test in the locations as shown on the Drawings, the Schedule 80 polyvinyl chloride (PVC) and chlorinated polyvinyl chloride (CPVC) piping, fittings and appurtenances specified herein. Schedule 80 PVC and CPVC piping shall be used on all small diameter PVC and CPVC piping systems (3 inches and smaller in diameter) which includes, but are not limited to, non-potable water, potable water and chemical feeds and in all other locations as shown on the Drawings.

###### B. Related Work Described Elsewhere:

1. Painting: Section 09900.
2. Piping, Valve and Equipment Identification System: Section 09905.
3. Chemical Feed Systems: Section 11241.
4. Mechanical – General Requirements: Section 15000.
5. Pressure Testing of Piping: Section 15044.
6. PVC and CPVC Double Wall Containment Piping: Section 15076.
7. Chemical Feed System Piping: Section 15090.
8. Pipe Hangers and Supports: Section 15126.
9. Couplings and Connectors: Section 15129.

###### C. General Design:



1. Schedule 80 PVC and CPVC piping shall be installed in the locations as shown on the Drawings. All plastic pipe and fittings shall conform to this specification section whether provided as a part of an equipment "package" or purchased separately by the Contractor.
2. All small diameter pipe, 3-inch diameter and smaller, shall be made of polyvinyl chloride unless noted otherwise on the Drawings or in other sections of the specifications.

## 1.02 QUALITY ASSURANCE

- A. All plastic pipe, fittings and appurtenances shall be furnished by a single manufacturer who is fully experienced, reputable, and qualified in the manufacture of the items to be furnished. The equipment shall be designed, constructed, and installed in accordance with the best practices and methods and shall comply with these Specifications. The equipment shall be manufactured by Spears, IPEX, or Charlotte Pipe and Foundry.
- B. All plastic valves of similar type shall be furnished by a single manufacturer who is fully experienced, reputable, and qualified in the manufacture of the items to be furnished. The valve equipment shall be designed, constructed, and installed in accordance with the best practices and methods and shall comply with these specifications. The equipment shall be manufactured by Asahi/America, Plast-O-Matic, or Hayward.

## 1.03 SUBMITTALS

- A. Materials and Shop Drawings:
  1. Shop drawings shall be submitted to the Engineer for approval in accordance with the General Conditions and Section 01340. All products within this specification shall be combined into a single submittal which shall include at least the following:
    - a. Dimensioning and the technical specification for all piping, fittings, and appurtenances to be furnished.
    - b. Letter of Certification from the National Sanitation Foundation International (NSF) stating compliance with Standard 14 and Standard 61.
    - c. Letter from the Manufacturer verifying chemical compatibility of all products to be used in chemical feed systems.

- d. For valves, show valve dimensions, including laying lengths. Show part sizes, show dimensions and orientation of valve activators installed on the valves.
- e. For valves, submit Manufacturer's catalog data and detail construction sheets showing all valve parts. Describe each part by material of construction, specification (such as ANSI, ASTM, SAE, or CDA), and grade or type. Identify each valve by tag number and service to which the catalog data and detail sheets pertain.

B. Additional Information:

- 1. Submit to the Engineer, for approval, samples of all materials specified herein, along with the manufacturer's Certificates of Inspection, descriptive literature, illustrations, specifications, installation instructions and related information.

#### 1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Piping, fittings, valves and appurtenances shall be handled, shipped, and stored in accordance with Section 01600: Material and Equipment.
- B. PVC and CPVC pipe shall be delivered to the site in unbroken bundles packaged in such manner as to provide protection against damage. When possible, pipe should be stored at the job site in the unit packages until ready for use. Packaged units shall be handled using a forklift or a spreader bar with fabric straps. Packaged units shall not be stacked at the job site higher than two units high.
- C. When it is necessary to store PVC and CPVC pipe for more than 30 days, exposure to direct sunlight shall be prevented by covering the pipe with an opaque material. Adequate air circulation above and around the pipe shall be provided as required to prevent excessive heat accumulation. PVC and CPVC pipe shall not be stored close to heat sources or hot objects such as heaters, fires, boilers or engine exhaust. Pipe gaskets shall be protected from excessive exposure to heat, direct sunlight, ozone, oil and grease. The interior and all sealing surfaces of pipe, fittings and other appurtenances shall be kept clean and free of dirt and foreign matter.
- D. Care shall be taken in handling and laying pipe and fittings to avoid severe impact blows, crushing, abrasion damage, gouging or cutting. Pipe shall be lowered, not dropped, from trucks or into trenches. All cracked, damaged or defective pipe and fittings, or any length of pipe having a gouge, scratch or other permanent indentation of more than 10 percent of the wall thickness in depth, shall be

rejected and removed at once from the work and replaced with new acceptable pipe at no additional cost to the Owner.

## 1.05 WARRANTY AND GUARANTEES

- A. Provide equipment warranty in accordance with Section 01740 - Warranties and Bonds.

## PART 2 - PRODUCTS

### 2.01 GENERAL

- A. All materials that come into contact with the water being treated or the finished water shall be on either the EPA or NSF lists of products approved for use in contact with potable water. Manufacturers shall submit an affidavit with the shop drawings indicating approval by the EPA or NSF for the materials used in products that come into contact with the water, in accordance with Rule 62-555.320(3) Florida Administrative Code.
- B. Valve shall include operator, actuator, operating nut, and accessories for a complete operation.
- C. All valves and appurtenances shall have the name of the manufacturer and the working pressure for which they are designed cast in raised letters upon some appropriate part of the body.

### 2.02 MATERIALS AND EQUIPMENT

- A. Pipe:
  - 1. PVC Pipe:
    - a. Pipe shall be made of polyvinyl chloride, Schedule 80 PVC pipe, conforming to ASTM D1784 and ASTM D1785. Schedule 80 PVC pipe shall have solvent welded or threaded joints. Chemical feed lines shall have solvent welded joints.
  - 2. CPVC Pipe:
    - a. Pipe shall be made of chlorinated polyvinyl chloride, Schedule 80 CPVC pipe, conforming to ASTM D1784 and ASTM F441, Type IV, Grade 1 (Class 23477-B). Schedule 80 CPVC pipe shall have

solvent welded or threaded joints. Chemical feed lines shall have solvent welded joints.

B. Fittings:

1. PVC Fittings:

- a. Fittings for Schedule 80 PVC pipe 4 inches and smaller in diameter shall be socket type, solvent welded in conformance with ASTM D 2467 or threaded type in conformance with ASTM D 2464. Solvent welded and threaded joints shall be watertight. Liquid chlorine feed lines shall have solvent welded fittings.
- b. Fittings for Schedule 80 PVC pipe greater than 4 inches in diameter shall be socket type, solvent welded in conformance with ASTM D 2467. Fittings shall be a 1-piece injection molded design. Use of low pressure fabricated PVC fittings will not be permitted.

2. CPVC Fittings

- b. Fittings for Schedule 80 CPVC pipe 4 inches and smaller in diameter shall be socket type, solvent welded in conformance with ASTM D 2467 (Cell Classification 23447-A) or threaded type in conformance with ASTM D 2464 (Cell Classification 23447-A). Solvent welded and threaded joints shall be watertight. Liquid chlorine feed lines shall have solvent welded fittings.
- c. Fittings for Schedule 80 CPVC pipe greater than 4 inches in diameter shall be socket type, solvent welded in conformance with ASTM D 2467 (Cell Classification 23447-A). Fittings shall be a 1-piece injection molded design. Use of low pressure fabricated CPVC fittings will not be permitted.

C. Solvent Cement:

1. PVC and CPVC solvent cement in services other than Sodium Hypochlorite shall be in compliance with ASTM D 2564 and F656. Solvent Cement in Sodium Hypochlorite service shall be free of Silica. Products for Solvent Cement in Sodium Hypochlorite service shall be IPS "Weld-On" or Oatey "Lo V.O.C. PVC Heavy Duty Gray."
2. Solvent cement shall be specified by compatibility based on pipe service and size.

3. Manufacturer to provide certification with submittal.

D. Flanges:

1. Slip-on flanges shall be provided to connect to flanged valves, fittings, or equipment. Flanges shall match the connecting flanges on the adjacent fitting, valve or piece of equipment and must meet the test pressure of the piping system as specified in Section 15044.
2. Flange hardware (bolts, nuts, and washers) for PVC and CPVC flanges shall be Type 316 stainless steel in accordance with ASTM F593 and F594, respectively. Flange hardware for PVC and CPVC flanges on Hydrofluosilicic Acid and Sodium Hypochlorite piping shall be Hastelloy C.
3. Flange gaskets shall be EPDM for water service. For chemical feed piping systems, the gasket material shall be selected by the gasket manufacturer based on the chemical concentrations as specified in Section 15090: Chemical Feed System Piping.

E. Ball Valve

1. PVC Ball Valve

- a. Valve: Ball valves shall be manufactured of Grade 1, Type I, PVC with Teflon seats. Seals shall be EPDM except for hydrofluosilicic acid service, which shall be Viton. Valve shall be provided with double unions and ball blocking feature.
- b. Operator: Handle.
- c. Pressure: 150 psi @ 73°F.
- d. Service: Water, Sodium Hydroxide.
- e. Plast-O-Matic True Blue, Asahi/America Type 21 Ball Valve, or approved equal.

2. PVC Ball Valve with Vent Hole

- a. Valve: Ball valve shall be manufactured of Grade 1, Type I, PVC and shall be of true union design with two-way blocking capability. All O-rings shall be Viton and Teflon seats. Teflon seats shall have elastomeric backing cushion of the same material as the valve seals. Stem shall have double o-rings and be of blowout proof

design. The addition of a 1/8 inch vent hole drilled and deburred by the manufacturer is required. The valve shall be installed with the vent hole on the upstream side of the system to keep the cavity of the ball fluidized. The valve handle shall double as carrier removal and/or tightening tool.

- b. Operator: Handle.
- c. Pressure: 150 psi @ 73°F.
- d. Service: Sodium Hypochlorite.
- d. Plast-O-Matic True Blue, Asahi/America Type 21, or approved equal.

3. CPVC Ball Valve

- a. Valve: Ball valves shall be manufactured of Grade 1, Type IV, CPVC with Teflon seats. Seals shall be EPDM except for hydrofluosilicic acid service, which shall be Viton. Valve shall be provided with double unions and ball blocking feature.
- b. Operator: Handle.
- c. Pressure: 150 psi @ 73°F.
- d. Service: Hydrofluosilicic acid.
- e. Plast-O-Matic True Blue, Asahi/America Type 21 Ball Valve, or approved equal.

F. Check Valves

1. PVC Diaphragm Check Valve

- a. Valve: Diaphragm check valve shall be manufactured of Type I, Grade 1 PVC with a Viton diaphragm and shall be provided. The check valve shall utilize a normally closed design which is entirely automatic in action. The check valve must operate effectively in any position it is installed in.
- b. Pressure: 150 psi @ 73°F.
- c. Service: Water and sodium hypochlorite.

- d. Plast-O-Matic Series CKM or approved equal.
2. PVC Ball Check Valve
- a. Valve: Ball check valve shall be manufactured of Type I, Grade 1 PVC with Viton seals except for sodium hydroxide service, which shall be an EPDM diaphragm and designed for horizontal or vertical installation with equal effectiveness. Valves shall be provided with double true unions.
  - b. Pressure: 150 psi @ 73°F.
  - c. Service: Water, sodium hypochlorite, and sodium hydroxide.
  - d. Asahi/America, Hayward True Check, or approved equal.
3. CPVC Diaphragm Check Valve
- a. Valve: Diaphragm check valve shall be manufactured of Type I, Grade IV CPVC with a Viton diaphragm. The check valve shall utilize a normally closed design which is entirely automatic in action. The check valve must operate effectively in any position it is installed in.
  - b. Pressure: 150 psi @ 73°F.
  - c. Service: Hydrofluosilicic acid.
  - d. Plast-O-Matic Series CKM, or approved equal.
4. CPVC Ball Check Valve
- a. Valve: Ball check valve shall be manufactured of Type I, Grade IV CPVC with Viton seals, and designed for horizontal or vertical installation with equal effectiveness. Valves shall be provided with double true unions.
  - b. Pressure: 150 psi @ 73°F.
  - c. Service: Hydrofluosilicic acid.
  - d. Asahi/America, Hayward True Check, or approved equal.

## G. Diaphragm Valves

### 1. PVC Diaphragm Valves:

- a. Valve: Diaphragm valves shall be of solid thermoplastic construction with molded flanged ends, constructed of PVC conforming to ASTM D1784 Cell Classification 12454-A. Diaphragm shall be Viton. Valve shall provide bubble-tight closure at operating pressure. Valves shall come standard with a position indicator, travel stop, and bonnet o-ring sealing arrangement.
- b. Operator: Handwheel with capped indicator stem or 2-inch square nut for motorized actuator where called out in the Drawings.
- c. Pressure: 100 psi @ 74°F.
- d. Service: Sodium Hypochlorite
- e. Asahi/America Type 14, or approved equal.

## H. Butterfly Valves

### 1. PVC Butterfly Valves

- a. Valve: Butterfly valves shall be PVC conforming to ASTM D1487 cell classification 12454-A. The valve disc shall be manufactured of PVC of an equal grade to the body material. The valve stem shall be Type 316 and shall engage the disc over the full length of the disc. Valve stem shall be non-wetted. Seats and seals shall be Viton or EPDM and suitable for the intended service. The shaft bearings shall be upper and lower bearings of reinforced Teflon. Valve connections shall be wafer style for insertion between two ANSI B16.5 Class 150 flanges.
- b. Pressure: 150 psi at 70°F and 90 psi at a temperature of 140°F.
- c. Operator: 6" and below – Lever, 8" and above – Handwheel, over 6' above floor level – Chainwheel.
- d. Asahi/America Type 56, or approved equal.

## 2.03 ACCESSORIES (Not Applicable)



## 2.04 SPARE PARTS

- A. All special tools, solvents, lubricants, and cements required for normal installation shall be furnished with the pipe.

## 2.05 QUALITY CONTROL

- A. Contractor shall follow Manufacturer's and Supplier's recommended product quality control specifics as required for project.

## PART 3 - EXECUTION

### 3.01 PREPARATION (Not Applicable)

### 3.02 INSTALLATION

- A. Install PVC and CPVC pipe and valves where shown on the Drawings and in strict accordance with the manufacturer's technical data and printed instructions.
- B. Joints for Schedule 80 PVC and CPVC pipe and fittings shall be solvent welded, flanged, or threaded. All joints shall be made watertight. All pipe cutting, threading and jointing procedures for solvent welded and threaded PVC and CPVC pipe joints shall be in strict accordance with the pipe and fittings manufacturer's printed installation instructions. Thread lubricant for threaded joints shall be Teflon tape only. In making solvent welded connections, clean dirt and moisture from pipe and fittings, bevel pipe ends slightly with emery cloth, if necessary and apply solvent cement of proper grade.
- C. Installation of valves and fittings shall be strictly in accordance with the manufacturer's instructions. Particular care shall be taken not to over-stress threaded connections at sleeves. In making solvent weld connections the solvent shall not be spilled on valves or allowed to run from joints.
- D. All piping shall have sufficient number of unions to allow convenient removal and shall be as approved by the Engineer.
- E. Concrete inserts for hangers and supports shall be furnished and installed in the concrete as it is placed. The inserts shall be set in accordance with the requirements of the piping layout and the Contractor shall verify their locations from approved piping layout Drawings and the structural Drawings.

F. Field Painting:

1. Pipe normally exposed to view shall be painted and marked as specified in Section 09905: Piping, Valve and Equipment Identification System.

G. Jointing:

1. Clean each pipe length, coupling and fitting of all debris and dirt before installation.
2. Do not use pipe length if there are any cuts, abrasions, or defects on the surface of the pipe.
3. Provide and use coupling pullers for joining the pipe when required.
4. Shove home each length of pipe against the pipe previously laid and hold securely in position.
5. Do not pull or cramp joints.

H. Fabrication:

1. Cutting:

- a. Use a hand saw or pipe cutter with blades (not rollers).
- b. Examine all cut ends for possible cracks caused by cutting.

2. Connecting:

- a. Solvent weld connections are recommended by the manufacturer.
- b. Connect pipe and fittings only when temperature is above the minimum recommended by the manufacturer.
- c. Threaded adapters shall be connected only with plastic male into metal female.

### 3.03 INSPECTION AND TESTING

- A. All PVC and CPVC piping shall be hydrostatically pressure tested and flushed in accordance with the requirements in Section 15044: Pressure Testing of Piping.

3.04 DISINFECTION (See Section 15041 – Disinfection of Piping and Structures)

3.05 START-UP AND INSTRUCTION (Not Applicable)

END OF SECTION

## SECTION 15076

### PVC AND CPVC DOUBLE WALL CONTAINMENT PIPING

#### PART 1- GENERAL

##### 1.01 DESCRIPTION

###### A. Scope of Work:

1. Furnish all labor, materials, equipment and incidentals required, and install and test the double wall containment piping, fittings and appurtenances specified herein.
2. Double wall containment piping systems are required for the sodium hypochlorite feed lines. The double wall containment piping shall be used when the piping is in contact with the ground or any other location indicated on the Drawings.

###### B. Related Work Described Elsewhere:

1. Painting: Section 09900.
2. Piping, Valve, and Equipment Identification System: Section 09905.
3. Pressure Testing of Piping: Section 15044.
4. Polyvinyl Chloride (PVC) and Chlorinated Polyvinyl Chloride (CPVC) Pipe, Fittings, and Valves: Section 15070.
5. Valves and Appurtenances: Section 15100.
6. Pipe Hanger and Supports: Section 15126.

###### C. General Design

1. Double wall containment piping shall be installed in the locations as shown on the Drawings. All plastic pipe and fittings shall conform to this specification section whether provided as a part of an equipment "package" or purchased separately by the Contractor.
2. All double wall containment pipe shall be made of polyvinyl chloride or chlorinated polyvinyl chloride, matching the service shown on the Drawings for each chemical.

## 1.02 QUALITY ASSURANCE

- A. All double wall containment piping, fittings and appurtenances shall be furnished by a single manufacturer who is fully experienced, reputable, and qualified in the manufacture of the items to be furnished. The equipment shall be designed, constructed, and installed in accordance with the best practices and methods and shall comply with these Specifications.
- B. Solvent welder shall be qualified in accordance with Chapter VII of the ASME B31.3-93 Code, Part 9, Paragraph A328.
- C. Double wall containment pipe shall be as manufactured by Asahi, Ipex Guardian, or R.G. Sloane. The manufacturer should have at least five years experience and proven product reliability.

## 1.03 SUBMITTALS

- A. Materials and Shop Drawings:
  - 1. Shop drawings shall be submitted to the Engineer for approval in accordance with the General Conditions and Section 01340 and shall include dimensioning and the technical specification for all piping to be furnished.
- B. Additional Information:
  - 1. Submit to the Engineer, for approval, samples of all materials specified herein, along with the manufacturer's Certificates of Inspection, descriptive literature, illustrations, specifications, installation, instructions and related information.
  - 2. Submit pipe layout with proposed location of each detection sensor.

## 1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Double wall containment pipe shall be delivered to the site in unbroken bundles packaged in such manner as to provide protection against damage. When possible, pipe should be stored at the job site in the unit packages until ready for use. Packaged units shall be handled using a forklift or a spreader bar with fabric straps. Packaged units shall not be stacked at the job site higher than two units high.
- B. When it is necessary to store double wall containment pipe for more than 30 days, exposure to direct sunlight shall be prevented by covering the pipe with an

opaque material. Adequate air circulation above and around the pipe shall be provided as required to prevent excessive heat accumulation. Double wall containment pipe shall not be stored close to heat sources or hot objects such as heaters, fires, boilers or engine exhaust. Pipe gaskets shall be protected from excessive exposure to heat, direct sunlight, ozone, oil and grease. The interior and all sealing surfaces of pipe, fittings and other appurtenances shall be kept clean and free of dirt and foreign matter.

- C. Care shall be taken in handling and laying pipe and fittings to avoid severe impact blows, crushing, abrasion damage, gouging or cutting. Pipe shall be lowered, not dropped, from trucks or into trenches. All cracked, damaged or defective pipe and fittings, or any length of pipe having a gouge, scratch or other permanent indentation of more than 10 percent of the wall thickness in depth, shall be rejected and removed at once from the work and replaced with new acceptable pipe at no additional cost to the Owner.

#### 1.05 WARRANTY AND GUARANTEES

- A. Provide equipment warranty in accordance with Section 01740 - Warranties and Bonds

### PART 2- PRODUCTS

#### 2.01 GENERAL

- A. All double wall containment piping system components shall be pre-engineered, factory fabricated, tested, and assembled such that field assembly is minimized to primarily that of straight joints.

#### 2.02 MATERIALS AND EQUIPMENT

- A. Carrier Pipe:
  - 1. Polyvinyl chloride pipe shall be Schedule 80 pipe, conforming to ASTM D1784 and ASTM 1785. Schedule 80 pipe shall have solvent welded socket type joints.
  - 2. Chlorinated polyvinyl chloride pipe shall be Schedule 80 pipe, conforming to ASTM D1784 and ASTM F441, Type IV, Grade I. Schedule 80 pipe shall have solvent welded socket type joints. .

B. Containment Pipe

1. Containment pipe shall be made of polyvinyl chloride, Schedule 80, conforming to ASTM D1784. Two-piece clamshell style containment fittings shall not be allowed.

C. Fittings:

1. Fittings for Schedule 80 pipe shall be socket type, solvent welded in conformance with ASTM D2464 or D2467. Solvent welded joints shall be watertight.

D. Solvent Cement:

1. PVC and CPVC solvent cement in services other than Sodium Hypochlorite shall be in compliance with ASTM D2564 and F656. Solvent cement in Sodium Hypochlorite service shall be free of Silica. Products for solvent cement in Sodium Hypochlorite service shall be IPS "Weld-On" or Oatey "Lo V.O.C. PVC Heavy Duty Gray."

## 2.03 ACCESSORIES

A. Leak Detection System

1. Install in strict accordance with the system manufacturer's instructions and recommendations. Leak detection shall be installed with a leak detector sensor station located at the lowest point in the piping, with all pipe sloping to the location of the leak detection sensor station. The leak detection sensor system shall sound an alarm when a leak event occurs.
2. Signal wires from the low point sensor shall be connected to the local output panel. Contact with any aqueous chemical shall result in an audible alarm and a LED signal. The local output panel shall be housed in a NEMA 4X enclosure. The leak detection output panel shall be located directly outside the chemical feed pumping facility where the pipe first penetrates the ground surface. For any miscellaneous control component data see Division 13/16 Specifications. The output relays shall be capable of interfacing with the SCADA for the proposed plant expansion.
3. The leak detection system shall be Asahi, Ipex Centra-Guard, or equal.

## 2.04 SPARE PARTS

- A. All special tools, solvents, lubricants, and cements required for normal installation shall be furnished with the pipe.

## 2.05 QUALITY CONTROL

- A. Contractor shall follow Manufacturer's and Supplier's recommended product quality control specifics as required for project.

## PART 3 - EXECUTION

### 3.01 PREPARATION (Not Applicable)

### 3.02 INSTALLATION

- A. Install double wall containment pipe where shown on the Drawings and in strict accordance with the manufacturer's technical data and printed instructions.
- B. Joints for double wall containment pipe and fittings shall be solvent welded. All joints shall be made watertight. All pipe cutting, threading and jointing procedures for solvent welded pipe joints shall be in strict accordance with the pipe and fittings manufacturer's printed installation instructions. In making solvent welded connections, clean dirt and moisture from pipe and fittings, bevel pipe ends slightly with emery cloth, if necessary and apply solvent cement of proper grade.
- C. Installation of valves and fittings shall be strictly in accordance with the manufacturer's instructions. Particular care shall be taken not to over-stress threaded connections at sleeves. In making solvent weld connections the solvent shall not be spilled on valves or allowed to run from joints.
- D. All piping shall have sufficient number of unions to allow convenient removal and shall be as approved by the Engineer.
- E. Concrete inserts for hangers and supports shall be furnished and installed in the concrete as it is placed. The inserts shall be set in accordance with the requirements of the piping layout and the Contractor shall verify their locations from approved piping layout Drawings and the structural Drawings.
- F. All valves and equipment shall be supported independently from the pipe. Anchor valves such that the turning moment resulting from their operation will not be transmitted to the pipe.
- G. Field Painting:
  - 1. Pipe normally exposed to view shall be painted and marked as specified in Section 09905: Piping, Valve and Equipment Identification System.



### 3.03 INSPECTION AND TESTING

- A. All PVC and CPVC piping shall be hydrostatically pressure tested and flushed in accordance with the requirements in Section 15044: Pressure Testing of Piping.
- B. Following installation and testing:
  - 1. Flush clean the carrier and containment piping system.
  - 2. Purge the annular space of moisture with clean, dry air.

### 3.04 START-UP AND INSTRUCTION

- A. Provide manufacturer's representative to provide recommended installation training and instructions for system tests, containment pipe joint closure, installation and testing of the leak detection system, and training of owner's personnel in the operation and maintenance of the leak detection system. Manufacturer's instructional video shall be provided to the installing contractor for training and future reference. Manufacturer's representative shall complete a Manufacturer's Certificate of Proper Installation. Inspection and examination practices shall be according to ASME B31.3-93 for normal fluid service.

END OF SECTION

## SECTION 15090

### CHEMICAL FEED SYSTEM PIPING

#### PART 1 - GENERAL

##### 1.01 DESCRIPTION

###### A. Scope or Work:

1. This section covers furnishing and installation of piping and piping accessories and chemical feed systems for the sodium hypochlorite feed system and hydrofluosilicic acid feed system.
2. Piping shall be furnished and installed complete with all fittings, jointing materials, hangers, supports, anchors, and other necessary appurtenances.
3. Material furnished and work performed under this Section shall be coordinated with material and equipment furnished and installed in Section 11241, Chemical Feed System.

###### B. Related Work Described Elsewhere: Other sections directly related to work covered in this section include the following:

1. Excavating, Backfilling, and Compacting: Section 02220.
2. Painting: Section 09900.
3. Piping, Valve, and Equipment Identification System: Section 09905.
4. Division 15.

###### C. General Design (Not Applicable)

##### 1.02 QUALITY ASSURANCE

###### A. Acceptable Manufacturers:

1. PVC and CPVC Pipe: As specified in Section 15070

2. PVC CPVC Double Wall Containment Pipe: As specified in Section 15076
3. 316 Stainless Steel Pipe: Swagelok, Ham-let, or engineered approved equal.

### 1.03 SUBMITTALS

- A. Materials and Shop Drawings: Complete specifications, data, and catalog cuts or drawings covering the following items furnished under this section shall be submitted in accordance with Section 01340: Shop Drawings, Working Drawings and Samples.
  1. Expansion joints for PVC pipe.
  2. Flange gaskets.
  3. PVC chemical service pipe and fittings.
  4. Pipe sleeves.
  5. Pipe supports.

### 1.04 OPERATIONS AND MAINTENANCE DATA

- A. Operating and Maintenance Manual: Furnish Operation and Maintenance Manuals in accordance with Section 01730: Operating and Maintenance Data.

### 1.05 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Pipe and fittings shall be handled and stored in a manner which will ensure installation in sound, undamaged condition. Handling methods and equipment used shall prevent damage to the protective coating and shall include the use of end hooks, padded calipers, and nylon or similar fabric slings with spreader bars. Bare cables, chains, or metal bars shall not be used. Coated pipe shall be stored off the ground on wide padded skids. Whenever the storage period on the job exceeds 30 days, plastic coated pipe shall be covered or otherwise protected from exposure to sunlight.

## 1.06 WARRANTY AND GUARANTEES

- A. Provide equipment warranty in accordance with Section 01740 - Warranties and Bonds.

## PART 2 - PRODUCTS

### 2.01 GENERAL (Not Applicable)

### 2.02 MATERIALS AND EQUIPMENT

- A. Polyvinyl Chloride (PVC) Pipe and Fittings:

1. Materials for polyvinyl chloride pipe and fittings shall be as specified in Section 15070; Schedule 80 Polyvinyl Chloride (PVC) and Chlorinated Polyvinyl (CPVC) Pipe, Fittings, and Valves.
2. Joints and jointings shall be as specified in Section 15070; Schedule 80 Polyvinyl Chloride (PVC) and Chlorinated Polyvinyl (CPVC) Pipe and Fittings.

- B. Chlorinated Polyvinyl Chloride (CPVC) Pipe and Fittings:

1. Materials for chlorinated polyvinyl chloride pipe and fittings shall be as specified in Section 15070; Schedule 80 Polyvinyl Chloride (PVC) and Chlorinated Polyvinyl Chloride (CPVC) Pipe, Fittings, and Valves.
2. Joints and jointings shall be as specified in Section 15070; Schedule 80 Polyvinyl Chloride and Chlorinated Polyvinyl Chloride (CPVC) Pipe, Fittings, and Valves.

- D. Piping Schedule:

1. Refer to Table 15090-1 for the Schedule of Materials to be used on each piping system, the conditions of service and hydrostatic testing requirements.

- E. Fabrication and Manufacture:

1. A union shall be provided within 2 feet of each threaded end valve unless there are other connections which will permit easy removal of the valve. Unions shall also be provided in piping at locations adjacent to devices or

equipment which may require removal in the future and at locations required by the drawings or specifications.

2. Taps for pressure gauge connections on the suction and discharge of pumping units shall be provided with a nipple and a shutoff gauge cock.
3. Pipe hangers and supports shall be provided as specified in Section 15126; Hangers and Supports.

#### 2.03 ACCESSORIES (Not Applicable)

#### 2.04 SPARE PARTS (Not Applicable)

#### 2.05 QUALITY CONTROL

- A. Contractor shall follow Manufacturer's and Supplier's recommended product quality control specifics as required for this project.

### PART 3 - EXECUTION

#### 3.01 PREPARATION

- A. All fittings, couplings, specials, and other exterior surfaces of buried piping not protected with plastic coating shall be tape wrapped in the field. All surfaces to be tape wrapped shall be thoroughly cleaned and primed in accordance with the tape manufacturer's recommendations immediately before wrapping. Tape wrapping shall be two ply (half lap) application or as required to provide a total installed tape thickness of not less than 60 mils. Joints in plastic coated pipe shall be cleaned, primed, and tape wrapped after installation.

#### 3.02 INSTALLATION

- A. Pipe:
  1. Pipe shall be installed as specified, as indicated on the drawings or, in the absence of detail piping arrangement, in a manner acceptable to the Engineer.
  2. Pipe shall be cut from measurements taken at the site and not from the drawings. All necessary provisions shall be taken in laying out piping to provide throughout for expansion and contraction. Piping shall not

obstruct openings or passageways. Pipes shall be held free of contact with building construction so as not to transmit noise resulting from expansion.

3. Stuffing box leakage from water sealed pumps shall be piped to the nearest point of drainage collection.
4. Buried PVC piping shall be "snaked" in the trench and shall be kept as cool as possible during installation. PVC pipe shall be kept shaded and shall be covered with backfill immediately after installation and testing.
5. All piping shall be installed so that lines are readily accessible for cleaning. At changes in direction in all chemical piping, tees shall be provided with extra openings plugged to facilitate cleaning. Teflon thread tape or teflon thread sealer shall be applied to the threads of all plugs so that they can be easily removed. At each point where hose or reinforced plastic tubing is connected to rigid piping, a quick disconnect coupling shall be provided.

B. Pipe Joints: Pipe joints shall be carefully and neatly made in accordance with the requirements which follows.

1. Threaded:
  - a. Pipe threads shall conform to ANSI 82.1, NPT, and shall be full and cleanly cut with sharp dies. Not more than three threads at each pipe connection shall remain exposed after installation. Ends of pipe shall be reamed, after threading and before assembly, to remove all burrs.
  - b. Threaded joints in plastic piping shall be made up with teflon thread tape applied to all male threads.
2. Solvent Welded: All joint preparation, cutting and jointing operations shall comply with the pipe manufacturer's recommendations and ASTM D2855. Pipe ends shall be beveled or chamfered to the dimensions recommended by the manufacturer. Newly assembled joints shall be suitably blocked or restrained to prevent movement during the set time recommended by the manufacturer. Pressure testing of solvent welded piping systems shall not be performed until the applicable curing time, set forth in Table X2.1 of ASTM D2855, has elapsed.
3. Flanged: Flange bolts shall be tightened sufficiently to slightly compress the gasket and effect a seal, but not so tight as to fracture or distort the flanges.

A plain washer shall be installed under the head and nut of bolts connecting plastic pipe flanges. Anti-seize thread lubricant shall be applied to the threaded portion of all stainless steel bolts during assembly.

C. Pipe Sleeves:

1. Piping passing through or below concrete or masonry shall be installed through sleeves installed before the concrete is placed or when masonry is laid.
2. Unless otherwise indicated on the drawings, all pipes passing through or below walls or slabs shall be sealed watertight with special rubber gasketed sleeve and joint assemblies or with sleeves and modular rubber sealing elements.
3. Buried pipe sleeves enclosing chemical-piping shall be sloped to the open end as indicated on the drawings to allow observation of leakage of the chemical piping. The upper end of each sleeve shall be sealed watertight.

3.03 INSPECTION AND TESTING

- A. All shop applied plastic coatings and tape wrap on pipe or fittings shall be inspected for holidays and other defects after receipt of the pipe or fitting on the job and immediately before installation. All field applied tape wrap on pipe, pipe joints, fittings, and valves shall be inspected for holidays and other defects following completion of wrapping. Inspection of plastic coatings before installation of the pipe or fitting in the sleeve shall be made where, in the opinion of the Engineer, the coating may have been damaged during assembly. Holidays and defects disclosed by inspection shall be repaired in accordance with the recommendations of the coating or tape wrap manufacturer, as applicable.
- B. Inspection shall be made using an electrical holiday detector. The detector and inspection procedures shall conform to the requirements of Section 4.5.
- C. Pressure and Leakage Testing:
1. All specified tests shall be made by and at the expense of the Contractor in the presence, and to the satisfaction of, the Engineer. Each piping system shall be tested in accordance with Section 15044 and at a minimum, must experience no loss of pressure for at least one hour.
  2. Compressed air or pressure gas shall not be used to test plastic piping unless specifically recommended by the pipe manufacturer.

3. Leakage may be determined by loss of pressure, soap solution, chemical indicator, or other positive and accurate method acceptable to the Engineer. All fixtures, devices, or other accessories which are to be connected to the lines and which would be damaged if subjected to the specified test pressure shall be disconnected and ends of the branch lines plugged or capped as required during the testing procedures.
4. Drainage and venting systems shall be tested by filling with water to the level of the highest vent stack. Openings shall be plugged as necessary. Each system shall hold the water for 30 minutes without any drop in the water level.
5. All necessary testing equipment and materials, including tools, appliances and devices, shall be furnished and all tests shall be made by and at the expense of the Contractor and at such time as directed by the Engineer.
6. All joints in piping shall be tight and free from leaks. All joints which are found to leak by observation or during any specified test shall be repaired and tests repeated.

D. Cleaning:

1. The inside of all pipe, valves, and fittings shall be smooth, clean, and free from blisters, loose mill scale, sand, dirt, and other foreign matter when erected. The interior of all lines shall be thoroughly cleaned, to the satisfaction of the Engineer, before being placed in service.
2. Lines which have been flushed with water shall be air dried with compressed air immediately following drainage.



**TABLE 15090-1  
CHEMICAL FEED SYSTEM  
PIPING SCHEDULE**

Service	Pipe I.D.	Size (in.)	Pipe Material	Class	Specification Section No.	Test Pressure (psig)
Hydrofluosilicic Acid	HSFA	2 & Smaller	CPVC	SCH 80	15070	150
Sodium Hypochlorite	NaOCl	3 & Smaller	PVC	SCH 80	15070	150
Vent	V	6 & Smaller	PVC	SCH 80	15070	--

END OF SECTION

## SECTION 15100

### VALVES AND APPURTENANCES

#### PART 1 - GENERAL

##### 1.01 SCOPE OF WORK

- A. Scope of Work: Furnish, install, support, and test valves, gates, hydrants, strainers, stops, and faucets, (hereinafter referred to as "valves") in the location(s) and of the size(s) and quantities shown on the Drawings. The requirements of this specification apply to all valves specified.
- B. General Design
1. All of the equipment and materials specified herein are intended to be standard for use in controlling the flow of sewage, water, sludge, chemicals, air, etc., depending on the applications.
  2. All valves and appurtenances shall have the name of the manufacturer and the working pressure for which they are designed cast in raised letters upon some appropriate part of the body.
  3. For all buried valves in which the operating nut is deeper than four (4) feet from the finish ground surface, an extension rod with 2-inch operating nut and upper guide shall be installed permanently in the riser section.
  4. All exposed valves shall have "open/closed" position indicators. The position indicators shall be conveniently located for easy visibility. Valves shall open counter clockwise.
  5. All valves installed such that actuators are more than six feet above the floor shall have chain wheel operated geared actuators with stainless steel chains. Gear actuators shall be bevel or spur gear as recommended by the manufacturer.
  6. All exposed valves 6 inches and larger shall be handwheel operated. Valves over 6 feet above the finished floor shall have chain operator.
  7. Valve packing shall be replaceable without removing the valve from service.
  8. All valves in water service shall be in accordance with ANSI/NSF61.

## 1.02 QUALITY ASSURANCE

### A. Qualifications

1. All equipment furnished under this Specification shall be new and unused and shall be a standard product which has a successful record of reliable service in similar installations for a minimum of five (5) years.
2. All valves of same type and duty shall be furnished by a single manufacturer.

### B. Standards

1. ANSI
2. AISI
3. SSPC
4. AWWA

### C. Warranty: Provide manufacturer's warranty in accordance with the General Conditions and Section 01740: Warranties and Bonds.

### D. Equipment Manufacturers

1. Equipment manufacturers are named in each individual valve specification and where applicable shall be selected from one of the specified "Manufacturers" in the Orange County Utilities "List of Materials and Approved Manufacturers" as presented in an appendix of these technical specifications or approved equal.
2. The naming or reference to a specific manufacturer does not indicate that the manufacturer's standard equipment is acceptable in lieu of the specified component features. This reference is only an indication that the named manufacturers may have the capability of supplying the equipment as specified.

## 1.03 SUBMITTALS

### A. Materials and Shop Drawings: Copies of all materials required to establish compliance with the Specification shall be submitted in accordance with the provisions of the General Conditions and Section 01340: Shop Drawings, Working Drawings, and Samples. Submittals shall include at least the following:

1. Certified shop drawings showing all important details of construction, dimensions (including laying length), and weight.
2. Descriptive literature, bulletins, and/or catalogs showing all valve parts, and describing material of construction by material and specification, e.g., AISI.

3. Schedule of valves, referencing each valve type, end connections and actuators to the proposed location/application on the Drawings.
  4. Valve coatings and linings, if any.
  5. Valve Tag Identification Schedule (see PART 2).
  6. See individual sections for additional requirements.
- B. Operation and Maintenance Manuals: For all valves furnished under this Section, the Contractor shall submit operation and maintenance manuals in accordance with Section 01730: Operating and Maintenance Data, to include the following:
1. Equipment function.
  2. Description.
  3. Normal and limiting operating characteristics.
  4. Installation instructions (assembly, alignment and adjustment procedures).
  5. Operation instructions (normal start-up and shut-down procedures, normal operating conditions and emergency situations).
  6. Lubrication and maintenance instructions.
  7. Troubleshooting guide.
  8. Parts list and predicted life of parts subject to wear.
  9. Drawings - cross-sectional view, assembly diagrams.

#### 1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

##### A. Delivery of Materials and Equipment

1. All parts shall be properly protected so that no damage or deterioration will occur during a prolonged delay from the time of shipment until installation is completed.
2. Factory assembled parts and components shall not be dismantled for shipment unless permission is received in writing from the Engineer.
3. Finished surfaces of all exposed openings shall be protected by wooden blanks, strongly built and securely bolted thereto.
4. Finished iron or steel surfaces not painted shall be properly protected to prevent rust and corrosion.
5. After hydrostatic or other tests, all entrapped water shall be drained prior to shipment, and proper care shall be taken to protect parts from the entrance of water during shipment, storage and handling.

6. Each box or package shall be properly marked to show its net weight in addition to its contents.

B. Storage of Materials and Equipment

1. Store valves and accessories in an area on the construction site protected from weather, moisture, or possible damage.
2. Do not store valves or accessories directly on the ground or in the open.

C. Handling of Materials and Equipment

1. Handle valves and accessories to prevent damage of any nature.
2. Carefully inspect all materials for:
  - a. Defects in workmanship and materials.
  - b. Removal of debris and foreign material in valve openings and seats.
  - c. Proper functioning of all operating mechanisms.
  - d. Tightness of all nuts and bolts.

1.05 SPECIAL TOOLS AND SPARE PARTS

A. Special Tools

1. All special tools required for normal operation and maintenance shall be provided in accordance with Division 1.
2. One (1) each tee handle operator shall be provided for every three (3) buried valves.

PART 2 - PRODUCTS

2.01 GENERAL

- A. Materials shall be as indicated in specific sections, or on the Drawings, and compatible with intended use and shall meet at a minimum OCU Standards.
- B. Valves shall have the name of the manufacturer and the size of the valve cast or molded onto the valve body or bonnet or shown on a permanently stainless steel attached plate.
- C. Bolts, washers, nuts, and gaskets for flanged valves shall be as described in the specific piping sections.

- D. Coat metal valves located above ground or in vaults and structures the same as the adjacent piping. Apply the specified prime coat at the place of manufacture. Apply finish coat in field. Finish coat shall match the color of the adjacent piping. All prime and finish coats shall be in compliance with Division 9.

## 2.02 VALVE IDENTIFICATION

- A. On all valves except shut-off valves located at a fixture or piece of equipment, the Contractor shall provide a coded and numbered tag attached with brass chain and/or brass "S" hooks.
  - 1. Tag types
    - a. Tags for valves on pipe and tube lines conducting hot medium (steam, condensate, hot water, air, etc.) shall be brass or anodized aluminum.
    - b. Tags for all other valves shall be color plastic.
    - c. Colors for aluminum and plastic tags shall, where possible, match the color code of the pipe line on which installed.
    - d. Square tags shall be used to indicate normally closed valves and round tags shall indicate normally open valves.
  - 2. Coding: In addition to the color coding, each tag shall be stamped or engraved with wording or abbreviations to indicate the line service. All color and letter coding shall be approved by the Engineer.
  - 3. Manufacture: Tags shall be as manufactured by Seton Name Plate Corporation, Floy Tag & Manufacturing Co. or approved equal.
  - 4. Valve Schedule: the Contractor shall provide a typewritten list of all tagged valves giving tag color, shape, letter code and number, the valve size, type, use and general location within building.

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. Install valves and accessories in strict accordance with manufacturer's instructions and recommendations, as shown on the Drawings and/or as directed by the Engineer.
- B. Carefully erect all valves and support them in their respective positions free from distortion and strain.
- C. Bolt holes of flanged valves shall straddle the horizontal and vertical centerlines of the pipe run to which the valves are attached. Clean flanges by wire brushing before

installing flanged valves. Clean flange bolts and nuts by wire brushing, lubricate threads with oil and graphite, and tighten nuts uniformly and progressively. Clean threaded joints by wire brushing or swabbing. Apply Teflon joint compound or Teflon tape to pipe threads before installing threaded valves. Joints shall be watertight.

- D. Support all valves connected to pumps and equipment, and in piping systems that cannot support valves.
- E. Repair any scratches, marks and other types of surface damages, etc., with original prime coating as supply by the factory.
- F. Apply finish coating in accordance with Division 9.

### 3.02 INSPECTION AND TESTING

- A. Check and adjust all valves and accessories for smooth operation.
- B. Test valves for leakage at the same time that the connecting pipelines are tested. Protect or isolate any parts of valves, operators, or control and instrumentation systems whose pressure rating is less than the pressure tests.
- C. If flanges leak under pressure testing, loosen or remove the nuts and bolts, reseal or replace the gasket, reinstall or retighten the bolts and nuts, and retest the joints.

END OF SECTION

## SECTION 15101

### GATE VALVES

#### PART 1 - GENERAL

##### 1.01 SCOPE OF WORK

###### A. Scope of Work:

1. Furnish and install gate valves of the type and size and in the location as shown on the Drawings and/or specified herein.

###### B. General Design:

1. 2-inches and smaller, above ground, pressure Class 125 bronze.
2. 2½ inches and larger, above ground, iron body, bronze mounted, non-rising stem (NRS).
3. Below ground, iron body, bronze mounted, NRS. Use reducers as necessary to accommodate small buried piping.
4. Comply with the requirements of Section 15100.

##### 1.02 QUALITY ASSURANCE

###### A. Qualifications: See Section 15100.

###### B. Standards: See Section 15100.

###### C. Warranty: See Section 15100.

###### D. Equipment Manufacturers: Manufacturers shall be selected from one of the specified "Manufacturers" in the Orange County Utilities "List of Materials and Approved Manufacturers" as presented in an appendix of these technical specifications.

##### 1.03 SUBMITTALS

###### A. General: Submittals shall be in accordance with Section 15100.



#### 1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. General: Product delivery, storage and handling shall be in accordance with Section 15100.

#### 1.05 SPECIAL TOOLS AND SPARE PARTS

- A. General: Provide special tools in accordance with Section 15100.

### PART 2 - PRODUCTS

#### 2.01 GENERAL

- A. General: Valves shall comply with PART 2 - Products of Section 15100.

#### 2.02 MATERIALS

- A. General Service - 2-inches and smaller, above ground:

1. Bronze construction - 125 pound steam.
2. Union bonnet.
3. Inside screw, rising stem or non-rising stem.
4. Solid disc, taper wedge.
5. End connections:
  - a. Threaded
  - b. Or solder ends for copper pipe systems
6. Malleable iron, or steel hand wheel.

- B. General Service – 2½ inches through 30 inches:

1. Gate valves shall be resilient seat gate valves, manufactured to meet or exceed the requirements of AWWA C509, latest revision. Valves shall have an unobstructed waterway equal to or greater than the full nominal diameter of the valve.

2. Cast iron body, bonnet and bonnet cover, ASTM A126 Class B, 250 psi working pressure. 2-inch wrench nut shall be provided for operating the valve.
  3. Non-rising stem, made of cast, forged or rolled bronze as specified in AWWA C509. Two stem seals shall be provided and shall be of the o-ring type. The stem nut shall be independent of the gate.
  4. Ductile iron gate with vulcanized EPDM synthetic rubber coating (resilient seated). Zero leakage at test and normal working pressure when installed with the line flow from either direction.
  5. Valves for buried service shall have mechanical joints conforming to ANSI A21.11, above ground service joints shall be flanged conforming to ANSI B16.1 for Class 125 flanges.
  6. All ferrous surface inside and outside shall have a fusion-bonded epoxy coating in accordance with AWWA C550.
  7. Valves 16-inches and larger shall have side actuators.
- C. General Service - Greater than 30 inches: Valves shall meet the requirements of 2.01 and 2.02.B except as specified otherwise below:
1. Operator shall be bevel or spur geared.
  2. In horizontal installations, valves shall be equipped with bevel gear suitable for buried service.
  3. Valves 42-inch and greater shall be provided with by-pass gate valve.
  4. Working pressure shall be a minimum of 150 psi.

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. Install valves with stem position vertical, unless shown otherwise.
- B. Allow sufficient clearance around valve operator for proper operation.
- C. Install in accordance with "Valve and Specialties - General" Section 15100.

END OF SECTION

## SECTION 15116

### VALVE BOXES

#### PART 1 - GENERAL

- 1.01 SCOPE OF WORK: Furnish and install valve boxes of type and size and in the location shown on the Drawings and as specified herein.
- 1.02 QUALITY ASSURANCE
- A. Qualifications: See Section 15100.
  - B. Standards: All curb boxes shall be the product of one manufacturer.
  - C. Warranty: See Section 15100.
  - D. Equipment Manufacturers: Manufacturers shall be selected from one of the specified "Manufacturers" in the Orange County Utilities "List of Materials and Approved Manufacturers" as presented in an appendix of these technical specifications.

#### PART 2 - PRODUCTS

##### 2.01 MATERIALS AND EQUIPMENT

- A. All buried valves shall have cast iron, three (3) piece valve boxes. Valve boxes shall be provided with suitable heavy bonnets and to extend to such elevation at or slightly above the finished grade surface as directed by the Engineer.
- B. The barrel shall be screw type, having 5-1/4 inch diameter shaft. The upper section shall have a flange at the bottom having sufficient bearing area to prevent settling and shall be complete with cast iron covers.
- C. Covers shall have "WATER" cast into the top for all water mains and "SEWER" cast into the top of all wastewater force mains and "REUSE" cast into the top of all reclaimed water mains.
- D. All valves shall have actuating nuts extended to top of valve boxes.
- E. Valve box assemblies are required for any size main that is six feet or greater below finished grade or if mains are greater than 12-inches in diameter. The valve box assembly shall be one complete unit composed of the valve box and extension stem

that attaches to the valve body. All moving parts of the extension stem shall be enclosed in a housing to prevent contact with the soil. The valve box assembly shall be adjustable to accommodate variable trench depths six feet and greater as shown on the Drawings.

- F. The stem assembly shall be of a telescoping design that allows for variable adjustment length. The material shall be galvanized square steel tubing. The stem assembly shall have a built-in device that prevents the stem assembly from disengaging at its fully extended length. The extension stem shall be capable of surviving a torque test to 1,000 ft-lb without failure.
- G. Valve boxes shall have locking lids, utilizing a five sided nut with a special wrench needed to open. Valve lids shall be as shown on the Drawings.
- H. Valve collars shall be made of a fiberglass reinforced concrete polymer material manufactured to the specifications as shown on the Drawings utilizing a test station box made into the valve collar for placement of the locating wire. The locating wire shall be 10-gauge single strand solid core copper wire with insulation. The color of the insulation shall be the same color as the color code for the pipe being installed.

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. Install as shown on the Drawings and/or as directed by the Engineer.
- B. When installation is complete, no pressure shall be exerted by the valve box on either the valve or the pipe.

END OF SECTION

SECTION 15120  
PIPING SPECIALTIES

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Scope of Work: This section includes materials and installation of the miscellaneous piping specialties.
- B. Related Work Described Elsewhere:
  - 1. Pressure Testing of Piping: Section 15044.
  - 2. Chemical Feed System Piping: Section 15090.
  - 3. Valves and Appurtenances: Section 15100.
- C. General Design:
  - 1. Comply with Section 15100, Article 1.01.B.1, 2 and 3.
  - 2. Specialties shall have a working pressure rating equal to or greater than the piping installed in.

1.02 QUALITY ASSURANCE

- A. Qualifications: Comply with Section 15100.
- B. Standards: Comply with Section 15100.
- C. Warranty: Comply with Section 15100.
- D. Equipment Manufacturers: See PART 2.

1.03 SUBMITTALS

- A. Submittals be in accordance with Section 15100.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING:

- A. Product delivery, storage and handling shall be in accordance with Section 15100.

1.05 SPECIAL TOOLS AND SPARE PARTS:

- A. Provide special tools in accordance with Section 15100.

PART 2 - PRODUCTS

2.01 SOLENOID VALVES

- A. Solenoid valves shall be design for not less than 150 psi water working pressure and shall be installed where shown. Electrical operators for solenoid valves shall be in accordance with electrical drawings. Valves shall be two-way pattern, screwed, brass-body type, ASCO No. 8210 through 8223.
- B. Solenoid valves for the Sodium Hypochlorite Off-Gas lines shall be Asahi/American Series 93 on Type 21 Ball Valve or equal and shall be installed where shown. Electrical operators for solenoid valves shall be in accordance with the electrical drawings. Ball valves shall be in accordance with Section 15070.

2.02 TAPPING VALVES AND SLEEVES

- A. Tapping Valves shall be resilient seated. Tapping valves manufacturer shall be selected from one of the specified "Manufacturers" in the Orange County Utilities "List of Materials and Approved Manufacturers" as presented in an appendix of these technical specifications. Tapping valves shall include flush port, piped to above grade with isolation valve. Tapping valve shall hold in both directions with no leaks regardless of pressure differential across the valve.
- B. Tapping sleeve for ductile iron pipe shall be mechanical joint; with tapping valves which outlet to a flanged connection for the above ground applications, and outlet to a mechanical joint connection for buried pipe taps. Exact O.D. of pipe to be tapped shall be field measured prior to ordering sleeve. Tapping sleeves manufacturer shall be selected from one of the specified "Manufacturers" in the Orange County Utilities "List of Materials and Approved Manufacturers" as presented in an appendix of these technical specifications.

2.03 HOSE BIBS:

- A. Hose bibs shall be equal to Watts No. SC-3 or SC-4 of the size shown on the Drawings.

2.04 CORPORATION STOPS

- A. Corporation stops shall be threaded on the inlet side and the outlet side fitted with connections to suit connecting pipe or tubing. Manufacturer shall be selected from one of the specified "Manufacturers" in the Orange County Utilities "List of Materials and Approved Manufacturers" as presented in an appendix of these technical specifications.

2.05 CURB STOPS

- A. Curb stops shall be ball type. Manufacturer shall be selected from one of the specified "Manufacturers" in the Orange County Utilities "List of Materials and Approved Manufacturers" as presented in an appendix of these technical specifications.

2.06 QUICK CONNECT COUPLINGS FOR WATER SERVICE

- A. Quick connect couplings shall be Model 633-F hose shank adapter and Model 633-C hose shank coupler as manufactured by Dover Corporation OPW Division, Cincinnati, Ohio, equal by Ever-tite Coupling Co., Inc., New York, New York or equal.

2.07 QUICK CONNECT COUPLINGS FOR CHEMICAL SERVICE

- A. Quick connect couplings for Chemical Service shall be male adaptor/female thread type. Provide dust cap and security chain with each coupler. Bodies shall be glass fiber reinforced polypropylene. Gaskets shall be Teflon. Adaptors shall be Ever-tite Coupling Co. Port A/DC, Banjo Corporation Male Adapter/Female Thread with dust cap, Murray Equipment Inc., Style A/DC, or equal.

2.08 SERVICE SADDLES

- A. Service saddles shall be of the double-strap type. Straps and bodies shall be bronze or silicon bronze. Tap sizes on the outlet shall be 3/4-inch through 2 inches to accommodate the connecting piping or corporation stops. Manufacturer shall be selected from one of the specified "Manufacturers" in the Orange County Utilities

"List of Materials and Approved Manufacturers" as presented in an appendix of these technical specifications.

## 2.09 STRAINERS FOR WATER SERVICE

- A. Strainers shall be installed as shown on the Drawings and shall be of the "Y" type. Strainers shall have bronze bodies with a removable bronze screen and shall be as manufactured by Mueller Steam, Mineola, New York, Watts Regulator Company, Lawrence, Mass., or equal.

## 2.10 PVC WYE STRAINERS

- A. PVC wye strainers shall be manufactured of the same material as the PVC pipe to which it is installed, with 30-mesh screens and viton seals. Connecting ends shall be socket type, solvent weld. Provide one (1) spare screen for each strainer

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. Install piping specialties of the sizes and types in accordance with the manufacturer's instructions, and in the locations shown on the Drawings or specified herein.

END OF SECTION



## SECTION 15126

### PIPE HANGERS AND SUPPORTS

#### PART 1 - GENERAL

##### 1.01 DESCRIPTION

###### A. Scope of Work:

1. Furnish all labor, materials, equipment and incidentals and install pipe hangers, supports, concrete inserts, and anchor bolts including all metallic hanging and supporting devices for supporting exposed piping.

###### B. Related Work Described Elsewhere:

1. Concrete is included in Division 3.
2. Metal fabrications are included in Section 05500.
3. Painting is included in Section 09900.
4. Pipe and fittings are included in respective sections of Division 15.
5. Mechanical - General Requirements: Section 15000.

###### C. General Design (Not Applicable)

##### 1.02 QUALITY ASSURANCE

- A. Hangers and supports shall be of approved standard design where possible and shall be adequate to maintain the supported load in proper position under all operating conditions. The minimum working factor of safety for pipe supports shall be five (5) times the ultimate tensile strength of the material, assuming 10 feet of water filled pipe being supported.
- B. All pipe and appurtenances connected to equipment shall be supported in such a manner as to prevent any strain being imposed on the equipment. When manufacturers have indicated requirements that piping loads shall not be transmitted to their equipment, the Contractor shall submit a certification stating that such requirements have been complied with.

### 1.03 SUBMITTALS

#### A. Materials and Shop Drawings:

1. Submit to the Engineer for approval, as provided in the General Conditions and Section 01340, shop drawings of all items to be furnished under this Section.
2. Submit to the Engineer, for approval, samples of all materials specified herein.

### 1.04 PRODUCT DELIVERY STORAGE AND HANDLING

- #### A.
- The equipment provided under this section shall be shipped, handled and stored in accordance with the Manufacturer's written instructions, and in accordance with Section 01600 - Material and Equipment.

### 1.05 WARRANTY AND GUARANTEES

- #### A.
- Provide equipment warranty in accordance with Section 01740 - Warranties and Bonds.

## PART 2 - PRODUCTS

### 2.01 GENERAL

- #### A.
- All pipe and tubing shall be supported as required to prevent significant stresses in the pipe or tubing material, valves, and fittings and to support and cure the pipe in the intended position and alignment. All supports shall be designed to adequately secure the pipe against excessive dislocation due to thermal expansion and contraction, internal flow forces, and all probable external forces such as equipment, pipe, and personnel contact. All pipe supports shall be approved prior to installation.
- #### B.
- The Contractor shall select and design all piping support systems within the specified spans and component requirements. Structural design and selection of support system components shall withstand the dead loads imposed by the weight of the pipes filled with water, plus any insulation. Commercial pipe supports and hangers shall have a minimum safety factor of 5.
- #### C.
- No attempt has been made to show all required pipe supports in all locations, either on the Drawings or in the details. The absence of pipe supports and details

on any drawings shall not relieve the Contractor of the responsibility for providing them throughout the plant.

- D. All support anchoring devices, including anchor bolts, inserts and other devices used to anchor the support onto a concrete base, roof, wall or structural steel works, shall be of the proper size, strength and spacing to withstand the shear and pullout loads imposed by loading and spacing on each particular support.
- E. All materials used in manufacturing hangers and supports shall be capable of meeting the respective ASTM Standard Specifications with regard to tests and physical and chemical properties, and be in accordance with MSS SP-58.
- F. Hangers and supports shall be spaced in accordance with ANSI B31.1.0 except that the maximum unsupported span shall not exceed 10 feet unless otherwise specified herein.
- G. Unless otherwise specified herein, pipe hangers and supports shall be as manufactured by Anvil International, Inc., Carpenter and Patterson, Inc., or equal. 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. Any item comparable in type, style, quality, design and performance will be considered for approval.

## 2.02 MATERIALS AND EQUIPMENT

### A. Pipe Hangers and Supports for Metal Pipe:

- 1. Suspended single pipes shall be supported by hangers suspended by steel rods from galvanized concrete inserts, beam clamps, or ceiling mounting bolts as follows:

- a. Hangers

<u>Pipe Size, Inches</u>	<u>Anvil Fig. No.</u>
Less than 1/2	138R
1/2 through 1	97C
1-1/4 through 4	104
6 through 12	590
14 through 30	171

- b. Hanger rods shall be rolled steel machine threaded with load ratings conforming to ASTM Specifications and the strength of the rod shall be based on root diameter. Hanger rods shall have the following minimum diameters:

<u>Pipe Size, Inches</u>	<u>Min. Rod Diameter, In.</u>
Less than 2-1/2	3/8
2-1/2 to 3	1/2
4	5/8
6	3/4
8 to 12	7/8
14 to 18	1

- c. Where applicable, structural attachments shall be beam clamps. Beam clamps, for rod sizes 1/2-inch through 3/4-inch shall be equal to Anvil Fig. No. 229, and for rod sizes 7/8-inch through 1-1/4 inches shall be equal to Anvil Fig. No. 228, or equal.
- d. Concrete inserts for pipe hangers shall be; continuous metal inserts designed to be used in ceilings, walls or floors, spot inserts for individual pipe hangers, or ceiling mounting bolts for individual pipe hangers and shall be as manufactured by Unistrut Corp., Wayne, Michigan; Carpenter and Patterson, Inc., Laconia, New Hampshire; Richmond or equal and shall be as follows:
  - i. Continuous concrete inserts shall be used where applicable and/or as shown on the Drawings and shall be used for hanger rod sizes up to and including 3/4-inch diameter. Inserts to be used where supports are parallel to the main slab reinforcement shall be Series P3200 by Unistrut Corp., Fig 1480 Type 2 by Carpenter and Patterson, Inc., or equal. Inserts to be used where supports are perpendicular to the main slab reinforcement shall be Series P3300 by Unistrut Corp., Fig. 1480 Type I by Carpenter and Patterson, Inc. or equal.
  - ii. Spot concrete inserts shall be used where applicable and shall be used for hanger sizes up to and including 7/8-inch diameter. Inserts shall be Fig. 650 by Carpenter and Patterson, Inc. for hanger rod sizes 1/2-inch through and including 3/4-inch, and Fig. 266 by Carpenter and Patterson Inc., for 7/8-inch hanger rods.
  - iii. Ceiling mounting bolts shall be used where applicable and be for hanger rod sizes 1-inch through and including 1-1/4 inches and shall be Fig. 104M as manufactured by Carpenter and Patterson, Inc., or equal.

- e. All pipe hangers shall be capable of vertical adjustment under load and after erection. Turnbuckles, as required and where applied, shall be equal to Anvil Fig. No. 230.
2. Wall or column supported pipes shall be supported by welded steel brackets equal to Anvil Fig. 194, 195 and 199 as required, for pipe sizes up to and including 20-inch diameter. Additional wall bearing plates shall be provided where required.
- a. Where the pipe is located above the bracket, the pipe shall be supported by an anchor chair and U-bolt assembly supported by the bracket for pipes 4 inches and larger and by a U-bolt for pipes smaller than 4 inches. Anchor chairs shall be equal to Carpenter Patterson Fig. No. 127. U-bolts shall be equal to Anvil Fig. No. 120 and 137.
  - b. Where the pipe is located below the bracket, the pipes shall be supported by pipe hangers suspended by steel rods from the bracket. Hangers and steel rods shall be as specified above.
3. Floor supported pipes 3-inches and larger in diameter shall be supported by either cast-in-place concrete supports or adjustable pipe saddle supports as directed by the Engineer. In general, concrete supports shall be used when lateral displacement of the pipes is probable (unless lateral support is provided), and adjustable pipe saddle type supports shall be used where lateral displacement of pipes is not probable.
- a. Each concrete support shall conform to the details shown on the Drawings. Concrete shall be poured after the pipe is in place with temporary supports. Concrete piers shall conform accurately to the bottom 1/3 to 1/2 of the pipe. Top edges and vertical corners of each concrete support shall have 1-inch bevels. Each pipe shall be secured on each concrete support by a wrought iron or steel anchor strap anchored to the concrete with cast-in-place bolts or with expansion bolts. Where directed by the Engineer, vertical reinforcement bars shall be grouted into drilled holes in the concrete floor to prevent overturning or lateral displacement of the concrete support. Unless otherwise approved by the Engineer, maximum support height shall be five (5) feet.
  - b. Concrete piers used to support base elbows and tees shall be similar to that specified above. Piers may be square or rectangular.
  - c. Each adjustable pipe saddle support shall be screwed or welded to the corresponding size 150 pound companion flanges or slip-on

welding flanges respectively. Supporting pipe shall be of Schedule 40 steel pipe construction. Each flange shall be secured to the concrete floor by a minimum of two (2) expansion bolts per flange. Adjustable saddle supports shall be equal to Anvil Fig. No. 264. Where used under base fittings, a suitable flange shall be substituted for the saddle.

4. Vertical piping shall be supported as follows:
  - a. Where pipes change from horizontal to vertical, the pipes shall be supported on the horizontal runs within 2 feet of the change in direction by pipe supports as previously specified herein.
  - b. For vertical runs exceeding 15 feet, pipes shall be supported by approved pipe collars, clamps, brackets, or wall rests at all points required to insure a rigid installation.
  - c. Where vertical piping passes through a steel floor sleeve, the pipe shall be supported by a friction type pipe clamp which is supported by the pipe sleeve. Pipe clamps shall be equal to Anvil Fig. 262.
5. Anchor bolts shall be equal to Kwik-Bolt as manufactured by the McCulloch Industries, Minneapolis, Minnesota, or Wej-it manufactured by Wej-it Expansion Products, Inc., Bloomfield, Colorado.
6. All rods, hangers, inserts, brackets, and components shall be furnished with galvanized finish.

B. Pipe Hangers and Supports for Plastic Pipe:

1. Single plastic pipes shall be supported by pipe supports as previously specified herein.
2. Multiple, suspended, horizontal plastic pipe runs, where possible, and rubber hose shall be supported by ladder type cable trays such as the Electray Ladder by Husky-Burndy, the Globetray by the Metal Products Division of United States Gypsum, or equal. Ladder shall be of mild steel construction. Rung spacing shall be approximately 18 inches for plastic pipe and 12 inches for rubber hose. Tray width shall be approximately 6-inch for single runs of rubber hose and 12 inches for double runs of rubber hose. Ladder type cable trays shall be furnished complete with all hanger rods, rod couplings, concrete inserts, hanger clips, etc. required for a complete support system. Individual plastic pipes shall be secured to the rungs of the cable tray by strap clamps or fasteners equal to Globe Model M-CAC, Husky-Burndy Model SCR or approved equal. Spacing between

clamps shall not exceed 9 feet. The cable trays shall provide continuous support along the length of the pipe.

3. Individual clamps, hangers, and supports in contact with plastic pipe shall provide firm support but not so firm as to prevent longitudinal movement due to thermal expansion and contraction.

C. Pipe Supports for Small Diameter PVC and Steel Pipe:

1. Small diameter Schedule 80 PVC piping 3-inches in diameter and smaller, and steel piping 2-inches in diameter and smaller shall be supported with "SUSPORT" system arrangements as manufactured by Universal Suspension Systems Inc. of Gillette, New Jersey or an equal approved by the Engineer. Clamping halves for the pipe support shall be manufactured of molded polypropylene and shall support and fit closely for 360° around the pipe. To support piping carrying non-corrosive fluids or gases and located in noncorrosive, indoor environments, all hardware for the "SUSPORT" system shall be nickel chrome plated carbon steel. To support piping carrying corrosive fluids or gases, piping located in corrosive environments or piping located outdoors, all hardware for the system shall be manufactured of Type 304 stainless steel.
2. In some cases, to adequately support small diameter PVC or steel piping, a metal frame support structure may be required for support of the "SUSPORT" system specified above. Where required, metal frame support structures shall be constructed using channels, fittings, brackets, hardware and other accessories as manufactured by B-Line Systems, Inc. of Highland, Illinois, or an equal approved by the Engineer. If located in indoor, non-corrosive environments, the materials for the frame structure shall be carbon steel with an epoxy coating applied by a cathodic, electro-deposition process which is equal to "Dura-a-Green" by B-Line Systems, Inc. For corrosive or outdoor environments, the materials for the frame structure be Type 316 stainless steel unless otherwise noted on the Drawings. Hardware used to construct the frame support structure shall be cadmium plated for carbon steel supports or Type 316 stainless steel for stainless steel supports.
3. Pipe supports for small diameter PVC and steel piling shall be located wherever necessary in the opinion of the Engineer to adequately support the pipe, however, they shall have a maximum spacing as specified below for straight pipe runs. Adequate supports shall especially be used adjacent to valves and fittings in pipelines. The following table is based on spacing requirements for Schedule 80 PVC or Standard Weight (Schedule 40) steel pipe carrying a fluid with a Specific Gravity of 1.0 at a temperature not exceeding 120°F. Support spacing for PVC or steel piping carrying fluids

with Specific Gravities or temperatures exceeding those stated above shall be approved by the Engineer.

Nominal Pipe Diameter, Inches	Support Spacing, Feet	
	PVC Pipe	Steel Pipe
1/2"	3.5	4.5
3/4"	4.0	5.0
1"	4.5	5.5
1-1/4"	5.0	6.5
1-1/2"	5.0	7.5
2"	5.5	8.0
2-1/2"	5.5	-
3"	6.0	-

2.03 ACCESSORIES (Not Applicable)

2.04 SPARE PARTS (Not Applicable)

2.05 QUALITY CONTROL

- A. Contractor shall follow Manufacturer's and Supplier's recommended product quality control specifics as required for this project.

### PART 3 - EXECUTION

3.01 PREPARATION

- A. Prior to prime coating, all pipe hangers and supports shall be thoroughly clean, dry and free from all mill-scale, rust, grease, dirt, paint and other foreign substances to the satisfaction of the Engineer.
- B. All submerged pipe supports shall be prime coated with Koppers 654 Epoxy Primer or approved equal. All other pipe supports shall be prime coated with Rustinhibitive Primer No. 621 as manufactured by Koppers Company, Inc., Pittsburgh, Pa., or equal.
- C. Finish coating shall be compatible with the prime coating used and shall be applied as specified in Section 09900 - Painting.



### 3.02 INSTALLATION

- A. All pipes, horizontal and vertical, shall be rigidly supported from the building structure by approved supports. Supports shall be provided at changes in direction and elsewhere as shown in the Drawings or specified herein. No piping shall be supported from other piping or from metal stairs, ladders, and walkways, unless it is so indicated on the Drawings, or specifically directed or authorized by the Engineer.
- B. All pipe supports shall be designed with liberal strength and stiffness to support the respective pipes under the maximum combination of peak loading conditions to include pipe weight, liquid weight, liquid movement, and pressure forces, thermal expansion and contraction, vibrations, and all probable externally applied forces. Prior to installation, all pipe supports shall be approved by the Engineer.
- C. Pipe supports shall be provided to minimize lateral forces through valves, both sides of split 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.
- D. Pipe supports shall be provided as follows:
  - 1. Cast iron and ductile iron shall be supported at a maximum support spacing of 10 feet, 0-inches with minimum of one support per pipe section at the joints.
  - 2. All vertical pipes shall be supported at each floor or at intervals of at least 15 feet by approved pipe collars, clamps brackets or wall rests, and at all points necessary to insure rigid construction.
- E. Effects of thermal expansion and contraction of the pipe shall be accounted for in pipe support selection and installation.
- F. Inserts for pipe hangers and supports shall be installed on forms before concrete is poured. Before setting these items, all Drawings and figures shall be checked which have a direct bearing on the pipe location. Responsibility for the proper location of pipe supports is included under this Section.
- G. Continuous metal inserts shall be embedded flush with the concrete surface.
- H. Standard Pipe Supports:
  - 1. Horizontal Suspended Piping:

- a. Single Pipes: Adjustable swivel-ring, splint-ring, or clevis hangers.
  - b. Grouped Pipes: Trapeze hanger systems.
  - c. Furnish galvanized steel protection shield and oversized hangers for all insulated pipe.
  - d. Furnish precut sections of rigid insulation with vapor barrier at hangers for all insulated pipe.
2. Horizontal Piping Supported From Walls:
- a. Single Pipes: Wall brackets or wall clips attached to wall with anchors. Clips attached to wall mounted framing also acceptable.
  - b. Stacked Piping:
    - 1) Wall mounted framing system and clips acceptable for piping smaller than 3-inch minimal diameter.
    - 2) Piping clamps which resist axial movement of pipe through support not acceptable.
  - c. Wall mounted piping clips not acceptable for insulated piping.
3. Horizontal Piping Supported From Floors:
- a. Stanchion Type:
    - 1) Pedestal type; adjustable with stanchion, saddle, and anchoring flange.
    - 2) Use yoke saddles for piping whose centerline elevation is 18 inches or greater above the floor and for all exterior installations.
    - 3) Provide neoprene waffle isolation pad under anchoring flanges, adjacent to equipment or where otherwise required to provide vibration isolation.
  - b. Floor Mounted Channel Supports:

- 1) Use for piping smaller than 3-inch nominal diameter running along floors and in trenches at piping elevations lower than can be accommodated using pedestal pipe supports.
- 2) Attach channel framing to floors with anchor bolts.
- 3) Attach pipe to channel with clips or pipe clamps.
- c. Concrete Cradles: Use for piping larger than 3-inch along floor and in trenches at piping elevations lower than can be accommodated using stanchion type.
4. Vertical Pipe: Support with wall brackets and base elbow or riser clamps on floor penetrations.
5. Standard Attachments:
  - a. To Concrete Ceilings: Concrete inserts.
  - b. To Steel Beams: I-beam clamp or welded attachments.
  - c. To Wooden Beams: Lag screws and angle clips to members not less than 2-1/2 inches thick.
  - d. To Concrete Walls: Concrete inserts or brackets or clip angles with anchor bolts.
6. Existing Walls and Ceilings: Install as specified for new construction, unless shown otherwise.

3.03 INSPECTION AND TESTING (Not Applicable)

3.04 START-UP AND INSTRUCTION (Not Applicable)

END OF SECTION

## SECTION 15129

### COUPLINGS AND CONNECTORS

#### PART 1 - GENERAL

##### 1.01 DESCRIPTION

- A. Scope of Work: Furnish and install couplings and connectors of the type(s) and size(s) in the location(s) shown on the Drawings and as specified herein. Pipe supports shall be placed where shown on the Drawings. The Contractor may install additional pipe supports and flexible couplings to facilitate piping installation, provided that complete details describing their location, the pipe supports and hydraulic thrust protection are submitted. Thrust protection shall be adequate to sustain the force developed by 150% of the design operating pressures specified.
- B. Related Work Described Elsewhere:
  - 1. Mechanical- General Requirements: Section 15000.
  - 2. Pressure Testing of Piping: Section 15044.
- C. General Design (Not Applicable).

##### 1.02 QUALITY ASSURANCE

- A. Minimum pressure rating equal to that of the pipeline in which they are to be installed.
- B. Couplings and connectors, other than those specified herein, are subject to the Engineer's approval.

##### 1.03 SUBMITTALS

- A. Materials and Shop Drawings:
  - 1. Submit shop drawings in accordance with the Section 01340 and the following.
  - 2. Submit manufacturer's catalog data on couplings and connectors. Show manufacturer's model or figure number for each type of coupling or joint for each type of pipe material for which couplings are used.

3. Submit manufacturer's recommended torques to which the coupling bolts shall be tightened for the flexible gasketed sleeve-type compression pipe couplings.
  4. Show materials of construction by ASTM reference and grade. Show dimensions.
  5. Show number, size and material of construction of the rods and lugs for each thrust harness on the project.
- B. Additional Information (Not Applicable)
- C. Operating Instructions (Not Applicable)

#### 1.04 PRODUCT DELIVERY STORAGE AND HANDLING

- A. Equipment shall be handled, shipped and stored in accordance with Section 01600 - Material and Equipment.

#### 1.05 WARRANTY AND GUARANTEES

- A. Provide equipment warranty in accordance with Section 01740 - Warranties and Bonds.

### PART 2 - PRODUCTS

#### 2.01 GENERAL

- A. All couplings and connectors shall be restrained type.

#### 2.02 MATERIALS AND EQUIPMENT

- A. All Couplings and Connectors:
1. Gasket Materials: Composition suitable for exposure to the liquids to be contained within the pipes.
  2. Diameters to properly fit the specified types of pipes on which couplings and connectors are to be installed.
- B. Sleeve-Type Couplings (when applicable):

1. Exposed couplings (when applicable):
  - a. Steel middle ring
  - b. Two steel follower rings
  - c. Two wedge-section gaskets
  - d. Sufficient steel bolts to properly compress the gaskets
  - e. Acceptable manufacturers
    - (1) Smith - Blair, Inc. 470 Series Pipe-Lok
    - (2) Dresser Manufacturing Co.
    - (3) Romac
  
2. Buried Couplings (when applicable):
  - a. Steel middle ring
  - b. Steel or ductile iron follower rings
  - c. Two wedge-section gaskets
  - d. Bolts and nuts for buried couplings, shall be Type 316 stainless steel conforming to ASTM A 193, Grade B8 for bolts, and ASTM A 194, Grade 8 for nuts.
  - e. Acceptable manufacturers:
    - (1) Smith-Blair, Inc. 470 Series Pipe-Lok
    - (2) Dresser Manufacturing Co.
    - (3) Romac

C. Flanged Adapters (when applicable):

1. For joining plain end or grooved end pipe to flanged pipes and fittings.
2. Adapters shall conform in size and bolt hole placement to ANSI standards for steel and/or cast iron flanges 125 or 150 pound standard unless otherwise required for connections.

3. Exposed Sleeve Type (Ferrous Piping):
  - a. Constructed from steel
  - b. Coating: Epoxy
  - c. Bolts: Carbon steel
  - d. Pipe Restraint: Wedge type restraint
  - e. Acceptable manufacturers:
    - (1) Smith-Blair Inc. – 911 or 920 Series FlangeLok
    - (2) Dresser Manufacturing Co.
    - (3) Romac
4. Buried Sleeve Type:
  - a. Constructed from cast iron
  - b. Bolts and nuts for buried sleeves shall be Type 316 stainless steel conforming to ASTM A 193, Grade B8 for bolts, and ASTM A 194, Grade 8 for nuts and washers.
  - c. Acceptable manufacturers:
    - (1) Dresser Manufacturing Co. - Style 127 locking type for cast iron, ductile iron, asbestos cement and steel pipes with diameters of 3 inches through 12 inches.
    - (2) Smith-Blair Inc.
    - (3) Romac

D. Flexible Expansion Joints:

1. Joints designed to permit a nominal maximum deflection of 15 degrees in all directions from the axis of the adjacent pipe length, will prevent pulling apart, and will remain watertight at any angle of deflection under 15 degrees.

2. Material to be manufactured from a composition material suitable for exposure to the liquid, pressure and temperature to be contained within the pipe.
  3. Supplied with control rods as required.
- F. Transition Couplings: Transition couplings for connecting different pipes having different outside diameters shall be steel: Dresser Style 62 or 162, Rockwell Series 413, or Baker Series 212 or 240.
- G. Dismantling Joints
1. Combines flanged coupling adaptor and flanged spigot into one assembly.
  2. Longitudinal adjustment is provided by the telescoping action of the spigot inside the flanged coupling adapter. The joint shall accommodate up to 2 inches of longitudinal movement.
  3. Materials:  
  
Flanged Adaptor Body and Spigot: Steel– ASTM A53 or A283. Grade C, minimum yield strength of 30,000 psi.  
Follower Flange: Steel- ASTM A536, Ductile Iron per ASTM A536, or carbon steel, minimum yield of 30,000 psi.  
Gasket: Buna-N
  4. Manufacturing Smith Blair, Model 975, Romac DJ 400 Series or Dresser Manufacturing Co.

## 2.03 ACCESSORIES

- A. Joint Harnesses:
1. Tie bolts or studs shall be as shown in the following table. Bolt or stud material shall conform to ASTM B 193, Grade B7. Nuts shall conform to ASTM A 194, Grade 2H. Lug material shall conform to ASTM A 36, ASTM A 283, Grade B, C, or D, or ASTM A 285, Grade C. Lug dimensions shall be as shown in AWWA Manual M11, Table 19.7.



**TIE BOLTS OR STUD REQUIREMENTS  
FOR FLEXIBLE PIPE COUPLINGS**

Tie Bolt or Stud Minimum Requirements

Nominal Pipe Size (Inches)	150 psi		300 psi	
	No. Bolts or Studs	Size (Inches)	No. Bolts or Studs	Size (Inches)
2	2	5/8	2	5/8
3	2	5/8	2	5/8
4	2	5/8	2	4/8
6	2	5/8	2	5/8
8	2	5/8	2	5/8
10	2	5/8	2	5/8
12	2	3/4	2	7/8
14	2	3/4	2	1
16	2	7/8	2	1-1/4
18	2	1	2	1-3/8
20	2	1	2	1-1/2
24	4	1	4	1-1/4
30	4	1-1/8	4	1-1/2
36	4	1-1/4	4	1-3/4
42	4	1-1/2	6	1-5/8
48	6	1-3/8	6	1-7/8
54	6	1-1/2	6	2-1/4
60	6	1-5/8	8	2
66	6	1-3/4	8	2-1/4
72	6	1-7/8	10	2-1/4
84	6	2-1/4	12	2-1/4
96	8	2-1/4	14	2-1/4

2. Select number and size of bolts based on the test pressure shown in Section 15044. For test pressures less than or equal to 150 psi, use the 150-psi design in the table above. For test pressures between 150 and 300 psi, use the 300-psi design in the table above.
3. Provide washer for each lug. Washer material shall be the same as the nuts. Minimum washer thickness shall be 1/8-inch.

B. Bolts and Nuts for Flanges:

1. Bolts and nuts for flanges located indoors and in enclosed vaults and structures shall be carbon steel, ASTM A 307, Grade B.
2. Bolts and nuts for buried and submerged flanges, flanges in open vaults and structures, and flanges located outdoors above ground shall be Type 316 stainless steel conforming to ASTM A 193, Grade B8M for bolts, and ASTM A 194, Grade 8M for nuts. Bolts and nuts greater than 1 1/8-inches shall be carbon steel, ASTM A 307, Grade B., with cadmium plating, ASTM A 165, Type NS.
3. Bolts used in flange insulation kits shall conform to ASTM B 193, Grade B7. Nuts shall comply with ASTM A 194, Grade 2H.
4. Provide washers for each unit. Washers shall be of the same material as the nuts.

2.04 SPARE PARTS (Not Applicable)

2.05 QUALITY CONTROL

- A. Contractor shall follow Manufacturer's and Supplier's recommended product quality control specifics as required for this project.

PART 3 - EXECUTION

3.01 PREPARATION (Not Applicable)

3.02 INSTALLATION

A. Sleeve Type Couplings (when applicable):

1. Thoroughly clean pipe ends for a distance of 8 inches from the ends prior to installing couplings and use soapy water as a gasket lubricant.
2. Slip a follower ring and gasket (in that order) over each pipe and place the middle ring centered over the joint.
3. Insert the other length into the middle ring the proper distance.
4. Press the gaskets and followers evenly and firmly into the middle ring flares.

5. Insert the bolts, finger tighten and progressively tighten diametrically opposite nuts uniformly around the adapter with a torque wrench applying the torque recommended by the manufacturer.
  6. Insert and tighten the tapered threaded lock pins.
  7. Insert the nuts and bolts for the flange, finger tighten and progressively tighten diametrically opposite bolts uniformly around the flange to the torque recommended by the manufacturer.
- B. Split Type Flange Adapters (when applicable): Install in the same manner as Split Type Couplings.
- C. Buried Couplings, Adapters and Connectors (when applicable): Thoroughly coat all exterior surfaces, including nuts and bolts, after assembly and inspection by the Engineer with a heavy-bodied bituminous mastic as approved by the Engineer.
- D. Install thrust rods, supports, and other provisions to properly support pipe weight and axial equipment loads.

### 3.03 INSPECTION AND TESTING

- A. Hydrostatically test flexible pipe couplings, and joints, in place with the pipe being tested. Test in accordance with Section 15044.

### 3.04 START-UP AND INSTRUCTION (Not Applicable)

END OF SECTION

SECTION 15130  
PRESSURE GAUGES

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Scope of Work: This section includes materials and installation of pressure gauges and accessories.
- B. General Design: Minimum pressure rating shall be equal to that of the pipeline in which they are to be installed.

1.02 QUALITY ASSURANCE

- A. Qualifications: The manufacturer shall have a minimum of five (5) years experience in the manufacture of pressure gauges.
- B. Manufacturers: Gauges and tools shall be as manufactured by Ashcroft, Terrice, Winters Gauges, Palmer Gauges, or equal.

1.03 SUBMITTALS: Submit shop drawings in accordance with the General Conditions and Section 01340: Shop Drawings, Working Drawings, and Samples.

- A. Manufacturer's catalog data and descriptive literature.
- B. Materials of construction by ASTM reference and grade.
- C. Manufacturer's certificate of compliance with the referenced ANSI standards.

PART 2 - PRODUCTS

2.01 GENERAL

- A. Gauge Design: Gauges shall comply with ANSI B40.1, Grade 2A. Gauges shall incorporate the following features:
  - 1. Solid or open front with side or rear blowout relief.
  - 2. Pressure tight.

3. 270 degree arc with adjustable pointer.
4. Stem mounted.
5. Oil or glycerin filled unless specified otherwise.
6. Size of gauge shall be 4-1/2 inches for all process liquid and 6 inches for process air unless otherwise indicated on the Drawings.
7. Stem or connection size shall be 3/8 inch minimum.
8. Provide a gauge having a pressure range determined by the greater of the following two criteria:
  - a. Two times the normal operating pressure; and
  - b. One and one-third times the test pressure.
9. Gauges of size smaller than 4-1/2 inches shall conform to ANSI B40.1, Grade A. Otherwise, construction shall be as described above.

## 2.02 MATERIALS

- A. Materials of construction shall be as shown in the following table:

<u>Item</u>	<u>Material</u>	<u>Specification</u>
1. Case	Stainless steel	AISI 316
2. Bourdon tube	Stainless steel	AISI 316
3. Windows	Glass	--
4. Ring	Stainless steel	AISI 316
5. Stem	Stainless steel	AISI 316
6. Dial face	Aluminum with clear baked-on acrylic coating	6061-T6, ASTM B 209

## 2.03 ACCESSORIES

- A. Pipe Nipples and Fittings: Nipples for connection gauges to piping shall be Schedule 80S, Grade TP 316 seamless stainless steel, conforming to ASTM A 312. Fittings shall conform to ASTM A 403, Class WP316. Threads shall conform to ANSI B2.1. Size of pipe nipple shall match the gauge connection size.

- B. Tools for Gauges: Provide one gauge tool kit, containing a hand jack set, screwdriver, five reamers (minimum), two pin vise holders, wiggler, tweezers, and carrying case.
- C. Gauge Protectors (for use in process piping containing liquids having solids concentration greater than 1.0 percent):

1. Gauge protector shall consist of three parts: a flexible, impermeable, elastomer cylinder; a captive sensing liquid; and a stainless steel housing.
2. As process liquid flows through the housing, the cylinder shall transmit pressure through the sensing liquid. An attached 4-1/2 inch pressure gauge, as specified previously, shall indicate the pressure. Gauge outlet in the spool or ring shall be threaded, 1/4 inch, per ANSI B2.1.
3. Spools of sizes 1 inch through 4 inches shall be of the isolation-spool type with flanged ends. Spools of sizes 6 through 10 inches shall be of the isolation-ring type, fitting between two adjacent flanges.
4. Determine the flange rating based on the test pressure. For test pressure 200 psi and less, use Class 150 flanges, ANSI B16.5. For test pressures greater than 200 psi, use Class 300 flanges, ANSI B16.4.
5. Materials of construction shall be as follows:

<u>Item</u>	<u>Material</u>	<u>Specification</u>
Housing	Stainless steel	AISI 316
Flexible cylinder	Buna N. or Neoprene	---
Sensing liquid	Silicone oil	---

6. Protectors shall be manufactured by Ronningen-Petter, Red Valve, or equal.

- D. Diaphragm Seals (for use in all processing piping containing liquids, except potable and nonpotable water):

1. Provide diaphragm seals with gauge mountings where shown on the drawings. Material of construction shall be Type 316 stainless steel. Pressure rating shall be at least that of the pressure gauge to which it is attached. Liquid filling shall be silicone.

2. Gauge and diaphragm seal shall be assembled together at the factory, with the liquid fill included. Provide a Type 316 stainless steel plug or cock in the flush connection.
  3. Provide one pint of replacement fill liquid for every ten gauges having diaphragm seals or one pint for the entire project, whichever quantity is greater.
- E. Pressure Snubbers: Provide pressure snubbers with gauge mountings where shown on the Drawings. Material of construction shall be Type 303 or 316 stainless steel. Inlet and outlet connections shall be 1/2-inch NPT.

### PART 3 - EXECUTION

3.01 INSTALLATION: Install gauges before conducting pressure tests. Ream, clean and remove burrs from threaded piping before making up joints. Apply thread lubricant to threaded ends before assembling.

3.02 INSPECTION AND TESTING:

- A. Compare pressure readings of permanent gauges with Master test gauge. If reading of installed gauges varies by more than  $\pm 5$  percent from the Master gauge the installed gauge shall be replaced.
- B. Provide factory certification of testing and calibration for each Annular Seal or Diaphragm Seal Assembly. Unit shall be tested and calibrated in accordance with practice procedures on test equipment traceable to the National Institute of Standard (NIST).

END OF SECTION

## SECTION 15140

### PLUMBING SUPPORTS AND ANCHORS

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

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

##### 1.02 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. Pipe stands.
8. Equipment supports.

- B. Related Sections:

1. Division 5 for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.

##### 1.03 DEFINITIONS

- A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.



#### 1.04 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Structural Performance: Hangers and supports for HVAC 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.

#### 1.05 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show fabrication and installation details and include calculations for the following; include Product Data for components:
  - 1. Trapeze pipe hangers.
  - 2. Metal framing systems.
  - 3. Fiberglass strut systems.
  - 4. Pipe stands.
  - 5. Equipment supports.

#### 1.06 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

## PART 2 - PRODUCTS

### 2.01 METAL PIPE HANGERS AND SUPPORTS

#### A. Carbon-Steel Pipe Hangers and Supports (Electrical Room):

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
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 (Process Area):

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 Type 316 stainless steel.

### 2.02 TRAPEZE PIPE HANGERS

- #### A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

### 2.03 FIBERGLASS PIPE HANGERS

#### A. Clevis-Type, Fiberglass Pipe Hangers:

1. Description: Similar to MSS SP-58, Type 1, steel pipe hanger except hanger is made of fiberglass or fiberglass-reinforced resin.
2. Hanger Rods: Continuous-thread rod, washer, and nuts made of fiberglass or stainless steel.

B. Strap-Type, Fiberglass Pipe Hangers:

1. Description: Similar to MSS SP-58, Type 9 or Type 10, steel pipe hanger except hanger is made of fiberglass-reinforced resin.
2. Hanger Rod and Fittings: Continuous-thread rod, washer, and nuts made of stainless steel.

2.04 METAL FRAMING SYSTEMS

A. MFMA Manufacturer Metal Framing Systems:

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. B-line, an Eaton business.
  - b. Flex-Strut Inc.
  - c. Thomas & Betts Corporation; A Member of the ABB Group.
  - d. Unistrut; Part of Atkore International.
2. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes.
3. Standard: MFMA-4.
4. Channels: Continuous slotted steel channel with inturned lips.
5. Channel Nuts: Formed or stamped steel 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 (administration area) or stainless steel (process area).
7. Metallic Coating: Hot-dipped galvanized.

2.05 THERMAL-HANGER SHIELD INSERTS

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. Carpenter & Paterson, Inc.

2. Clement Support Services.
  3. ERICO International Corporation.
  4. National Pipe Hanger Corporation.
  5. Pipe Shields Inc.
  6. Piping Technology & Products, Inc.
  7. Rilco Manufacturing Co., Inc.
- B. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psi or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psi minimum compressive strength and vapor barrier.
  - C. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
  - D. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
  - E. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

## 2.06 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, stainless steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

## 2.07 PIPE STANDS

- A. Pipe stands in this article require calculating and detailing at each use.
- B. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.
- C. Compact Pipe Stand: One-piece plastic unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.

- D. Low-Type, Single-Pipe Stand: One-piece stainless-steel base unit with plastic roller, for roof installation without membrane penetration.
- E. Curb-Mounting-Type Pipe Stands: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

## 2.08 PIPE POSITIONING SYSTEMS

- A. Description: IAPMO PS 42, positioning system of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.

## 2.09 EQUIPMENT SUPPORTS

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

## 2.10 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
  - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
  - 2. Design Mix: 5000-psi, 28-day compressive strength.

# PART 3 - EXECUTION

## 3.01 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
  - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified 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-69 and MSS SP-89. Install hangers and attachments as required to properly support piping from building structure.
  - D. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.
  - E. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
  - F. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
  - G. Pipe Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture.
  - H. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
  - I. Install hangers and supports to allow controlled thermal 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.
  - J. Install lateral bracing with pipe hangers and supports to prevent swaying.
  - 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. 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. 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.
  - N. 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 to NPS 12: 12 inches long and 0.06 inch thick.
- 5. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

### 3.02 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.

### 3.03 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.

#### 3.04 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.

#### 3.05 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: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Section 09961.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

#### 3.06 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.



- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use carbon-steel pipe hangers and supports metal trapeze pipe hangers and metal framing systems and attachments for general service applications.
- F. Use fiberglass pipe hangers and corrosion-resistant attachments for nonmetallic piping applications in chemical areas.
- G. Use stainless-steel pipe hangers and stainless-steel attachments for metallic piping in process areas.
- H. Use padded hangers for piping that is subject to scratching.
- I. Use thermal-hanger shield inserts for insulated piping and tubing.
- J. 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. 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.
  - 3. 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.
  - 4. 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.
  - 5. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
  - 6. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
  - 7. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
  - 8. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.

9. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
  10. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
  11. 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.
  12. 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.
  13. 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.
- K. 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.
- L. 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.
- M. 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. C-Clamps (MSS Type 23): For structural shapes.
  5. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
  6. 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.
  7. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
  8. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
  9. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- N. 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.
- O. Comply with MSS SP-69 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

## SECTION 15190

### HVAC AND PLUMBING PIPING AND EQUIPMENT IDENTIFICATION

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

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

##### 1.02 SUMMARY

- A. Section Includes:
  - 1. Equipment labels.
  - 2. Pipe labels.
  - 3. Valve tags.

##### 1.03 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

##### 2.01 EQUIPMENT LABELS

- A. Metal Labels for Equipment:
  - 1. Material and Thickness: Brass, 0.032-inch or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.

2. Letter Color: White.
3. Background Color: Black.
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. 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: White.
3. Background Color: Black.
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.

- C. 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.

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

## 2.02 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. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- C. 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.

## 2.03 VALVE TAGS

- A. Description: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
  - 1. Tag Material: Brass, 0.032-inch or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
  - 2. Fasteners: Brass wire-link chain or beaded chain.
- 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

### 3.01 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.

### 3.02 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.

### 3.03 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

### 3.04 PIPE LABEL INSTALLATION

- A. Piping Color Coding: Painting of piping is specified in Division 9.
- B. 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.
- C. Directional Flow Arrows: Arrows shall be used to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.
- D. Pipe Label Color Schedule:
  1. Domestic Water Piping: White letters on a safety-green background

### 3.05 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.
  1. Valve-Tag Colors:
    - a. Potable and Other Water: White letters on a safety-green background.
    - b. 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

END OF SECTION

## SECTION 15256

### PLUMBING PIPING INSULATION

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

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

##### 1.02 SUMMARY

- A. Section includes insulating the following HVAC piping systems:
  - 1. Domestic cold-water piping.

##### 1.03 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).

##### 1.04 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.

##### 1.05 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 E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing 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.

## 1.06 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.

## 1.07 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 15140.
- 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.

## 1.08 SCHEDULING

- A. Schedule insulation application after pressure testing systems. 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

### 2.01 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 in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.

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. Aeroflex USA, Inc.
  - b. Armacell LLC.
  - c. K-Flex USA.

## 2.02 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: Comply with MIL-A-24179A, Type II, Class I.
- D. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
- E. PVC Jacket Adhesive: Compatible with PVC jacket.
  1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Dow Corning Corporation.
    - b. Johns Manville; a Berkshire Hathaway company.
    - c. P.I.C. Plastics, Inc.

## 2.03 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
- B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below-ambient services.
  1. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.

2. Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).
  3. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
  4. Color: White.
- C. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.
1. Water-Vapor Permeance: ASTM F 1249, 1.8 perms (1.2 metric perms) at 0.0625-inch (1.6-mm) dry film thickness.
  2. Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).
  3. Solids Content: 60 percent by volume and 66 percent by weight.
  4. Color: White.

## 2.04 SEALANTS

### A. Cellular-Glass, Phenolic, and Polyisocyanurate Joint Sealants:

### B. 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 (Minus 40 to plus 121 deg C).
4. Color: Aluminum.

### C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC 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 (Minus 40 to plus 121 deg C).
4. Color: White.

## 2.05 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-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.

## 2.06 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.
  - 1. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
  - 2. 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. Johns Manville; a Berkshire Hathaway company.
    - b. P.I.C. Plastics, Inc.
    - c. Proto Corporation.
  - 3. Adhesive: As recommended by jacket material manufacturer.
  - 4. Color: White.
  - 5. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
    - a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.
- C. Metal Jacket:

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. ITW Insulation Systems; Illinois Tool Works, Inc.
    - b. RPR Products, Inc.
  2. Aluminum Jacket: Comply with ASTM B 209, 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 Outdoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper.
    - d. Factory-Fabricated Fitting Covers:
      - 1) Same material, finish, and thickness as jacket.
      - 2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
      - 3) Tee covers.
      - 4) Flange and union covers.
      - 5) End caps.
      - 6) Beveled collars.
      - 7) Valve covers.
      - 8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.
- D. Underground Direct-Buried Jacket: 125-mil- (3.2-mm-) thick vapor barrier and waterproofing membrane consisting of a rubberized bituminous resin reinforced with a woven-glass fiber or polyester scrim and laminated aluminum foil.

## 2.07 TAPES

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

1. Width: 3 inches (75 mm).
  2. Thickness: 11.5 mils (0.29 mm).
  3. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
  4. Elongation: 2 percent.
  5. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
  6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
1. Width: 2 inches (50 mm).
  2. Thickness: 6 mils (0.15 mm).
  3. Adhesion: 64 ounces force/inch (0.7 N/mm) in width.
  4. Elongation: 500 percent.
  5. Tensile Strength: 18 lbf/inch (3.3 N/mm) in width.
- C. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
1. Width: 2 inches (50 mm).
  2. Thickness: 3.7 mils (0.093 mm).
  3. Adhesion: 100 ounces force/inch (1.1 N/mm) in width.
  4. Elongation: 5 percent.
  5. Tensile Strength: 34 lbf/inch (6.2 N/mm) in width.

## 2.08 SECUREMENTS

### A. Bands:

1. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing seal] or closed seal.
2. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.



- B. Staples: Outward-clinching insulation staples, nominal 3/4-inch- (19-mm-) wide, stainless steel or Monel.
- C. Wire: 0.062-inch soft-annealed, stainless steel.

## PART 3 - EXECUTION

### 3.01 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.
  - 3. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.02 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

### 3.03 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 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 application and finishing.

- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
  - 1. Install insulation continuously through hangers and around anchor attachments.
  - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
  - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
  - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
  - 1. Draw jacket tight and smooth.
  - 2. Cover circumferential joints with 3-inch wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
  - 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
    - a. For below-ambient services, apply vapor-barrier mastic over staples.
  - 4. Cover joints and seams with tape, 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 pipe flanges and fittings.

- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

#### 3.04 PENETRATIONS

- A. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations 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: Install insulation continuously through penetrations of fire-rated walls and partitions.
  - 1. Comply with requirements in Section 15160 for fire-stopping and fire-resistive joint sealers.
- E. 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 15160.

### 3.05 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
  - 1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
  - 2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
  - 3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
  - 4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
  - 5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
  - 6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.

7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
  8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
  9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
  2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
  3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
  4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
  5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

### 3.06 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

- A. Seal longitudinal seams and end joints with manufacturers 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 pipe insulation.
  - 4. Secure insulation to flanges and seal seams with manufacturers 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 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.

### 3.07 FIELD-APPLIED JACKET INSTALLATION

- A. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications. Seal with manufacturers 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.
- B. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

### 3.08 FINISHES

- A. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- B. Do not field paint aluminum or stainless-steel jackets.

### 3.10 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
  - 1. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.
- C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

### 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.

### 3.12 PIPING INSULATION SCHEDULE

- A. Outdoor Domestic Cold Water:

1. All Pipe Sizes: Insulation shall be one of the following:

a. Flexible Elastomeric: 2 inch thick.

B. Interior Domestic Cold Water:

1. NPS 1-1/4 to 2-1/2: Insulation shall be one of the following:

a. Flexible Elastomeric: 1 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. General Service – PVC, 30 mils thick.

2. Process/Chemical Areas – Stainless Steel, Type 316, Smooth 2B Finish, 0.016 inch thick.

### 3.14 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Piping, Concealed:

1. General Service – PVC, 30 mils thick.

2. Process/Chemical Areas – Stainless Steel, Type 316, Smooth 2B Finish, 0.016 inch thick.

D. Piping, Exposed:



1. General Service – PVC, 30 mils thick.
2. Process/Chemical Areas – Stainless Steel, Type 316, Smooth 2B Finish, 0.016 inch thick.

END OF SECTION

## SECTION 15258

### DUCTWORK INSULATION

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

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

##### 1.02 SUMMARY

- A. Section includes insulating the following duct services:
  - 1. Indoor, exposed supply and outdoor air.
- B. Related Sections:
  - 1. Section 15256 "Piping Insulation."
  - 2. Section 15815 "Metal Ducts" for double wall ductwork.

##### 1.03 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).

##### 1.04 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.

## 1.05 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 E 84, 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.

## 1.06 DELIVERY, STORAGE, AND HANDLING

- A. Retain this article to require shipping container markings. Container marking is an option in ASTM standards; default condition does not include the marking in this article unless specified in the Contract.
- B. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

## 1.07 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 15140.
- 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.

## 1.08 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

### 2.01 INSULATION MATERIALS

- A. If retaining more than one type of insulation in this article, indicate where each type applies in insulation system schedules.
- B. 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.
- C. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- D. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- E. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- F. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- G. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type II for sheet materials.
  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. Aeroflex USA, Inc.
    - b. Armacell LLC.
    - c. K-Flex USA.
- H. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type III with factory-applied FSP jacket] Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
  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. Johns Manville; a Berkshire Hathaway company.
    - b. Knauf Insulation.
    - c. Owens Corning.

- I. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation 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. Johns Manville; a Berkshire Hathaway company.
    - b. Knauf Insulation.
    - c. Owens Corning.

## 2.02 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
- B. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.
- C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
- D. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

## 2.03 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
- B. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below ambient services.
  - 1. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 35-mil dry film thickness.
  - 2. Service Temperature Range: 0 to 180 deg F.
  - 3. Solids Content: ASTM D 1644, 44 percent by volume and 62 percent by weight.
  - 4. Color: White.
- C. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.

1. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
2. Service Temperature Range: Minus 20 to plus 180 deg F.
3. Solids Content: 60 percent by volume and 66 percent by weight.
4. Color: White.

## 2.04 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.

## 2.05 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. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
2. FSP Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C 1136, Type II.

## 2.06 TAPES

### A. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.

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.

### 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 width.

## 2.07 SECUREMENTS

### A. Bands:

1. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch (0.38 mm) thick, 1/2 inch (13 mm) wide with wing seal.
2. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing seal.

### B. Insulation Pins and Hangers:

1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch-diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.

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

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

## 2.08 CORNER ANGLES

### A. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch, aluminum according to ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14.

### B. Stainless-Steel Corner Angles: 0.024 inch thick, minimum 1 by 1 inch, stainless steel according to ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316.

## PART 3 - EXECUTION

### 3.01 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.

### 3.02 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

### 3.03 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 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.

### 3.04 PENETRATIONS

- A. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- B. 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 15160.
- C. 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 15160.

### 3.05 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.

### 3.06 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 50 percent coverage of duct and plenum surfaces.
2. 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 over compress 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.
3. 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.

4. 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.
  5. 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.
  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.
- 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 50 percent coverage of duct and plenum surfaces.
  2. 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 over compress 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.
  3. 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.

4. 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.
5. 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.

### 3.07 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 15160.

### 3.08 FINISHES

- A. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

### 3.09 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
  1. Inspect ductwork, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each duct system defined in the "Duct Insulation Schedule, General" Article.
- C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

### 3.10 DUCT INSULATION SCHEDULE, GENERAL

- A. Plenums and Ducts Requiring Insulation:
  1. Indoor, exposed supply, return and outdoor air.

2. Outdoor, exposed supply and return air shall be double wall ductwork. See 15815 for additional details.

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.

### 3.11 INSULATION SCHEDULE

A. Exposed, rectangular, supply-air duct insulation shall be one of the following:

1. Mineral-Fiber Board: 2 inches thick and 2-lb/cu. ft. nominal density.

B. Exposed, rectangular, return-air duct insulation shall be one of the following:

1. Mineral-Fiber Board: 2 inches thick and 2-lb/cu. ft. nominal density.

### 3.12 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Ducts and Plenums, Concealed:

1. None.

B. Ducts and Plenums, Exposed:

1. None.

END OF SECTION

## SECTION 15260

### DUCT SUPPORTS

#### PART 1 - GENERAL

##### 1.01 SECTION INCLUDES

- A. Portable, non-penetrating, rooftop support system for:
  - 1. Ducts.
  - 2. HVAC equipment.
  - 3. Plumbing equipment.
  - 4. High Wind application for items listed above.

##### 1.02 RELATED SECTIONS

- A. Section 15815 - Ductwork and Accessories.

##### 1.03 REFERENCES

- A. ASTM A 123/A 123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- B. ASTM A 153/A 153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
- C. ASTM A 525 - Specification for General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process
- D. ASTM D 1929 - Standard Test Method for Determining Ignition Temperature of Plastics.
- E. MSS SP-58 - Pipe Hangers and Supports -- Materials, Design and Manufacture; Manufacturers Standardization Society of the Valve and Fittings Industry.
- F. MSS SP-69 - Pipe Hangers and Supports -- Selection and Application; Manufacturers Standardization Society of the Valve and Fittings Industry.

#### 1.04 SYSTEM DESCRIPTION

- A. Support piping on roof with an engineered prefabricated Duct Support System designed for installation without roof penetrations, flashing or damage to the roofing material. The system shall consist of bases, made of high density polypropylene plastics with UV Protection, a HDG structural steel frame and suitable pipe hangers for the application. Nuts, threaded rods and washers shall be HDG, spring nuts and bolts for spring nuts will be electro-plated. System shall be custom designed to fit piping and conduit to be installed and the actual conditions of service.
- B. Support ductwork on roof with an engineered prefabricated PHP-Duct System designed for installation without roof penetrations, flashing or damage to the roofing material. The system shall consist of bases, made of high density polypropylene plastics with UV Protection, and a HDG structural steel frame. Nuts, threaded rods and washers shall be HDG, spring nuts and bolts for spring nuts will be electro-plated. System shall be custom designed to fit the load requirements that will be required.
- C. High Wind applications shall be provided for all categories listed above.

#### 1.05 SUBMITTALS

- A. Submit under provisions of Section 01340.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
  - 1. Preparation instructions and recommendations.
  - 2. Storage and handling requirements and recommendations.
  - 3. Installation methods.
- C. Shop Drawings: Show installation layout, sizes of units, and details of installation.
- D. Verification Samples: Actual samples of bases, each type of support, hanger, and fasteners, and not less than 12 inches (300 mm) of framing members.
- E. Manufacturer's Certificates: Certify products meet or exceed specified requirements.
- F. Closeout Submittals: Provide manufacturer's maintenance instructions that include recommendations for periodic checking and adjustment of components.

#### 1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing pipe support systems, with a minimum of eight years of documented experience.

- B. Installer Qualifications: Company approved by manufacturer and with not less than five years of experience in installation of piping support systems.
- C. References: Submit list of references comprising not less than 10 installations that have been in use for a minimum of five years. Include contact name and phone numbers for each reference.
- D. Pre-Installation Meeting: After approval of submittals, but before beginning installation, conduct a meeting at project site attended by Architect, Contractor, installers of roofing, and mechanical and electrical piping to be installed on pipe support systems.
  - 1. Purpose of meeting is to describe in detail the installation process and to establish agreement, coordination, and responsibilities.
  - 2. Prepare detailed meeting report and distribute copies to the Architect and all attendees.

#### 1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver all materials to project site in manufacturer's original packaging, marked with manufacturer's name, product model names and catalog numbers, identification numbers, and other related information.
- B. Store materials under cover until needed for installation.

#### 1.08 WARRANTY

- A. See Section 01740 – Warranties and Bonds, for additional warranty requirements.
- B. Warranty: Provide 5 year limited warranty to repair or replace any products found to be structurally defective in material or workmanship.

### PART 2 - PRODUCTS

#### 2.01 MANUFACTURERS

- A. Acceptable Manufacturer: PHP Systems/Design or approved equal.

#### 2.02 APPLICATION

- A. Support pipes and ducts minimum of 6 inches above roof surface.
  - 1. Support Spacing: See Manufacturer's recommendations.



2. For Ductwork: Portable Pipe Hanger Model number PPH-D - Goal Post style.
3. For Ductwork: Portable Pipe Hanger Model number PPH-D - Enclosed style.
4. Accessories for PSE Custom and Other Applications when required
  - a. On Sloped Roof Surfaces, Where Slope Exceeds 1/4 inch per foot (13 mm per 305 mm): Provide base with swivel for slope adjustment. Note: PHP Approved bracing required when using base with swivel.
  - b. Un-insulated Piping: Roller support or clevis hanger.
  - c. Insulated Piping: Band hanger supported from horizontal strut or clevis hanger with Insulation Protection Shield.
  - d. Conduit: Band hanger supported from horizontal strut.
  - e. Bracing required when using base with swivel, when pipe exceeds 24 inches (610 mm) above roof, or when thermal expansion of pipe is great.

B. Attachment of Base to Roof Surface when required for a High Wind Application based on manufacturer's recommendations. May be either or a combination of the following:

1. Mechanically fastened to roof deck.

## 2.03 MATERIALS

- A. Portable Support System: Engineered, portable system specifically designed for installation without the need for roof penetrations or flashings, and without causing damage to the roofing membrane.
1. Design system using high density / high impact polypropylene bases with carbon black, anti-oxidants for UV protection, and steel framing for support is 1-5/8 inch (41 mm) B22TH or 1-7/8 inch (48 mm) BTS22TH.
  2. Custom design system to fit piping, conduits, equipment, or walkways to be installed and actual conditions of service and loading.
  3. Piping Supports: Provide suitable hangers and supports.
  4. Duct and Equipment Supports: Factory fabricated to support exact duct sizes and equipment to be installed.
  5. Walkways and Platforms: Provide galvanized slotted metal grating, in configurations as indicated, and tubular handrails where indicated.
- B. Bases: Injection molded high density / high impact polypropylene with UV-inhibitors and anti-oxidants, conforming to the following:
1. Moisture Content: Negligible.
  2. Shrinkage/Swelling Due to Moisture: Negligible.
  3. Density: 55.8 lb/cu ft (894 kg/cu m).
  4. Insect Resistance: No known insect damage potential.
  5. Chemical Resistance (oil, brake fluid, gasoline, diesel, antifreeze,

- battery acid, and sulfuric acid: No visual or physical change apparent.
6. Flammability: No ignition after 10 minutes, 25 kW/m, when tested in accordance with ASTM D 1929.
  7. Sized as required by loading conditions and as indicated on the drawings.
  8. Shop fabricated with inserts for square tubing or threaded rods as required.
  9. Color: Integral black color as molded.
  10. Bases for Mechanical Attachment: Sealant chamber around penetration point, with injection port for sealing after fastening; beveled lip for sealant bead around entire diameter.
  11. Do not use bases containing carbonated plastics, press molded recycled rubber and plastics, steel, stainless steel, or any injection molded threaded receivers.
- C. Stainless Steel Framing:
1. Channel Types: 1-5/8 inch (41.3 mm) or 1-7/8 inch (47.6 mm), as required for loading conditions.
  2. Thickness: 12 gage (2.7 mm).
  3. Form: Roll-formed 3-sided or tubular shape.
  4. Finish: Mill finish.
  5. Do not use tubing or tube steel.
- D. Pipe Supports and Hangers: Conform to MSS SP-58 and MSS SP-69 and as follows:
1. Fabricate of carbon steel where framing is carbon steel; fabricate of stainless steel where framing is stainless steel; finished same as framing.
  2. Sizes 2-1/2 inch (63 mm) and smaller: Single roller supports for piping subject to expansion and contraction; 3-sided channels and pipe clamps.
  3. Sizes 3 inch (76 mm) and larger: Rollers, clevis hangers, or band hangers, to allow for expansion and contraction without movement of the bases or framing.
- E. Accessories: Clamps, bolts, nuts, washers, and other devices as required for a complete system.
1. Carbon Steel: Hot-dip galvanized in accordance with ASTM A 153/A 153M.
  2. For Mechanical Fastening to Deck: For concrete decks use threaded rods and adhesive anchors, with rod embedded at least 1-3/4 inches (44 mm) into concrete.

## PART 3 - EXECUTION

### 3.01 EXAMINATION

- A. Verify that roofing system is complete and that roof surfaces are smooth, flat,

and ready to receive work of this section.

- B. Verify that roof surface temperature is at minimum 60 degrees F (15.5 degrees C), for proper adhesive performance.

### 3.02 PREPARATION

- A. Clean surfaces of roof in areas to receive portable support bases.
  - 1. Remove loose gravel from gravel surfaced roofs.
  - 2. Remove dirt, dust, oils, and other foreign materials.
  - 3. Use care in handling portable support system components during installation, to avoid damage to roofing, flashing, equipment, or related materials.

### 3.03 INSTALLATION

- A. Pipe and Duct Support Systems:
  - 1. Locate bases and support framing as indicated on drawings and as specified herein. Provide complete and adequate support of all piping, ducts, and conduit, whether or not all required devices are shown.
  - 2. The use of wood for supporting piping is not permitted.
  - 3. Provide supports spaced so deflection of piping does not exceed 1/240 of span.
  - 4. Install framing at spacing indicated, but in no case at greater than 10 feet (3m) on center.
  - 5. Accurately locate and align bases.
    - a. Consult manufacturer of existing or new roofing system as to the type of isolation pads required between the roof and base.
    - b. Set isolation pads in adhesive if required by manufacturer's instructions.
    - c. Place bases on isolation pads.
    - d. Adhere or mechanically attach if required by code.
    - e. Where applicable, replace gravel around bases.
  - 6. Set framing posts into bases and assemble framing structure as indicated.
  - 7. Use galvanized fasteners for galvanized framing and stainless steel fasteners for stainless steel framing.
- B. Duct Support Systems
  - 1. Locate bases and support framing as indicated on drawings and as specified herein. Provide complete and adequate support of all piping, ducts, and conduit, whether or not all required devices are shown.
  - 2. Accurately locate and align bases.

- a. Consult manufacturer of existing or new roofing system as to the type of isolation pads required between the roof and base.
  - b. Set isolation pads in adhesive if required by manufacturer's instructions.
  - c. Place bases on isolation pads.
  - d. Adhere or mechanically attach if required by code.
  - e. Where applicable, replace gravel around bases.
3. Place pre-assembled support on bases and attach framing post to base bracket with 1/2 inch bolts provided and adjust as needed. Support shall be adjustable to maintain existing elevation and slope.
  4. Use galvanized fasteners for galvanized framing and stainless steel fasteners for stainless steel framing.
- C. FIELD QUALITY CONTROL Provide a factory-trained representative of the manufacturer to visit the site while the work is in progress to assure that the installation conforms to the design requirements and the manufacturer's installation requirements.

#### 3.04 CLEANING AND PROTECTION

- A. Remove all packaging, unused fasteners, adhesive, and other installation materials from the project site.
- B. Remove adhesive from exposed surfaces of supports and bases, and leave the work in clean condition.
- C. Provide protection as required to leave the work in undamaged condition at the time of substantial completion.

END OF SECTION

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## SECTION 15300

### FIRE PROTECTION SYSTEM

#### PART 1 - GENERAL

##### 1.01 SUMMARY

A. This Section includes fire-suppression sprinklers, piping, and equipment for the following building systems:

1. Wet fire-suppression sprinkler systems, including piping, valves, specialties, automatic sprinklers, and accessories.

B. Work Included:

1. The system shall include all sprinklers, piping drain risers, cabinets, hangers, seismic bracing, alarms as required for a complete system. Buildings or areas will be fully sprinkled (exception only as per local code).
2. All areas will be supplied from a sprinkler riser system.
3. The lowest design temperature setpoint is above freezing so anti-freeze techniques against freezing will not be used.
4. Before any work is commenced, shop drawings shall be carefully prepared and submitted for approval. It is required that the sprinkler systems be sized hydraulically in accordance with NFPA standards. Submit hydraulic calculation of each system with shop drawings showing balanced system delivery, and balanced supply and demand for the appropriate hazard class as defined in NFPA 13, 2010 edition. Such drawings and calculations must be reviewed and approved by all governing authorities, Fire Department, and Owners Insurance Underwriters.

##### 1.02 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. Related Sections include the following:

1. Division 16 Section "Fire Alarm Systems" for alarm devices not in this Section.

### 1.03 DEFINITIONS

- A. Working Plans: Documents, including drawings, calculations, and material specifications prepared according to NFPA 13 for obtaining approval from authorities having jurisdiction.
- B. Automatic: As applied to fire protection devices, is a device or system providing an emergency function without the necessity for human intervention and activated as a result of a predetermined temperature rise, rate of temperature rise, or combustion products.
- C. Automatic Sprinkler System: A sprinkler system, for fire protection purposes, is an integrated system of underground and overhead piping designed in accordance with fire protection engineering standards. The system includes a suitable water supply. The portion of the system above the ground is a network of specially sized or hydraulically designed piping installed in a structure or area, generally overhead, and to which automatic sprinklers are connected in a systematic pattern. The system is usually activated by heat from a fire and discharges water over the fire area.
- D. Fire Protection System: Approved devices, equipment and systems or combinations of systems used to detect a fire, activate an alarm, extinguish or control a fire, control or manage smoke and products of a fire or any combination thereof.
- E. Initiating Device: A system component that originates transmission of a change-of-state condition, such as in a smoke detector, manual fire alarm box, or supervisory switch.
- F. Listed: Equipment, materials or services included in a list published by an organization acceptable to the code enforcement official and concerned with evaluation of products or services that maintains periodic inspection of production of listed equipment or materials or periodic evaluation of services and whose listing states either that the equipment, material or service meets identified standards or has been tested and found suitable for a specified purpose
- G. Record Drawings: Drawings ("as built") that document the location of all devices, appliances, wiring, sequences, wiring methods, and connections of the components of a fire alarm system as installed.
- H. NPS: National Pipe Standard.

### 1.04 SYSTEM PERFORMANCE REQUIREMENTS

- A. Contractor shall design sprinkler system according to Local Code and to the following and obtain approval from authorities having jurisdiction:

1. Include 10 percent margin of safety for available water flow and pressure.
  2. Include losses through water-service piping, valves, and backflow preventers.
  3. Sprinkler Occupancy Hazard Classifications: Shall be per Local Code, NFPA, and Requirements of the Authority having Jurisdiction. In the absence of more restrictive requirements, the following classifications shall apply:
    - a. Chemical Storage Rooms: Ordinary Hazard, Group 2.
  4. Minimum Density for Automatic Wet-Pipe Sprinkler Design: Shall be as follows:
    - a. Ordinary-Hazard, Group 2 Occupancy: 0.20 gpm over 1500-sq. ft. area.
  5. Sprinkler design area shall be increased 30% for sloped ceilings with a pitch exceeding 1 in 6 (a roof slope of 16.7 %).
  6. Maximum Protection Area per Sprinkler: Shall be in accordance with the sprinkler listing or as follows:
    - a. Chemical Storage Rooms: 130 sq. ft.
    - b. Other Areas: According to NFPA 13 recommendations, unless otherwise indicated.
- B. Components and Installation: Capable of producing piping systems with 175-psig minimum working-pressure rating, unless otherwise indicated.
- C. The sprinklers in all areas are to be installed in the center of the tile or centered with lights, diffusers or similar elements as indicated on the architectural reflected ceiling drawings. Sprinklers must also be installed on a true axis line in both directions with a maximum deviation from the axis line of ½" plus or minus. At the completion of the installation, if any sprinklers are found to exceed the above mentioned tolerance, same shall be removed and reinstalled by this Contractor at no additional cost to the Owner.
- D. Provide all sprinklers and work in strict conformance with approved shop drawings. The Architect and/or Design Engineer reserves the right to reject any and all work not in accordance with the approved shop drawing.
- E. Whether or not the system shown on the Contract Drawings meets the requirements of the National Fire Protection Association, these specifications require the



furnishing and installation of sprinkler systems complete in all details and in accordance with the standards of the National Fire Protection Association.

- F. Perform the following in areas where painting occurs or when sprinkler piping is painted. As soon as sprinklers are in place and the Contractor shall cover each head with a small bag of an Underwriter's approved type, which shall be removed only after all painting is complete. After the bag is removed, all heads shall be cleaned and polished.
- G. Hydraulic Calculations: Submit hydraulic calculations as part of the shop drawings. Prepare hydraulic calculations in accordance with NFPA 13 and the design criteria indicated on the drawings with the following exceptions:
  - 1. Minimum operating pressure of any sprinkler shall be according to NFPA 13 and UL listed.
  - 2. Pipe friction losses may be calculated by using the nearest foot for all piping over one foot in length. Horizontal lengths less than one foot may be neglected. Vertical length less than one foot shall be included for elevation purposes only.
  - 3. Flows shall be calculated to the nearest whole gallon.
  - 4. Velocity pressures may be neglected.
  - 5. Provide a minimum 10 percent pressure differential between the available water supply and total system demand of the calculated sprinkler flow plus hose demand at residual pressure required for system.
  - 6. Refer to sprinkler design criteria on drawings for additional information.

#### 1.05 SUBMITTALS

- A. Product Data:
  - 1. Pipe and fitting materials and methods of joining for sprinkler piping.
  - 2. Pipe hangers, supports, seismic bracing and restraints.
  - 3. Valves, including specialty valves, accessories, and devices.
  - 4. Alarm devices. Include electrical data.
  - 5. Sprinklers, escutcheons, and guards. Include sprinkler flow characteristics, mounting, finish, and other pertinent data.
- B. Fire-Hydrant Flow Test Report: This information is necessary to provide hydraulic calculations.

- C. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction. Include hydraulic calculations, for all applicable systems. Plans and calculations must be signed and stamped by a professional fire protection engineer registered in the State of Florida.
- D. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping" and "Contractor's Material and Test Certificate for Underground Piping."
- E. Record/ As-Built Drawings: Submit record/as-built drawings to the Architect and Engineer for approval. The drawings are to contain all the information required for working plans in accordance with NFPA 13.
- F. Operation and Maintenance Data: For each type of sprinkler specialty to include in maintenance manuals. Include a copy of NFPA 25.

#### 1.06 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has designed and installed fire-suppression piping similar to that indicated for this Project and obtained design approval and inspection approval from authorities having jurisdiction.
- B. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer. Base calculations on results of fire-hydrant flow test.
- C. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of fire-suppression piping that are similar to those indicated for this Project in material, design, and extent.
- D. Manufacturer Qualifications: Firms whose equipment, specialties, and accessories are listed by product name and manufacturer in UL's "Fire Protection Equipment Directory" and that comply with other requirements indicated.
- E. Sprinkler Components: Listing/approval stamp, label, or other marking by a testing agency acceptable to authorities having jurisdiction. All components shall be domestically produced by reputable manufacturer with all certificates in place. Components of questionable quality or origin shall not be used.
- F. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.

- G. NFPA Standards: In addition to Local Code Requirements, all Equipment, specialties, accessories, installation, and testing complying with the following:
  - 1. NFPA 13, "Installation of Sprinkler Systems."

#### 1.07 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Sprinkler Cabinets: Finished, wall-mounting steel cabinet and hinged cover, with space for a minimum of six spare sprinklers plus sprinkler wrench. Include the number of sprinklers required by NFPA 13 and wrench for sprinklers. Include separate cabinet with sprinklers and wrench for each type of sprinkler on Project. Unless otherwise noted, the cabinet shall be located in the incoming fire service valve room.

### PART 2 - PRODUCTS

#### 2.01 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Specialty Valves and Devices:
    - a. Vicatolic Co.
    - b. Globe Fire Sprinkler Corp.
    - c. Reliable Automatic Sprinkler Co., Inc.
    - d. Tyco Fire Products
    - e. Viking Corp.
  - 2. Water-Flow Indicators and Supervisory Switches:
    - a. System Sensor
    - b. Potter Electric Signal Co.

3. Sprinkler, Drain and Alarm Test Fittings:
  - a. Fire-End and Croker Corp.
  - b. AFG Manufacturing, Inc.
  - c. Victaulic Co.
4. Sprinkler, Branch-Line Test Fittings:
  - a. AFG Manufacturing, Inc.
  - b. Elkhart Brass Mfg. Co., Inc.
  - c. Fire-End and Croker Corp.
  - d. Potter Roemer.
5. Sprinkler, Inspector's Test Fittings:
  - a. Croker Corp.
  - b. Victaulic Co.
6. Sprinklers:
  - a. Globe Fire Sprinkler Corp.
  - b. Reliable Automatic Sprinkler Co., Inc.
  - c. Viking Corp.
  - d. Victaulic Co.
  - e. Tyco Fire Products

## 2.02 PIPING MATERIALS

- A. Refer to part 3.2 of this Section for applications of pipe, tube, fitting, and joining materials.

## 2.03 PIPES

- A. Refer to Part 3.2 of this Section.

## 2.04 PIPE FITTINGS

- A. Refer to Part 3.2 of this Section.

## 2.05 JOINING MATERIALS

- A. Refer to Part 3.2 of this Section.
- B. Refer to valve manufacturers listed in this document for gate, ball, butterfly, globe, and check valves not required to be UL listed.

## 2.06 FIRE-PROTECTION-SERVICE VALVES

- A. General: UL listed, with minimum 175-psig nonshock working-pressure rating or as required by local code and authority having jurisdiction. Valves for grooved-end piping may be furnished with grooved ends instead of type of ends specified.
- B. Provide Supervisory Tamper switches on all control valves. Wiring to alarm panel is under other sections of the work.
- C. Control valves of O.S. & Y. pattern gate valves with equalizing bypass for valves 6" and larger in size.

## 2.07 WATER-FLOW INDICATOR

- A. Provide where indicated, Potter Electric Switch Company, or other approved Type VSR-D Detector with flexible vane and retarding device to prevent false alarms from line surges.
- B. Wiring to fire alarm system will be provided by the Electrical Trade.

## 2.08 SPRINKLER DRAINS AND TEST CONNECTION

- A. Provide all necessary drain valves, drain risers, capped nipples, auxiliary piping, etc., as required to drain the system risers and mains and all trapped portions of the system. Drain valves which are not connected to drain pipes leading to floor drains shall be hose end type.
- B. Main drains and test connections shall be piped to the exterior of the building.
- C. Provide all piping required to spill the drains and test connections to the floor, funnel or other drainage connections provided under the Plumbing Contract, or arrange with the Plumbing Trade to provide additional drainage facilities, in which case pay all charges related to the additional Plumbing Construction work.
- D. Provide Inspectors Test connections in accordance with NFPA 13, and as required by Local Fire Department or authorities having jurisdiction. Pipe to exterior of the

building and include sight connection as necessary.

## 2.09 SPRINKLERS

- A. Provide approved automatic sprinklers of Victaulic Co., or other approved manufacturer.
- B. Sprinkler locations, type and finish as scheduled on the drawings.
- C. All sprinklers shall be of the proper temperature rating for the locations in which they are installed.
- D. Provide sprinkler guards where sprinklers are located 7'-0" AFF or where sprinklers are subject to damage.
- E. Provide stock of extra sprinklers, sprinkler wrenches in accordance with NFPA 13. Cabinets shall be Victaulic or other approved.

## 2.10 ALARM BELL

- A. Provide ACME or other approved, WSVB electric, weatherproof, underdome vibration alarm gongs. Waterflow alarm bell shall have a diameter of not less than 6 inches and have a factory red finish. Waterflow alarm bell shall be rated for 24 VDC and shall be connected to the building fire alarm system.

## 2.11 LADDERS

- A. Steel ladders to all valves located 7 ft. or as required by local authorities above finished floor will be provided by others.
- B. This Trade shall furnish a location list of all required ladders to the installing trade.

## 2.12 SPRINKLERS

- A. Automatic Sprinklers: With heat-responsive element complying with the following:
  - 1. UL 199.
- B. Sprinkler Types and Categories: As noted on the contract drawings.
- C. Sprinkler types, features, and options include the following:
  - 1. Upright sprinklers.
- D. Sprinkler Finishes: As noted on the contract drawings.

- E. Special Coatings: As noted on the contract drawings.
- F. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications, unless alternate finish is specified by architect. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.
- G. Sprinkler Guards: Wire-cage type, including fastening device for attaching to sprinkler. Guards shall be UL listed for use with the specific sprinkler (manufacturer and model) to be protected. Guards shall be provided on sprinklers located less than 7 feet above the finished floor and where specifically noted on the drawings.

### 2.13 SPECIALTY SPRINKLER FITTINGS

- A. Specialty Fittings: UL listed; made of steel, ductile iron, or other materials compatible with piping.
- B. Not used.
- C. Locking-Lug Fittings: UL 213, ductile-iron body with locking-lug ends.
- D. Mechanical-T Fittings: Not permitted.
- E. Mechanical-Cross Fittings: Not permitted.
- F. Drop-Nipple Fittings: UL 1474, with threaded inlet, threaded outlet, and seals; adjustable.
- G. Sprinkler, Drain and Alarm Test Fittings: UL-listed, cast- or ductile-iron body; with threaded inlet and outlet, test valve, and orifice and sight glass.
- H. Sprinkler, Branch-Line Test Fittings: UL-listed, brass body; with threaded inlet and capped drain outlet and threaded outlet for sprinkler.
- I. Sprinkler, Inspector's Test Fittings: UL-listed, cast- or ductile-iron housing; with threaded inlet and drain outlet and sight glass.

### 2.14 ALARM DEVICES

- A. General: Provide types matching piping and equipment connections.
- B. Water-Flow Indicators: UL 346; electrical-supervision, vane-type water-flow detector; with 250-psig pressure rating; and designed for horizontal or vertical installation. Include 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.

- C. Valve Supervisory Switches: UL 753; electrical; single-pole, double throw; with normally closed contacts. Include design that signals controlled valve is in other than fully open position.
- D. Indicator-Post Supervisory Switches: UL 753; electrical; single-pole, double throw, with normally closed contacts. Include design that signals controlled indicator-post valve is in other than fully open position.

## 2.15 PRESSURE GAUGES

- A. Pressure Gauges: UL 393, 3-1/2- to 4-1/2-inch- diameter dial with dial range of 0 to 300 psig, or to two times (2x) the working pressure, whichever is greater.

## 2.16 AUTOMATIC AIR VENT

- A. Furnish and install air release valve(s) at the high point(s) on the fire sprinkler system piping determined by the sprinkler system designer or engineer to assure evacuation of air from the system during and after filling. The automatic air release valve shall consist of a 40 mesh "Y" type strainer connected to an automatic air vent valve. The output of the air vent valve shall be a 1/2" NPT male connection which allows a drain attachment for safely draining inadvertent discharge of water that is inherent in the operation of the automatic air vent. Install drain pipe to appropriate location. The air vent assembly shall be field replaceable without disabling the sprinkler system by the installation of a 1/2" ball valve installed before the Y strainer for isolation purposes. The automatic air release valve shall be mounted in a vertical position and shall require a minimum of 8" of clearance above the fire sprinkler main or branch line piping. The Automatic Air Release Valve shall be a model PAV manufactured by Potter Electric Signal Company LLC or approved equal.

## 2.17 PRESSURE RELIEF VALVE

- A. Furnish and install a pressure relief trim device above the system check valve.
  - a. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
  - b. Pressure Rating: Factory set at 175 psi or 10 psi in excess of the maximum system pressure, whichever is greater.
  - c. Body Material: Bronze body and stainless steel spring.
  - d. Components: External identification plate and integral flushing handle to remove debris.
  - e. 1/2 inch MIPT inlet, 1/2 inch FIPT outlet
  - f. Relief pressure shall be factory set to project specifications.
  - g. Relief valve shall operate to the OPEN position between 90% and 105% of the set pressure.



- h. Relief valve shall reseal or CLOSE at a maximum of 80% of set pressure.

## PART 3 - EXECUTION

### 3.01 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 in Part 1 of this Section.
- B. Report test results promptly and in writing.

### 3.02 PIPING APPLICATIONS

- A. Do not use welded joints with galvanized steel pipe.
- B. Flanges, unions, and transition and special fittings with pressure ratings the same as or higher than system's pressure rating may be used in aboveground applications, unless otherwise indicated.
- C. Underground Service-Entrance Piping:
  - 1. Use ductile-iron, push-on-joint pipe and fittings and restrained joints.
  - 2. Use ductile-iron, mechanical-joint pipe and fittings and restrained joints.
- D. Aboveground Sprinkler Piping: Use the following:
  - 1. NPS 2 and Smaller:
    - a. Steel pipe shall be black, schedule 40 and shall conform to the applicable provisions of ASTM A53. Pipe shall have threaded ends, with malleable-iron threaded fittings, and threaded joints. Malleable iron fittings shall conform to ASME B16.3.
  - 2. NPS 2-1/2 and larger:
    - a. Steel pipe shall be black, schedule 40 and shall conform to the applicable provisions of ASTM A53. Pipe shall have threaded ends, with malleable-iron threaded fittings, and threaded joints. Malleable iron fittings shall conform to ASME B16.3.
    - b. Steel pipe shall be black, schedule 40 and shall conform to the applicable provisions of ASTM A53 with grooved ends; steel, grooved-end fittings; steel, keyed couplings; and grooved joints.

### 3.03 VALVE APPLICATIONS

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
  - 1. Fire-Protection-Service Valves: UL listed for applications where required by NFPA 13.
    - a. Shutoff Duty: Use gate valves.
  - 2. General-Duty Valves: For applications where UL listed valves are not required by NFPA 13.
    - a. Shutoff Duty: Use gate, ball, or butterfly valves.
    - b. Throttling Duty: Use globe, ball, or butterfly valves.
- B. Refer to Part 3.2 of this Section.

### 3.04 JOINT CONSTRUCTION

- A. Refer to Part 3.2 of this Section.
- B. Dissimilar-Piping-Material Joints: Construct joints using adapters or couplings compatible with both piping materials. Use dielectric fittings if both piping materials are metal.

### 3.05 SERVICE-ENTRANCE PIPING

- A. Connect sprinkler piping to water-service piping of size and in location indicated for service entrance to building.
- B. Install shutoff valve, check valve, pressure gauge, drain, and other accessories at connection to water service.

### 3.06 PIPING INSTALLATION

- A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.
  - 1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.
- B. Install underground service-entrance piping according to Local Code and NFPA 24 and with restrained joints.

- C. Use approved fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
- D. Install "Inspector's Test Connections" in sprinkler piping, complete with shutoff valve, sized and located according to NFPA 13.
- E. Install sprinkler piping with drains for complete system drainage.
- F. Install sprinkler zone control valves, test assemblies, and drain risers adjacent to sprinkler risers when sprinkler branch piping is connected to sprinkler risers.
- G. Install alarm devices in piping systems.
- H. Hangers and Supports: Comply with NFPA 13 for hanger materials and installation.
- I. Protection of Piping Against Earthquake Damage: Seismically protect the system piping against damage from earthquakes. Install the seismic protection of the system piping in accordance with NFPA 13.
- J. Install piping with grooved joints according to manufacturer's written instructions. Construct rigid piping joints, unless otherwise indicated.
- K. Install pressure gauges on riser or feed main and at each sprinkler test connection. Include pressure gauges with connection not less than NPS 1/4 and with soft metal seated globe valve, arranged for draining pipe between gauge and valve. Install gauges to permit removal, and install where they will not be subject to freezing.

### 3.07 VALVE INSTALLATION

- A. For installing general-duty valves. Install fire-protection specialty valves, trim, fittings, controls, and specialties according to NFPA 13, manufacturer's written instructions, and authorities having jurisdiction.
- B. Service Control Valves: Install fire-protection-service valves supervised-open, located to control sources of water supply except from fire department connections. Provide 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.

### 3.08 SPRINKLER APPLICATIONS

- A. General: Use sprinklers according to the following applications, or as directed by the Architect.

1. Rooms without Ceilings: Upright sprinklers, as indicated.
2. Sprinkler Finishes: Use sprinklers with the following finishes or as directed by the Architect.
  - a. Upright, Pendent, and Sidewall Sprinklers: Chrome-plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; nickel teflon where exposed to acids, chemicals, or other corrosive fumes.
  - b. Concealed Sprinklers: Rough brass, with factory-painted white cover plate; Color by Architect.

### 3.09 SPRINKLER INSTALLATION

- A. Sprinklers: Space, locate, and position sprinklers in accordance with the reflected ceiling plans and the design criteria.
  1. The sprinklers in all areas are to be installed on a true axis line in both directions with a maximum deviation from the axis line of ½" plus or minus from architects reflected ceiling plans. At the completion of the installation, if any sprinklers are found to exceed the above mentioned tolerance, same shall be removed and reinstalled by this Contractor.
  2. Install sprinklers in center of tiles.
  3. Provide all sprinklers and work in strict conformance with approved shop drawings. The Architect reserves the right to reject any and all work not in accordance with the approved shop drawing.
  4. Perform the following in areas where painting occurs or when sprinkler piping is painted. As soon as sprinklers are in place, the Contractor shall cover each sprinkler with a small bag of an Underwriter's approved type, which shall be removed only after all painting is complete. After the bag is removed, all sprinklers shall be cleaned and polished.
  5. Do not install pendant or sidewall, wet-type sprinklers in areas subject to freezing. Use dry type sprinklers. Locate water supply within heated space.

### 3.10 CONNECTIONS

- A. Connect water supplies to sprinklers. Include backflow preventers.
- B. Connect piping to specialty valves, specialties, and accessories.
- C. Electrical Connections: Power wiring is specified in Division 26.
- D. Connect alarm devices to fire alarm.

### 3.11 LABELING AND IDENTIFICATION

- A. Install labeling and pipe markers on equipment and piping according to requirements of the Authority having Jurisdiction, NFPA 13
- B. Install labeling and pipe markers on equipment and piping according to requirements as required by the Authority having Jurisdiction, NFPA 13

### 3.12 FIELD QUALITY CONTROL

- A. Flush, test, and inspect sprinkler piping according to the Authority having Jurisdiction, NFPA 13,
- B. Replace piping system components that do not pass test procedures and retest to demonstrate compliance. Repeat procedure until satisfactory results are obtained.
- C. Report test results promptly and in writing to Architect and authorities having jurisdiction.

### 3.13 CLEANING

- A. Clean dirt and debris from sprinklers.
- B. Remove and replace sprinklers having paint other than factory finish.

### 3.14 PROTECTION

- A. Protect sprinklers from damage until Substantial Completion.

### 3.15 COMMISSIONING

- A. Verify that specialty valves, trim, fittings, controls, and accessories are installed and
- B. Verify that specified tests of piping are complete.

- C. Verify that damaged sprinklers and sprinklers with paint or coating not specified are replaced with new, correct type.
- D. Verify that sprinklers are correct types, have correct finishes and temperature ratings, and have guards as required for each application.
- E. Verify that potable-water supplies have correct types of backflow preventers.
- F. Fill wet-pipe sprinkler piping with water.
- G. Energize circuits to electrical equipment and devices.
- H. Adjust operating controls and pressure settings.
- I. Coordinate with fire alarm tests. Operate as required.

### 3.16 DEMONSTRATION

- A. Demonstrate equipment, specialties, and accessories. Review operating and maintenance information.
- B. Schedule demonstration with Owner with at least seven days' advance notice.

END OF SECTION

## SECTION 15400

### PLUMBING SYSTEM

#### PART 1 - GENERAL

##### 1.01 WORK INCLUDED

- A. The following described work, materials and equipment shall be furnished and installed as shown on the Drawings and as herein specified.
  - 1. All plumbing fixtures, accessories and trims as shown on the Drawings and as herein specified.
  - 2. Domestic water service, specialties and piping to all fixtures and equipment.

##### 1.02 RELATED WORK

- A. Section 15140 – HVAC and Plumbing Supports and Anchors
- B. Section 15160 – HVAC and Plumbing Through Penetration Fire Stopping
- C. Section 15256 – HVAC and Plumbing Piping Insulation
- D. Section 15410 – Plumbing System Valves

##### 1.03 REFERENCES

- A. All plumbing installation and fabrication shall be in accordance with applicable State and Local Plumbing Codes.

##### 1.04 SUBMITTALS

- A. Submit catalog data and shop drawings for all materials and equipment listed under this section and per basic mechanical requirements. Include submittal data on related specifications also.
- B. Materials, fixtures, or equipment installed without review or after rejection shall be replaced by this contractor with acceptable items at the Engineer's direction.
- C. All materials, equipment, and appliances shall be new, without defect, first line quality unless specifically noted or specified otherwise.
- E. The supplier, by submitting, certifies the materials and equipment to be satisfactory for the application involved.
- F. Submit line drawings for review on all piping and equipment to be installed.

- G. Contractor further agrees that if deviations, discrepancies or conflicts between submittals and specifications are discovered either prior to or after submittals are processed by the engineer, the design drawings and specifications shall control and be followed.

#### 1.05 SERVICE AND UTILITY CONNECTIONS

- A. The source of water for potable use in the building will be brought to the building under another Division of the work and left as a flanged connection at point 5-ft-0-in outside the building or as otherwise shown on the Drawings.
- B. The backflow preventer unit shall be furnished and installed complete with all components as shown on Water Riser Diagrams. The water connections shall be made to these units as shown and from these points furnish and install all water to the building, equipment, fixtures and apparatus, as shown on the Drawings.

### PART 2 - PRODUCTS

#### 2.01 PLUMBING FIXTURES

- A. General: Provide all plumbing fixtures complete with trim required and connect in a manner conforming to the local Building Code. Certain fixtures may be furnished by others under other sections of these Specifications. Provide rough-in and final connections including all valves, traps, specialties, etc. required.
- B. Provide traps for all waste connections where not furnished with the equipment and stop cocks or valved shut-offs for all water connections to all sinks and other items of equipment. All exposed pipe and metal, including that within cabinets, shall be chrome plated.
- C. Faucets, trim, eyewashes and emergency showers furnished to Division 15 contractor by Division 11 contractor for installation by Division 15 contractor
- D. Reduced-Pressure-Backflow-Preventer (BFP):

Manufacturers: Apollo Flow Controls; WATTS, or Zurn Industries, LLC.

Standard: ASSE 1013

Operation: Continuous-pressure applications

Body: Bronze for NPS 2 and smaller; Cast Iron with interior lining that complies with AWWA C550 for NPS 2-1/2 and larger

End Connections: Threaded for NPS 2 and smaller; Flanged for NPS 2-1/2 and larger

Accessories:

Valves NPS 2 and smaller: Ball type with threaded ends on inlet and outlet



Air-Gap fittings: ASME A112.1.1, matching backflow-preventer connection. Provide test kits factory calibrated, with gages, fittings, hoses and carrying case with test-procedure instructions.

- E. Emergency Shower/Eye Wash Unit (ESS-1):  
Units shall have a 10-in cyclac plastic shower head and eye wash bowl, stay open ball valves and hand and foot control for eye wash. Units shall be complete with automatic flow control devices as required to limit emergency shower flow to 20 gpm and eye wash flow to 3 gpm. An emergency identification sign shall be included with each unit. Furnish and install flow alarm switches in conjunction with emergency showers, Haws 9001 or equal. Provide one emergency shower test kid for each building containing an emergency shower. Provide exterior showers with anti-scauld and freeze protection bleed valves.  
Units shall be one of the following with modifications as required to meet the requirements specified:

Haws - Model No. 8320

Guardian - Model No. G-1902-P-HFC

Western - Model No. 9201

Bradley - Model No. S19-310AC (Substitute yellow impact-resistant bowl)

- F. See fixture schedule on the drawings for additional fixtures.

## 2.02 DOMESTIC WATER PIPING SYSTEM

- A. Under-building-slab:
1. Copper Pipe, 3" and smaller: Type K hard drawn copper per ASTM B-88. Fittings: Wrought copper or cast brass. Joints: Lead free, tin-silver solder.
  2. Ductile Iron Pipe (D.I.P.), 4" and larger: Cement lined, per ANSI/AWWA C151/A21.51.
  3. Joints: Shall be push on or mechanical type as indicated on drawings.
- B. Above Grade (Exterior Piping):
1. Copper Pipe: Type L hard drawn copper per ASTM B-88. Fittings: Wrought copper or cast brass. Joints: Lead-free, tin-silver solder.

Note: Mechanically formed TEE connections will be allowed on hard drawn copper only. Joints must be brazed in accordance with the copper development association copper tube handbook using B-cup series filler metal, and manufacturing recommendations.

C. Above Grade (Inside Process 50 Building):

1. CPVC Pipe: Pipe and fittings shall be manufactured from virgin CPVC (chlorinated polyvinyl chloride) vinyl compounds with a cell class of 24448 as identified in ASTM D-1784. All pipe and fittings shall conform to ASTM D-2846 and National Sanitation Foundation (NSF) Standards 14 and 61. Buried pipe shall be installed in accordance with ASTM F-1668. Solvent cement joints shall be made using CPVC cement conforming to ASTM F-493

2.03 DOMESTIC WATER SPECIALTIES

A. Water Hammer Arrestors (WHA):

Standard: Meets ASSE 1010 and sized in accordance with PDI WH-201

Type: Copper tube with piston

Size: ASSE 1010, AA and A through F, or PDI-WH 201, Sizes A through F.

Arrestors shall be precharged suitable for operation in temperature range -100 to 300 degrees F and maximum 250 psig working pressure;

Model Z-1700 manufactured by Zurn; Josam, Wade or equal.

PART 3 - EXECUTION

3.01 DOMESTIC WATER PIPING SYSTEM

- A. Provide a complete system of domestic water piping including interior and exterior work as indicated.
- B. Piping shall be accurately cut to measurements established at the project site, worked into place without springing or forcing, run as directly as possible, run parallel or perpendicular to building lines, located as indicated on the Drawings and supported as specified elsewhere. Parallel piping shall be grouped together as much as practical. Piping shall be supported as high as practical. Piping not located in mechanical rooms shall be concealed unless noted otherwise.
- C. Piping shall be run as directly as possible, avoiding all unnecessary fittings and joints. Changes in routing of piping due to field conditions shall be at the expense of this Contractor.
- D. Contractor shall provide for expansion and contraction of piping systems. Expansion and contraction of piping shall not impart excess stress or strain on the building, pipe fittings, joints or connections to equipment.

- E. Piping shall be installed with sufficient spacing between fittings, valves, flanges, etc. so as to allow insulation fittings to be installed without trimming or modification.
- F. Provide sleeves for all piping penetrations of grade beams, floors above grade and walls. Sleeves for insulation piping above grade shall be sized for the insulation diameter. Sleeves for piping through walls below grade shall be sized for use of compressible rubber link seals unless noted otherwise.
- G. Piping thru slabs on grade shall be protected with 1/2" thick closed cell flexible foam insulation minimum 6 inches above and below slab. Wrap or coat all pipe layed in gravel or in contact with concrete.
- H. Provide escutcheon plates at each exposed piping penetration of walls and ceilings. Escutcheon plates for insulated piping shall be sized for the insulation diameter.
- I. All piping shall be installed to allow complete draining, slope as required. Provide drain valves at all low points where fixtures cannot be used to drain piping. Provide hose bibb with 3/4" hose connection and vacuum breaker/backflow preventer at water main entrance.
- J. Provide shutoff valves at each branch from main. Provide shutoff valves for each fixture group to minimize interruption of service for maintenance and repair. Provide an exterior main shutoff valve and valve box as indicated on drawings.
- K. Piping thru metal studs shall be isolated from metal to metal contact with plastic bushings specifically designed for the application.
- L. Provide water hammer arrestors for each fixture group as indicated. Capacity of each water hammer arrestor shall meet or exceed the total fixture units of each fixture group. All water hammer arrestors shall be accessible for inspection and/or replacement, provide access panels as required.
- M. All stubouts and exposed piping shall be rigidly supported to eliminate movement.
- N. This Contractor shall complete all equipment connections to the domestic water piping system. Provide shutoff valves and unions for each connection.
- O. Connections to water heaters and connections between ferrous and copper pipe shall be made with dielectric unions or flanges. Joints between plastic and metallic pipe shall be made with transition fittings for the specified purpose.
- P. Exterior water line shall have a minimum of 24" cover.

### 3.02 TESTING

- A. All piping shall be tested before being insulated or concealed in any manner. Where leaks or defects develop, required corrections shall be made and tests repeated until systems are proven satisfactory.
- B. Water piping systems shall be subjected to a hydrostatic test of one hundred twenty five pounds minimum or 1 1/2 times operating pressure, whichever is greater. The system shall be proven tight after a twenty-four (24) hour test.
- C. Provide test report in booklet form showing all field tests performed to prove compliance with the specified performance criteria. Booklet shall be submitted prior to submitting for final payment. Booklet shall include the following
  - a. SYSTEM TESTED (sanitary) (domestic water) (rain leaders)
  - b. Date of test
  - c. Test medium
  - d. Persons present
  - e. Pressure tested
  - f. Lines tested
  - g. Length of time test pressure was held
  - h. Pressure drop
  - i. Water pressure at most remote and highest location
  - j. residual chlorine
- D. This Contractor shall conduct all specified tests until approved by the Engineer. All tests shall be repeated until approved by the Engineer. Piping systems shall not be covered or otherwise concealed until tests inspections have been made and approvals obtained. This Contractor shall notify the Engineer four days prior to testing to allow for scheduling.
- E. All reduced Pressure Backflow Preventers (RPBP) and Double Check Backflow Preventers (DCBP) shall be tested by City Utilities or someone certified to test such devices and certificate shall be submitted indicating devices that passed tests.

### 3.03 STERILIZATION OF DOMESTIC WATER PIPING SYSTEM

- A. Thoroughly flush for a minimum of two hours and then drain the domestic water piping prior to sterilizing by the following method or other methods satisfactory to the Engineer and the Authority Having Jurisdiction.
- B. The Engineer reserves the right to test the water again at any time prior to final acceptance of the work and if found to be unsafe bacteriologically, to require the Contractor to rechlorinate the system until the water is proven equal to that supplied

by the public system.

- C. Contractor shall arrange for laboratory testing for a bacteriological examination of potable water system at various locations. The samples shall be tested to meet requirement of city and shall not be of less quality than provided by city. Submit copy from testing agency prior to submitting for final payment.
- D. Minor work such as repairs or replacement of single fitting or valve, pre-clean and disinfect by immersion in solution of 300 ppm chlorine for 1 hour.

#### 3.04 CLEANING

- A. At completion of all work, fixtures, exposed materials and equipment shall be thoroughly cleaned.
- B. All strainer screens, shall be removed and cleaned.

#### 3.05 FINAL ACCEPTANCE

Before final acceptance, the Plumbing Contractor shall furnish a certificate of inspection and final approval from the plumbing Inspector to the Owner and be in accordance with the latest revisions of the applicable codes and the Approved Plumbing Drawings and Specifications. Contractor shall also furnish booklet of test, sterilization compliance and backflow devices certificates.

END OF SECTION

## SECTION 15410

### PLUMBING SYSTEM VALVES

#### PART 1 - GENERAL

##### 1.01 WORK INCLUDED

- A. Furnish all labor, materials, equipment, and incidentals required and install complete and ready for operation all valves and appurtenances as shown on the Drawings and as specified herein.
- B. The valves included are:
  - 1. Ball valves
  - 2. Check valves
  - 3. Strainers

##### 1.02 SYSTEM DESCRIPTION

All of the materials specified herein is intended to be standard for use in controlling the flow of water, gases, or air, depending on the applications.

##### 1.03 QUALITY ASSURANCE

All of the types of valves shall be products of well established firms who are fully experienced, reputable and qualified in the manufacture of the particular product to be furnished. All materials of construction shall be of an acceptable type and shall be designated for the pressure and temperatures at which they are to be operated, for the materials they are to handle and for the use for which they are intended. The materials shall meet established technical standards of quality and strength necessary to assure safe installations and conform to applicable standards. The equipment shall be designed, constructed and installed in accordance with the best practices and methods and shall comply with these Specifications as applicable.

##### 1.04 SUBMITTALS

- A. Copies of all materials required to establish compliance with these Specifications shall be submitted. Submittals shall include at least the following:
  - 1. Certified drawings showing all important details of construction and dimensions.

2. Descriptive literature, bulletins, and/or catalogs cut sheets.
3. The total weight of each item.
4. A list of the manufacturer's recommended spare parts with one set to be turned over to the owner at final acceptance.
5. Manufacturer's standard warranty (two year minimum) for all materials provided.

## PART 2 - PRODUCTS

### 2.01 ACCEPTABLE MANUFACTURERS

- A. Where a manufacturer is referenced, equivalent valves by Homestead, Lunkenheimer, Milwaukee, or Stockham will be acceptable.

### 2.02 MATERIALS

- A. General
  1. All valves and appurtenances shall be of the size shown on the Drawings and as far as possible, all valves shall be from one manufacturer.
  2. All valves and appurtenances shall have the name of the maker, flow directional arrows, and the working pressure for which they are designed cast in raised letters upon some appropriate part of the body.

### 2.03 VALVE CONNECTIONS

- A. Provide valves suitable to connect to adjoining piping as specified for pipe joints. Use pipe size valves.
- B. Solder pipe sizes 2 inches and smaller.
- C. Flange pipe sizes 2-1/2 inches and larger.
- D. Solder or screw to solder adapters for copper tubing as required.

### 2.04 BALL VALVES

- A. Sizes 2" and smaller shall be Nibco Figure No. S-585-70-66; Bronze case; stainless steel ball & stem; TFE seats; packing and gaskets, 150 psi working steam pressure.

- B. Sizes 2-1/2" and larger shall require gate valves.

#### 2.05 CHECK VALVES (Swing Type)

- A. Sizes 2" and smaller shall be Nibco Figure No. S-413-W; bronze, solder ends with screwed cap, swing check, renewable bronze disc, working steam pressure 125 psi.
- B. Sizes 2-1/2" and larger shall be Nibco Figure No. F-918; swing check, flanged with bolted bonnet, renewable bronze seat and disc, working steam pressure 125 psi.

#### 2.06 STRAINERS

- A. Sizes 2" and smaller shall be Watts No. S777M1; "Y" type, bronze body, solder ends, #20 mesh stainless steel strainer screen, provide closure plug as required, working steam pressure 125 psi.
- B. Sizes 2-1/2" and larger shall be Watts No. 77F-ZD-FDA; "Y" type, cast iron body, flanged, #20 mesh stainless steel strainer screen, working steam pressure 125 psi.

### PART 3 - EXECUTION

#### 3.01 INSTALLATION

- A. All valves and appurtenances shall be installed in the locations shown, true to alignment and rigidly supported. Any damage to the above items shall be repaired to the satisfaction of the ENGINEER before they are installed.
- B. Control valves in all locations shall be so grouped and located that they may be easily operated, through access panels, doors, or adjacent to equipment.
- C. Valves shall be the same size as the pipe it is to be installed in.
- D. Valves 2 inches and smaller shall be solder end.
- E. Valves 2-1/2 inches and larger shall be flanged.
- F. Valves shall be installed with stems upright or horizontal, not inverted.
- G. Provide gate or ball valves for shut-off and isolating service, to isolate equipment, part of systems, or vertical risers as indicated on the drawings.



- H. Provide globe, or angle valves for throttling service and control device or meter by-pass.
- K. Provide drain valves at main shut-off valves, and low points of piping and where fixture cannot be used to drain piping.

END OF SECTION

## SECTION 15815

### DUCTWORK AND ACCESSORIES

#### PART 1 - GENERAL

##### 1.01 SUMMARY

A. Section Includes:

1. Rectangular ducts and fittings.
2. Double-wall rectangular ducts and fittings
3. Sheet metal materials.
4. Sealants and gaskets.
5. Hangers and supports.
6. Manual volume dampers.
7. Control dampers.
8. Flange connectors.
9. Turning vanes.
10. Duct-mounted access doors.
11. Flexible ducts.
12. Duct accessory hardware.

##### 1.02 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 performance requirements and design criteria indicated in "Duct Schedule" Article.
- B. Structural Performance: Duct hangers and supports and seismic restraints shall withstand the effects of gravity and seismic loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems."
1. Seismic Hazard Level A: Seismic force to weight ratio, 0.48.
- C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

##### 1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. 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, and static-pressure classes.
4. Elevation of top of ducts.
5. Dimensions of main duct runs from building grid lines.
6. Fittings.
7. Reinforcement and spacing.
8. Seam and joint construction.
9. Penetrations through fire-rated and other partitions.
10. Equipment installation based on equipment being used on Project.
11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
12. Hangers and supports, including methods for duct and building attachment, seismic restraints, and vibration isolation.
13. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:
  - a. Special fittings.
  - b. Manual volume damper installations.
  - c. Control-damper installations.
  - d. Fire-damper and smoke-damper installations, including sleeves; and duct-mounted access doors.
  - e. Wiring Diagrams: For power, signal, and control wiring.

C. 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, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation for selecting hangers and supports and seismic restraints.

#### 1.04 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
  1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
  2. Suspended ceiling components.
  3. Structural members to which duct will be attached.
  4. Size and location of initial access modules for acoustical tile.
  5. Penetrations of smoke barriers and fire-rated construction.
  6. Items penetrating finished ceiling including the following:
    - a. Lighting fixtures.
    - b. Air outlets and inlets.
    - c. Speakers.
    - d. Sprinklers.
    - e. Access panels.
    - f. Perimeter moldings.
- B. Welding certificates.

#### 1.05 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
  1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
  2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.
  3. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.
- B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."

- C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

## PART 2 - PRODUCTS

### 2.01 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 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."
- C. Longitudinal Seams: Select seam types and fabricate according to 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."
- D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 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."

### 2.02 DOUBLE-WALL RECTANGULAR DUCTS AND FITTINGS

- 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. McGill AirFlow LLC.
  - 2. MKT Metal Manufacturing.
  - 3. Sheet Metal Connectors, Inc.

- B. Outer Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," based on static-pressure class unless otherwise indicated.
1. Transverse Joints: Select joint types and fabricate according to 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."
  2. Longitudinal Seams: Select seam types and fabricate according to 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."
  3. Tees and Laterals: Select types and fabricate according to 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."
- C. Inner Duct: Minimum 0.028-inch solid sheet steel.
- D. Interstitial Insulation: Fibrous-glass liner complying with ASTM C 1071, 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.
- E. Interstitial Insulation: Flexible elastomeric duct liner complying with ASTM C 534, 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.

## 2.03 SHEET METAL MATERIALS

- A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
  - 1. Galvanized Coating Designation: G90.
  - 2. Finishes for Surfaces Exposed to View: Mill phosphatized.
- C. Carbon-Steel Sheets: Comply with ASTM A 1008/A 1008M, with oiled, matte finish for exposed ducts.
- D. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304 or 316, as indicated in the "Duct Schedule" Article; cold rolled, annealed, sheet. Exposed surface finish shall be No. 2B, No. 2D, No. 3, or No. 4 as indicated in the "Duct Schedule" Article.
- E. Aluminum Sheets: Comply with ASTM B 209 Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.
- F. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized. 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.
- G. 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.

## 2.04 SEALANT AND GASKETS

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
- 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: 3 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. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

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. Flanged Joint Sealant: Comply with ASTM C 920.

1. General: Single-component, acid-curing, silicone, elastomeric.
2. Type: S.
3. Grade: NS.
4. Class: 25.



- 5. Use: O.
- 6. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- E. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.
- F. Round Duct Joint O-Ring Seals:
  - 1. Seal shall provide maximum 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.

## 2.05 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Cadmium-plated 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 A 603.
- E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.
- F. Steel Cable End Connections: Cadmium-plated 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.

## 2.06 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.

## 2.07 MANUAL VOLUME DAMPERS

- A. Standard, Aluminum, Manual Volume Dampers:
  1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Air Balance Inc.; a division of Mestek, Inc.
    - b. American Warming and Ventilating; a division of Mestek, Inc.
    - c. McGill AirFlow LLC.
    - d. Nailor Industries Inc.
    - e. Pottorff.
    - f. Ruskin Company.
    - g. Trox USA Inc.
    - h. Vent Products Company, Inc.
  2. Standard leakage rating.
  3. Suitable for horizontal or vertical applications.
  4. Frames: Hat-shaped, 0.10-inch- thick, aluminum sheet channels; frames with flanges for attaching to walls and flangeless frames for installing in ducts.
  5. Blades:
    - a. Multiple or single blade.
    - b. Parallel- or opposed-blade design.
    - c. Stiffen damper blades for stability.
    - d. Roll-Formed Aluminum Blades: 0.10-inch- thick aluminum sheet.

- e. Extruded-Aluminum Blades: 0.050-inch- thick extruded aluminum.
  - 6. Blade Axles: Galvanized steel.
  - 7. Bearings:
    - a. Molded synthetic.
    - b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
  - 8. Tie Bars and Brackets: Aluminum.
- B. Jackshaft:
  - 1. Size: 0.5-inch diameter.
  - 2. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
  - 3. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.
- C. Damper Hardware:
  - 1. Zinc-plated, die-cast core with dial and handle made of 3/32-inch- thick zinc-plated steel, and a 3/4-inch hexagon locking nut.
  - 2. Include center hole to suit damper operating-rod size.
  - 3. Include elevated platform for insulated duct mounting.

## 2.08 CONTROL DAMPERS

- 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. American Warming and Ventilating; a division of Mestek, Inc.
  - 2. Arrow United Industries; a division of Mestek, Inc.
  - 3. Cesco Products; a division of Mestek, Inc.
  - 4. Greenheck Fan Corporation.
  - 5. Lloyd Industries, Inc.

6. McGill AirFlow LLC.
  7. Metal Form Manufacturing, Inc.
  8. Nailor Industries Inc.
  9. NCA Manufacturing, Inc.
  10. Pottorff.
  11. Ruskin Company.
  12. Vent Products Company, Inc.
  13. Young Regulator Company.
- B. Frames:
1. Hat shaped.
  2. 0.094-inch- thick, galvanized sheet steel.
  3. Mitered and welded corners.
- C. Blades:
1. Multiple blades with maximum blade width of 6 inches.
  2. Opposed-blade design.
  3. Aluminum.
  4. 0.064 inch thick single skin or 0.0747-inch- thick dual skin.
  5. Blade Edging: Closed-cell neoprene PVC.
  6. Blade Edging: Inflatable seal blade edging, or replaceable rubber seals.
- D. Blade Axles: 1/2-inch- diameter; galvanized steel; blade-linkage hardware of zinc-plated steel and brass; ends sealed against blade bearings.
1. Operating Temperature Range: From minus 40 to plus 200 deg F.
- E. Bearings:
1. Molded synthetic.

2. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
3. Thrust bearings at each end of every blade.

## 2.09 FIRE DAMPERS

- 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. Air Balance Inc.; a division of Mestek, Inc.
  2. Arrow United Industries; a division of Mestek, Inc.
  3. Cesco Products; a division of Mestek, Inc.
  4. Greenheck Fan Corporation.
  5. Nailor Industries Inc.
  6. NCA Manufacturing, Inc.
  7. Pottorff.
  8. Prefco; Perfect Air Control, Inc.
  9. Ruskin Company.
  10. Vent Products Company, Inc.
  11. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Type: Static; rated and labeled according to UL 555 by an NRTL.
- C. Closing rating in ducts up to 4-inch wg static pressure class and minimum 2000-fpm velocity.
- D. Fire Rating: 1-1/2 and 3 hours.
- E. Frame: Curtain type with blades inside airstream; fabricated with roll-formed, 0.034-inch- thick galvanized steel; with mitered and interlocking corners.
- F. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.
  1. Minimum Thickness: 0.05-inch- thick, as indicated, and of length to suit application.

2. Exception: Omit sleeve where damper-frame width permits direct attachment of perimeter mounting angles on each side of wall or floor; thickness of damper frame must comply with sleeve requirements.

G. Mounting Orientation: Vertical or horizontal as indicated.

H. Blades: Roll-formed, interlocking, 0.034-inch- thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch- thick, galvanized-steel blade connectors.

I. Horizontal Dampers: Include blade lock and stainless-steel closure spring.

J. Heat-Responsive Device: Replaceable, 165 deg F rated, fusible links.

## 2.10 FLANGE CONNECTORS

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. Ductmate Industries, Inc.
2. Nexus PDQ; Division of Shilco Holdings Inc.
3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Description: Add-on or roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.

C. Material: Galvanized steel.

D. Gage and Shape: Match connecting ductwork.

## 2.11 TURNING VANES

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. Ductmate Industries, Inc.
2. Duro Dyne Inc.
3. Elgen Manufacturing.
4. METALAIRE, Inc.
5. SEMCO Incorporated.

6. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
  1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.
- C. Manufactured Turning Vanes for Nonmetal Ducts: Fabricate curved blades of resin-bonded fiberglass with acrylic polymer coating; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
- D. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 4-3, "Vanes and Vane Runners," and 4-4, "Vane Support in Elbows."
- E. Vane Construction: Double wall.

#### 2.12 DUCT-MOUNTED ACCESS DOORS

- 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. American Warming and Ventilating; a division of Mestek, Inc.
  2. Cesco Products; a division of Mestek, Inc.
  3. Ductmate Industries, Inc.
  4. Elgen Manufacturing.
  5. Flexmaster U.S.A., Inc.
  6. Greenheck Fan Corporation.
  7. McGill AirFlow LLC.
  8. Nailor Industries Inc.
  9. Pottorff.
  10. Ventfabrics, Inc.
  11. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

- B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 7-2, "Duct Access Doors and Panels," and 7-3, "Access Doors - Round Duct."
1. Door:
    - a. Double wall, rectangular.
    - b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
    - c. Vision panel.
    - d. Hinges and Latches: 1-by-1-inch butt or piano hinge and cam latches.
    - e. Fabricate doors airtight and suitable for duct pressure class.
  2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
  3. Number of Hinges and Locks:
    - a. Access Doors Less Than 12 Inches Square: No hinges and two sash locks.
    - b. Access Doors up to 18 Inches Square: Two hinges and two sash locks.
    - c. Access Doors up to 24 by 48 Inches: Continuous and two compression latches.
    - d. Access Doors Larger than 24 by 48 Inches: Continuous and two compression latches with outside and inside handles.

## 2.13 FLEXIBLE CONNECTORS

- 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. Ductmate Industries, Inc.
  2. Duro Dyne Inc.
  3. Elgen Manufacturing.
  4. Ventfabrics, Inc.
  5. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Materials: Flame-retardant or noncombustible fabrics.
- C. Coatings and Adhesives: Comply with UL 181, Class 1.
- D. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches wide attached to two strips of 2-3/4-inch- wide, 0.028-inch- thick, galvanized



sheet steel or 0.032-inch- thick aluminum sheets. Provide metal compatible with connected ducts.

- E. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.
  - 1. Minimum Weight: 26 oz./sq. yd.
  - 2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
  - 3. Service Temperature: Minus 40 to plus 200 deg F.
- F. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.
  - 1. Minimum Weight: 24 oz./sq. yd.
  - 2. Tensile Strength: 530 lbf/inch in the warp and 440 lbf/inch in the filling.
  - 3. Service Temperature: Minus 50 to plus 250 deg F.

#### 2.14 DUCT ACCESSORY HARDWARE

- A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.
- B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

### PART 3 - EXECUTION

#### 3.01 DUCT INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.
- B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- C. Install round ducts in maximum practical lengths.
- D. Install ducts with fewest possible joints.

- E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
- F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
- I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
- J. 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.
- K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Section 15820 "Duct Accessories" for fire and smoke dampers.
- L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."

### 3.02 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 the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.
- E. Repair or replace with new, damaged sections and finished work that does not comply with these requirements.

### 3.03 DUCT ACCESSORIES INSTALLATION

- A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.
- B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.
- C. Install backdraft dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.
- D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Install volume dampers as far as possible from ceiling diffusers, supply grilles, return and exhaust grilles. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.
  - 1. Install steel volume dampers in steel ducts.
  - 2. Install aluminum volume dampers in aluminum ducts.
- E. Set dampers to fully open position before testing, adjusting, and balancing.
- F. Install test holes at fan inlets and outlets and elsewhere as indicated.
- G. Install fire and smoke dampers according to UL listing.
- H. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
  - 1. On both sides of duct coils.
  - 2. Upstream and downstream from duct filters.
  - 3. At outdoor-air intakes and mixed-air plenums.
  - 4. At drain pans and seals.
  - 5. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
  - 6. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors and shall be

outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.

7. At each change in direction and at maximum 50-foot spacing.
  8. Upstream and downstream from turning vanes.
  9. Upstream or downstream from duct silencers.
  10. Control devices requiring inspection.
  11. Elsewhere as indicated.
- I. Install access doors with swing against duct static pressure.
- J. Access Door Sizes:
1. One-Hand or Inspection Access: 8 by 5 inches.
  2. Two-Hand Access: 12 by 6 inches.
  3. Head and Hand Access: 18 by 10 inches.
  4. Head and Shoulders Access: 21 by 14 inches.
  5. Body Access: 25 by 14 inches.
  6. Body plus Ladder Access: 25 by 17 inches.
- K. Label access doors according to Section 15876 "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.
- L. Install flexible connectors to connect ducts to equipment.
- M. Connect terminal units to supply ducts with maximum 12-inch lengths of flexible duct. Do not use flexible ducts to change directions.
- N. Connect diffusers to ducts with maximum 60-inch lengths of flexible duct clamped or strapped in place.
- O. Connect flexible ducts to metal ducts with adhesive plus sheet metal screws.
- P. Install duct test holes where required for testing and balancing purposes.

### 3.04 DUCT SEALING

- A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

B. Seal ducts to the following seal classes according to 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.

### 3.05 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 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.

### 3.06 SEISMIC-RESTRAINT-DEVICE INSTALLATION

- A. Install ducts with hangers and braces designed to support the duct and to restrain against seismic forces required by applicable building codes. Comply with SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems."
  1. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
  2. Brace a change of direction longer than 12 feet.
- B. Select seismic-restraint devices with capacities adequate to carry present and future static and seismic loads.
- C. Install cables so they do not bend across edges of adjacent equipment or building structure.
- D. Install cable restraints on ducts that are suspended with vibration isolators.
- E. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction.
- F. Attachment to Structure: If specific attachment is not indicated, anchor bracing and restraints to structure, to flanges of beams, to upper truss chords of bar joists, or to concrete members.

G. Drilling for and Setting Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcement or embedded items during drilling. Notify the Architect if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Set anchors to manufacturer's recommended torque, using a torque wrench.
5. Install zinc-coated steel anchors for interior applications and stainless-steel anchors for applications exposed to weather.

3.07 CONNECTIONS

- A. Make connections to equipment with flexible connectors complying with Section 15820 "Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.08 DUCT CLEANING

- A. Clean new duct system(s) before testing, adjusting, and balancing.
- B. Use service openings for entry and inspection.
  1. Create new openings and install access panels appropriate for duct static-pressure class if required for cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Section 15820 "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.
- C. 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.
- D. 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.
- E. 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 according to NADCA 1992. 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 according to manufacturer's written instructions after removal of surface deposits and debris.

### 3.09 FIELD QUALITY CONTROL

#### A. Tests and Inspections:

1. Operate dampers to verify full range of movement.
2. Inspect locations of access doors and verify that purpose of access door can be performed.
3. Operate fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
4. Inspect turning vanes for proper and secure installation.

### 3.10 START UP

- #### A. Air Balance: Comply with requirements in Section 15950 "Testing, Adjusting, and Balancing."

### 3.11 DUCT SCHEDULE

#### A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:

1. Electrical Room Ductwork (Indoor): Galvanized Steel.
2. Electrical Room Ductwork (Outdoor): Double-Wall Rectangular Ducts

#### B. Supply Ducts:

1. Ducts Connected to Constant-Volume Air-Handling Units:
  - a. Pressure Class: Positive 2-inch wg.
  - b. Minimum SMACNA Seal Class: B.
  - c. SMACNA Leakage Class for Rectangular: 12.

2. Ducts Connected to Equipment Not Listed Above:
    - a. Pressure Class: Positive 2-inch wg.
    - b. Minimum SMACNA Seal Class: B.
    - c. SMACNA Leakage Class for Rectangular: 12.
- C. Return Ducts:
1. Ducts Connected to Air-Handling Units:
    - a. Pressure Class: Positive or negative 2-inch wg.
    - b. Minimum SMACNA Seal Class: C.
    - c. SMACNA Leakage Class for Rectangular: 24.
    - d. SMACNA Leakage Class for Round and Flat Oval: 12.
  2. Ducts Connected to Equipment Not Listed Above:
    - a. Pressure Class: Positive or negative 2-inch wg.
    - b. Minimum SMACNA Seal Class: C
    - c. SMACNA Leakage Class for Rectangular: 24.
    - d. SMACNA Leakage Class for Round and Flat Oval: 12.
- D. Intermediate Reinforcement:
1. Galvanized-Steel Ducts: Galvanized steel.
- E. 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."

F. 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: Spin in.
2. Round: 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

## SECTION 15835

### PACKAGED, LARGE-CAPACITY, ROOFTOP AIR-CONDITIONING UNITS

#### PART 1 - GENERAL

##### 1.01 SUMMARY

- A. Section includes packaged, large-capacity, rooftop air conditioning units (RTUs) and accessories:
  - 1. Casings.
  - 2. Fans.
  - 3. Motors.
  - 4. Coils.
  - 5. Refrigerant circuit components.
  - 6. Air filtration.
  - 7. Dampers.
  - 8. Electrical power connections.
  - 9. Controls.
  - 10. Accessories
  - 11. Roof curbs.

##### 1.02 DEFINITIONS

- A. DDC: Direct-digital controls.
- B. ECM: Electronically commutated motor.
- C. Outdoor-Air Refrigerant Coil: Refrigerant coil in the outdoor-air stream to reject heat during cooling operations and to absorb heat during heating operations. "Outdoor air" is defined as the air outside the building or taken from outdoors and not previously circulated through the system.
- D. RTU: Rooftop unit. As used in this Section, this abbreviation means packaged, large-capacity, rooftop air-conditioning units. This abbreviation is used regardless of whether the unit is mounted on the roof or on a concrete base on ground.
- E. Supply-Air Fan: The fan providing supply air to conditioned space. "Supply air" is defined as the air entering a space from air-conditioning, heating, or ventilating apparatus.
- F. Supply-Air Refrigerant Coil: Refrigerant coil in the supply-air stream to absorb heat (provide cooling) during cooling operations and to reject heat (provide

heating) during heating operations. "Supply air" is defined as the air entering a space from air-conditioning, heating, or ventilating apparatus.

### 1.03 ACTION SUBMITTALS

- A. Product Data: Include manufacturer's technical data for each RTU, including rated capacities, dimensions, required clearances, characteristics, furnished specialties, and accessories.
- B. Shop Drawings:
  - 1. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 2. Include diagrams for power, signal, and control wiring.
- C. Delegated-Design Submittal: For RTU supports indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
  - 1. Design Calculations: Calculate requirements for selecting vibration and for designing vibration isolation bases.
  - 2. Detail mounting, securing, and flashing of roof curb to roof structure. Indicate coordinating requirements with roof membrane system.
  - 3. Wind Restraint Details: Detail fabrication and attachment of wind restraints and snubbers. Show anchorage details and indicate quantity, diameter, and depth of penetration of anchors.

### 1.04 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plans and other 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. Structural members to which RTUs will be attached.
  - 2. Roof openings.
  - 3. Roof curbs and flashing.
- B. Field quality-control reports.
- C. Sample Warranty: For special warranty.

1.05 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

1.06 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Fan Belts: Two sets for each belt-driven fan.
  - 2. Filters: Two sets of filters for each unit.

1.07 QUALITY ASSURANCE

- A. ASHRAE Compliance:
  - 1. Comply with ASHRAE 33 for methods of testing cooling and heating coils.
  - 2. Comply with applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
- B. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."
- C. NFPA Compliance: Comply with NFPA 90A and NFPA 90B.
- D. UL Compliance: Comply with UL 1995.
- E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.08 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of RTUs that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period for Compressors: Manufacturer's standard, but not less than five years from date of Substantial Completion.
  - 2. Warranty Period for Solid-State Ignition Modules: Manufacturer's standard, but not less than three years from date of Substantial Completion.

3. Warranty Period for Control Boards: Manufacturer's standard, but not less than three years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.01 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide air handling units as scheduled and shown on drawings or a comparable product by one of the following:
  1. AAON, Inc.
  2. Addison Products Company.
  3. Carrier Corporation.
  4. Engineered Air.
  5. Lennox Industries Inc.
  6. McQuay International.
  7. Trane; American Standard Companies, Inc.
  8. YORK International Corporation.

### 2.02 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design mounting and restraints for RTUs, including comprehensive engineering analysis.
  1. Design RTU supports to comply with wind performance requirements.
- B. Wind-Restraint Performance:
  1. Basic Wind Speed: Refer to S001
  2. Building Classification Category: Refer to S001
  3. Minimum 10 lb/sq. ft. multiplied by the maximum area of the mechanical component projected on a vertical plane that is normal to the wind direction, and 45 degrees either side of normal.

### 2.03 CAPACITIES AND CHARACTERISTICS

- A. See Schedules.

## 2.04 CASING

- A. General Fabrication Requirements for Casings: Formed and reinforced double-wall insulated panels, fabricated to allow removal for access to internal parts and components, with joints between sections sealed.
- B. Exterior Casing Material: Galvanized steel with factory-painted finish, with pitched top panels and knockouts with grommet seals for electrical and piping connections and lifting lugs.
  - 1. Exterior Casing Thickness: 0.052 inch thick.
- C. Inner Casing Fabrication Requirements:
  - 1. Inside Casing: Galvanized steel, 0.034 inch, perforated 40 percent free area.
- D. Casing Insulation and Adhesive: Comply with NFPA 90A or NFPA 90B.
  - 1. Materials: ASTM C 1071, Type I.
  - 2. Thickness: 1 inch.
  - 3. Liner materials shall have air-stream surface coated with an erosion- and temperature-resistant coating or faced with a plain or coated fibrous mat or fabric.
  - 4. Liner Adhesive: Comply with ASTM C 916, Type I.
- E. Condensate Drain Pans: Formed sections of stainless-steel sheet, a minimum of 2 inches deep, and complying with ASHRAE 62.1.
  - 1. Double-Wall Construction: Fill space between walls with foam insulation and seal moisture tight.
  - 2. Drain Connections: Threaded nipple both sides of drain pan.
  - 3. Pan-Top Surface Coating: Corrosion-resistant compound.
- F. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.



2.05 FANS

- A. Belt-Driven Supply-Air Fans: Double width double inlet, forward curved, centrifugal; with permanently lubricated, multi-speed motor installed on an adjustable fan base resiliently mounted in the casing. Aluminum or painted-steel wheels, and galvanized- or painted-steel fan scrolls.
- B. Fan Motor: Comply with requirements in Division 16.

2.06 COILS

A. Supply-Air Refrigerant Coil:

- 1. Aluminum or Copper-plate fin and seamless copper tube in steel casing with equalizing-type vertical distributor.
- 2. Polymer strip shall prevent all copper coil from contacting steel coil frame or condensate pan.
- 3. Coil Split: Interlaced.
- 4. Corrosion-Resistant Coating: Apply a corrosion-resistant coating capable of withstanding a 3,000 hour salt-spray test according to ASTM B 117 to base, frame, and casing coils and fan guards
  - a. Standards:
    - 1) ASTM B-117 for salt spray.
    - 2) ASTM D-2794 for minimum impact resistance of 100 in-lb
    - 3) ASTM B-3359 for cross-hatch adhesion of 5B.
  - b. Application: Spray.
  - c. Thickness: 1 mil.
  - d. Gloss: Minimum of 50 gloss units on a single-angle, 60-degree meter.
- 5. Condensate Drain Pan: Stainless steel formed with pitch and drain connections complying with ASHRAE 62.1.

B. Refrigeration Specialties:

- 1. Refrigerant: R-410A.
- 2. Expansion valve with replaceable thermostatic element.

3. Refrigerant filter/dryer.
4. Manual-reset high-pressure safety switch.
5. Automatic-reset low-pressure safety switch.
6. Minimum off-time relay.
7. Automatic-reset compressor motor thermal overload.
8. Brass service valves installed in compressor suction and liquid lines.
9. Low-ambient kit high-pressure sensor.
10. Hot-gas reheat solenoid valve single stage or modulating with a replaceable magnetic coil.
11. Hot-gas bypass solenoid valve with a replaceable magnetic coil.
12. Four-way reversing valve with a replaceable magnetic coil, thermostatic expansion valves with bypass check valves, and a suction line accumulator.

C. Hot-Gas Reheat Refrigerant Coil:

1. Aluminum or Copper-plate fin and seamless copper tube in steel casing with equalizing-type vertical distributor.
2. Polymer strip shall prevent all copper coil from contacting steel coil frame or condensate pan.
3. Corrosion-Resistant Coating: Apply a corrosion-resistant coating capable of withstanding a 3,000 hour salt-spray test according to ASTM B 117 to base, frame, and casing coils and fan guards
  - a. Standards:
    - 1) ASTM B-117 for salt spray.
    - 2) ASTM D-2794 for minimum impact resistance of 100 in-lb
    - 3) ASTM B-3359 for cross-hatch adhesion of 5B.
  - b. Application: Spray.
  - c. Thickness: 1 mil.
  - d. Gloss: Minimum of 50 gloss units on a single-angle, 60-degree meter.
4. Suction-discharge bypass valve.

## 2.07 AIR FILTRATION

- A. Minimum arrestance according to ASHRAE 52.1, and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.
- B. Pleated, minimum MERV 8.

## 2.08 DAMPERS

- A. Discharge-Air Damper Two-position, opposed-blade galvanized-steel dampers mechanically fastened to cadmium plated for galvanized-steel operating rod with motorized damper.
- B. Outdoor- and Return-Air Mixing Dampers: Parallel- or opposed-blade (select proper blade type to provide the best air mixing) galvanized-steel dampers mechanically fastened to cadmium plated for galvanized-steel operating rod in reinforced cabinet. Connect operating rods with common linkage and interconnect linkages so dampers operate simultaneously.
  - 1. Damper Motor: Modulating with adjustable minimum position.
  - 2. Relief-Air Damper: Gravity actuated or motorized, as required by ASHRAE/IESNA 90.1, with bird screen and hood.

## 2.09 ELECTRICAL POWER CONNECTION

- A. Provide for single connection of power to unit with unit-mounted disconnect switch accessible from outside unit and control-circuit transformer with built-in overcurrent protection.

## 2.10 CONTROLS

- A. Control equipment and sequence of operation are shown on drawings.
- B. Basic Unit Controls:
  - 1. Control-voltage transformer.
  - 2. Wall-mounted thermostat or sensor with the following features:
    - a. Fan on-auto switch.
    - b. Automatic changeover.

- c. Adjustable deadband.
- d. Concealed set point.
- e. Concealed indication.
- f. Degree F indication.

C. Controller:

1. Controller shall have volatile-memory backup.
2. Safety Control Operation:
  - a. Smoke Detectors: Stop fan and close its associated outdoor-air or its associated discharge-air damper if smoke is detected. Provide additional contacts for alarm interface to fire alarm control panel.
  - b. Firestats: Stop fan and close outdoor-air or discharge-air damper if air greater than 130 deg F enters unit. Provide additional contacts for alarm interface to fire alarm control panel.
  - c. Fire Alarm Control Panel Interface: Provide control interface to coordinate with operating sequence described in Fire Alarm System specification."
3. Scheduled Operation: See Sequence of Operation on drawings.
4. Supply Fan Operation: See Sequence of Operation on drawings.
5. Economizer Outdoor-Air Damper Operation:
  - a. See Sequence of Operation on drawings.

2.11 ACCESSORIES

- A. Duplex, 115-V, ground-fault-interrupter outlet with 15-A overcurrent protection. Include transformer if required. Outlet shall be energized even if the unit main disconnect is open.
- B. Filter differential pressure switch with sensor tubing on either side of filter. Set for final filter pressure loss.

2.12 CAPACITIES AND CHARACTERISTICS

- A. See Drawings.

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. Roof Curb: Install on roof structure or concrete base, level and secure, according to NRCA's "NRCA Roofing Manual: Membrane Roof Systems." Install RTUs on curbs and coordinate roof penetrations and flashing with roof. Secure RTUs to upper curb rail, and secure curb base to roof framing or concrete base with anchor bolts.
- B. Unit Support: Install unit level on structural curbs. Coordinate wall penetrations and flashing with wall construction. Secure RTUs to structural support with anchor bolts.
- C. Install piping adjacent to air handling units to allow service and maintenance. Connect supply and return ducts to air handling units with flexible duct connectors specified in Section 15881 "Galvanized Sheet Metal Ductwork."

### 3.02 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. Report results in writing.
- B. Perform tests and inspections and prepare test reports.
  - 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. Report results in writing.
- C. Tests and Inspections:
  - 1. After installing air handling units and after electrical circuitry has been energized, test units for compliance with requirements.
  - 2. Inspect for and remove shipping bolts, blocks, and tie-down straps.
  - 3. 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 with new.

- D. Remove and replace malfunctioning units with new and retest as specified above.

### 3.03 CLEANING AND ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to site during other-than-normal occupancy hours for this purpose.
- B. After completing system installation and testing, adjusting, and balancing air handling unit and air-distribution systems, clean filter housings and install new filters.

END OF SECTION

## SECTION 15838

### FRP POWER VENTILATORS

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

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

##### 1.02 SUMMARY

- A. Section Includes:
  - 1. FRP Propeller fans.

##### 1.03 PERFORMANCE REQUIREMENTS

- A. Project Altitude: Base fan-performance ratings on actual Project site elevations.
- B. Operating Limits: Classify according to AMCA 99.

##### 1.04 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Also include the following:
  - 1. Certified fan performance curves with system operating conditions indicated.
  - 2. Certified fan sound-power ratings.
  - 3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
  - 4. Material thickness and finishes, including color charts.
  - 5. Dampers, including housings, linkages, and operators.
  - 6. Fan speed controllers.
- 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. Delegated-Design Submittal: For unit hangars and supports indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- 1.05 INFORMATIONAL SUBMITTALS
- A. Field quality-control reports.
- 1.06 CLOSEOUT SUBMITTALS
- A. Operation and Maintenance Data: For power ventilators to include in emergency, operation, and maintenance manuals.
- 1.07 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.
- 1.08 QUALITY ASSURANCE
- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. AMCA Compliance: Fans shall have AMCA-Certified performance ratings and shall bear the AMCA-Certified Ratings Seal.
- C. UL Standards: Power ventilators shall comply with UL 705. Power ventilators for use for restaurant kitchen exhaust shall also comply with UL 762.
- 1.09 COORDINATION
- A. Coordinate size and location of structural-steel support members.
- B. Coordinate sizes and locations of concrete bases with actual equipment provided.



- C. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

## PART 2 - PRODUCTS

### 2.01 PROPELLER FANS

- 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. M. K. Plastics Corporation or approved equal.
- B. General:
  - 1. Base fan performance at standard conditions (density 0.075 Lb/ft<sup>3</sup>).
  - 2. Each fan shall be direct driven in AMCA arrangement 4 according to drawings.
  - 3. Motor /Fan assembly support shall be fabricated of corrosion resistant FRP.
  - 4. Fasteners to be 304 stainless steel.
- C. Fan Assembly:
  - 1. Fan assembly shall be designed and configured for exhaust ventilation or make-up air supply, as shown on the project drawings.
  - 2. Fan assembly to be aerodynamically designed with high-efficiency venturi, engineered to reduce air turbulence.
  - 3. Fan venturi, and motor support shall be manufactured in specifically formulated resins, for maximum corrosion resistance and reinforced with fiberglass for structural strength. Resins shall be UV inhibited and be formulated for a flame retardancy of 25 or less. Fastening bolts holding the motor to the support plate shall be 304 stainless steel.
  - 4. Fans shall be supplied with a graphite coating and grounding strap to remove static electricity for potentially explosive applications, if scheduled.
  - 5. Standard finish color to be light gray.
- D. Fan Propeller:
  - 1. Propellers are injected molded in Glass Reinforced Polypropylene (PPG). The hub may be in plastic or coated aluminum according to the fan size.
  - 2. Hub shall be molded to two parts each of them has half socket for receiving blades.
  - 3. Blades and hub shall be assembled on a special jig for precise blades pitch.

4. The propeller assembly shall be statically and dynamically balanced in accordance with AMCA 204 to Fan Application Category BV-3, Balance Quality Grade G6.3.

E. Wall Box / Sleeve:

1. A wall box / sleeve fabricated of corrosion resistant fiberglass, providing installation through a wall, shall be provided as shown on the drawings.
2. A discharge gravity backdraft damper fabricated of corrosion resistant fiberglass shall be provided as shown on the drawings.
3. A discharge (exhaust) or intake (supply) hood and birdscreen fabricated of corrosion resistant fiberglass shall be provided, if required, as shown on the drawings.
4. Inlet or outlet screens or OSHA guards fabricated of corrosion resistant PVC as shown on the drawings.

F. Fan Motor:

1. Motors shall be premium efficiency, standard NEMA frame, 900, 1200, or 1800 RPM, with a 1.15 service factor. Motors shall be TEFC, Mill and Chemical Duty, or Explosion Proof, as shown on the drawings.

G. Capacities and Characteristics:

1. See Schedule on Drawings.

## 2.02 SOURCE QUALITY CONTROL

- A. Certify sound-power level ratings according to AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.
- B. Certify fan performance ratings, including flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests according to AMCA 210, "Laboratory Methods of Testing Fans for Aerodynamic Performance Rating." Label fans with the AMCA-Certified Ratings Seal.

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. Install power ventilators level and plumb.
- B. Label units according to requirements specified in Section 15160 "Identification for HVAC Piping and Equipment."

### 3.02 CONNECTIONS

- A. Install ducts adjacent to power ventilators to allow service and maintenance.
- B. Ground equipment according to Division 16.
- C. Connect wiring according to Division 16.

### 3.03 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
  - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Tests and Inspections:
  - 1. Verify that shipping, blocking, and bracing are removed.
  - 2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
  - 3. Verify that cleaning and adjusting are complete.
  - 4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
  - 5. Adjust belt tension.
  - 6. Adjust damper linkages for proper damper operation.
  - 7. Verify lubrication for bearings and other moving parts.
  - 8. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
  - 9. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
  - 10. Shut unit down and reconnect automatic temperature-control operators.
  - 11. Remove and replace malfunctioning units and retest as specified above.
- C. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Prepare test and inspection reports.

### 3.04 ADJUSTING

- A. Adjust damper linkages for proper damper operation.
- B. Adjust belt tension.

- C. Comply with requirements in Section 15980 "Testing, Adjusting, and Balancing" for testing, adjusting, and balancing procedures.
- D. Replace fan and motor pulleys as required to achieve design airflow.
- E. Lubricate bearings.

END OF SECTION

## SECTION 15955

### TEMPERATURE CONTROLS

#### PART 1 - GENERAL

##### 1.01 WORK INCLUDED

- A. Provide a complete automatic temperature control system as indicated on the drawings and as specified herein for proper system control.
- B. Provide:
  - 1. Identification of Controls System Components
  - 2. Valves, Dampers and Actuators
  - 3. Control System Wiring and Conduit
  - 4. Portable Operators Terminal
  - 5. Sensors, Transmitters, Transducers, Relays, Enclosures
  - 6. Distributed Processing DDC
  - 7. Training of Operations Personnel
  - 8. As-Builts and Framed Approved Control Diagrams

##### 1.02 SUBMITTALS

- A. Manufacturer's literature and data for all components including the following:
  - 1. Controllers
  - 2. Control Dampers, Control Valves and Actuators
  - 3. Temperature Control Panel Sizes and Faceplate Layout
  - 4. Instrumentation Products
- B. Control Drawings:
  - 1. AutoCAD drawing files.
  - 2. Three complete sets of prints

##### 1.03 CONTROL SYSTEMS

- A. Furnish and install complete and ready for operation with control sequences as indicated on the drawings.

- B. Control equipment, except for items comprising an integral part of the water or refrigeration system, shall be installed by trained mechanic employed by the control contractor.
- C. Include the services of a full time control technician for calibrating controls for the first 5 working days after owner has occupied building.
- D. Before installation, submit for approval one set of reproducible drawings and one complete set of diagrams. Hang a photostatic copy of the approved diagram, framed behind glass in each mechanical room. Provide one set of reproducible "As-Built" control diagrams at completion of the project for the Owners use.
- E. Provide permanent nameplates for control switches and motor starters. Nameplates: Engraved laminated plastic with letters legible under normal operating conditions (White on Black).
- F. Permanently identify control devices other than room thermostats, so they may be identified on control diagrams. Provide engraved plastic nameplates for items mounted outside of or on faces of panels. Mark other instruments with indelible ink.
- G. The control contractor shall have a five year record of installation and service of temperature controls within 100 miles of the project area for similar types of systems. Acceptable manufacturers are Trane, Johnson Controls or approved equal.

#### 1.04 CONTROL WIRING

- A. Include all control and interlocking wiring and power wiring for control panel in this section. Install in conduit in accordance with provisions of the electrical specifications.
- B. Firestop conduit penetrations of fire rated walls and partitions.
- C. Wire all devices individually to terminal strips in control panels.
- D. Furnish necessary relays and auxiliary contactors and other accessories required. Provide interlock relays per N.E.C. Coordinate start-up stations, auxiliary contacts, etc., with supplier of starters and motor control centers specified in electrical work.

## PART 2 - PRODUCTS

### 2.01 DIRECT DIGITAL CONTROLLER (DDC)

- A. The DDC's shall be microprocessor based units that monitor the HVAC equipment through the proper control mode, maintain the desired conditions by operating the proper activators and switching devices. All control programs shall be resident in each DDC. Each controller shall contain all necessary electronic circuits utilizing state of the art digital and microprocessor technology and shall be contained in a protective metal housing.
- B. Provide a minimum of 48 hours of battery back-up to protect the volatile memory of each controller.
- C. Failure of any other DDC or system processor shall not degrade the operation of other controllers in the system.

### 2.02 PORTABLE OPERATOR TERMINAL

Provide a portable terminal capable of addressing all system parameters at each remote controller. The terminal shall be capable of readout and adjustment of all setpoints, temperatures, throttling ranges, reset times, rate control parameters, enthalpy, volume (CFM and GPM), time and date schedules, etc., via an LED display and shall provide for system entry via a keyboard or keypad arrangement. Provide licensed software if needed. Provide computer with 21" screen for this system/work station.

### 2.03 ELECTRONIC TEMPERATURE SENSORS

- A. Electronic temperature sensors shall be of corrosion resistant construction, tamper proof, suitable for mounting on a vibrating surface.
- B. All duct mounted temperature sensors (except outdoor and return air) shall have a minimum 20 foot capillary average element.
- C. All sensing elements for water pipe mounting shall be furnished complete with protecting wells filled with heat conducting compound.
- D. Space temperature sensors shall be provided with room type locking covers.
- E. Sensors shall be factory calibrated and shall be thin film platinum.

## 2.04 ELECTRONIC STATIC PRESSURE SENSORS

Electronic static pressure sensors shall be of the strain gauge type with 4-20 mA or 0-1 VDC output. Static accuracy shall be not more than 2% or span. Provide appropriate span for each application: 0-2" water column for duct static pressure and 0-0.5 inches of water column for velocity pressure. Sensors shall be Dwyer, Celesco, or approved equal.

## 2.05 ELECTRONIC DIFFERENTIAL PRESSURE SENSORS

Electronic differential pressure sensors shall be of the industrial type with plus or minus 1% accuracy over the entire span of the instrument. Span shall be appropriate for the application. Approved manufacturers are ITE, Honeywell, Foxboro, Fisher, and Moore Industries. Use of pneumatic differential pressure sensors shall not be acceptable.

## 2.06 AUTOMATIC DAMPERS

Automatic dampers shall be opposed blade type with adjacent blades rotating in opposite directions. They shall be furnished in standard sizes using damper louvers 4 inches in width. Damper blade length shall be a minimum of 12 inches to a maximum of 48 inches. Where larger dampers are required, provide the necessary shaft and blade linkages to allow multiple sections to operate as a single damper. Dampers shall be provided with solid stops for tight closing with vinyl seals on the blade edges and flexible metal compression type sides of the damper frame, which will stand a temperature of up to 200 degrees F. These stops shall be so assembled that they may be easily replaced if they become damaged. Dampers shall be tightly closing and shall be capable of less than 1% at the applied static pressure. Bearings shall be oilite or nylon. Dampers shall be provided with pneumatic operators of the proper size to provide the control sequence desired and shall be equipped with pilot positioners where required to provide sequence action. Damper linkage shall be provided either linear or equal percentage air flow the control system manufacturer to provide all necessary devices, electronic circuitry, and other equipment to make the output of the DDC system compatible with the motor controller. Pneumatic signals will not be acceptable for this purpose and shall not in any way be used to control the variable speed motor drives.

## 2.07 VALVE AND DAMPER ACTUATORS

- A. Electric valve and damper motors (where indicated) shall have oil immersed gear trains and spring return to normal position.
- B. The dampers shall open prior to exhaust fan starting.

## 2.08 MISCELLANEOUS

- A. Capillary Supports: securely support all duct mounted and casing mounted



thermostat capillaries using factory fabricated copper bulb supports.

- B. Provide standoffs for control devices mounted on externally insulated ducts and equipment.
- C. Anchor all items mounted on gypsum board (dry-wall) using toggle bolts or moly bolts, not expansion shields.
- D. Pressure Gauges:
  - 1. Provide 1-1/2" dial branch pressure gauges as close as possible to each valve and damper operator. Provide 1" minimum dial gauge on each port of each instrument, including transmitters and P.E.'s.

## 2.09 SOFTWARE

- A. Each direct digital controller shall contain all custom and standard programs necessary to accomplish the sequence of operation specified for the equipment it serves and perform the energy management function specified in the Data and Control Summary.
- B. All custom software to accomplish the sequence of control shall be generated in the manufacturer's local office and shall be tested and de-bugged prior to its installation at the job site. The DDC system shall provide a real time control language for user programming of HVAC application designed to accomplish easy transition from hardware control system design to software based control system design. The custom software shall allow the user to program custom control sequences directly into micro-computer memory. Provide a portable laptop computer with all software loaded and configured to control all devices through internet and direct connection. Provide a licensed backup copy of all software used in this project with settings.

## PART 3 - EXECUTION

### 3.01 FINAL ADJUSTMENT

Adjustments shall be performed by a factory trained technician to make all final control adjustments. The Temperature Control Contractor shall work closely with the Testing, Adjusting and Balancing contractor to troubleshoot and calibrate systems installed under this section for proper operation and balance.

### 3.02 TRAINING FOR OPERATION PERSONNEL

The Temperature Controls Contractor shall conduct suitable training period for the Owner's representative to properly explain all facets of the control system operation.

### 3.03 ACCEPTANCE, GUARANTEE AND SERVICE

All components, parts, and assemblies shall be guaranteed against defects in workmanship and materials per 01740. In addition, the Control Contractor shall provide prevention maintenance, operator instruction, and system maintenance training through one (1) full heating and cooling season.

END OF SECTION

## SECTION 15980

### TESTING, ADJUSTING, AND BALANCING

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

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

##### 1.02 SUMMARY

- A. Section Includes:
  - 1. Balancing Air Systems:
    - a. Constant-volume air systems.
  - 2. Testing, Adjusting, and Balancing Equipment:
    - a. Motors.
  - 3. Control system verification.

##### 1.03 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.

#### 1.04 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. Strategies and Procedures Plan: Within 60 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.
- D. System Readiness Checklists: Within 60 days of Contractor's Notice to Proceed, submit system readiness checklists as specified in "Preparation" Article.
- E. Examination Report: Submit a summary report of the examination review required in "Examination" Article.
- F. Certified TAB reports.
- G. Sample report forms.
- H. 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.

#### 1.05 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 TABB.
  - 1. TAB Field Supervisor: Employee of the TAB specialist and certified by TABB

2. TAB Technician: Employee of the TAB specialist and certified by TABB as a TAB technician.
- C. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."

#### 1.06 FIELD CONDITIONS

- A. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

### PART 2 - PRODUCTS (NOT USED)

### PART 3 - EXECUTION

#### 3.01 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 heat-transfer coils for correct piping connections and for clean and straight fins.
- M. Examine operating safety interlocks and controls on HVAC equipment.
- N. 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.

### 3.02 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.

### 3.03 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" 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 15810 "Ductwork."
  - 3. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Section 15258 "Duct Insulation," and Section 15256 "HVAC and Plumbing 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.

### 3.04 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 15815 "Metal Ducts."

### 3.05 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.



### 3.06 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.

### 3.07 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.

### 3.08 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. Fan curves.
  2. Manufacturers' test data.
  3. Field test reports prepared by system and equipment installers.
  4. Other information relative to equipment performance; do not include Shop Drawings and Product Data.
  5. General Report Data: In addition to form titles and entries, include the following data:
    6. Title page.
    7. Name and address of the TAB specialist.
    8. Project name.
    9. Project location.
    10. Architect's name and address.
    11. Engineer's name and address.
    12. Contractor's name and address.
    13. Report date.
    14. Signature of TAB supervisor who certifies the report.
  15. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
  16. 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.

17. Nomenclature sheets for each item of equipment.
  18. Notes to explain why certain final data in the body of reports vary from indicated values.
  19. Test conditions for fans and pump performance forms including the following:
    - a. Settings for outdoor-, return-, and exhaust-air dampers.
    - b. Fan drive settings including settings and percentage of maximum pitch diameter.
    - c. Other system operating conditions that affect performance.
- C. System Diagrams: Include schematic layouts of air and hydronic distribution systems.
- D. 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.
- E. Instrument Calibration Reports:
  - 1. Report Data:
    - a. Instrument type and make.
    - b. Serial number.
    - c. Application.
    - d. Dates of use.
    - e. Dates of calibration.

### 3.09 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, Owner may contact AABC Headquarters regarding the AABC National Performance Guaranty.
- F. Prepare test and inspection reports.

### 3.10 ADDITIONAL TESTS

- A. 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

**DIVISION 16**  
**ELECTRICAL**

## SECTION 16010

### BASIC ELECTRICAL REQUIREMENTS

#### PART 1 - GENERAL

##### 1.01 RELATED SECTIONS

- A. Requirements specified within this section apply to all sections in Division 16, ELECTRICAL. Work specified herein shall be performed as if specified in the individual sections.

##### 1.02 DESIGN REQUIREMENTS

- A. All electronic boards as part of electrical equipment shall meet the atmospheric conditions of the space the equipment is installed in. All electronic boards that are not installed in a conditioned environment shall be fungus-resistant.
- B. All electrical equipment shall be rated for the conditions the equipment is installed in.

##### 1.03 ELECTRICAL COORDINATION

- A. Major Work Provided Under this Contract:
  - 1. Provide and install all conduit and wire to support instrumentation and control systems, unless otherwise noted in the drawings and specifications, complete in place.
  - 2. Provide all miscellaneous electrical including disconnect switches, terminations, fittings, etc. not specified but obviously necessary for complete working systems in place.
  - 3. Contractor shall coordinate with Process and I&C, for all required wire, conduit, power and signal requirements for all package system. Contractor shall review all Process, I&C and other systems shop drawings for all electrical requirements and provide all materials and labor as necessary.

4. Contractor shall coordinate with other disciplines for demolition of existing equipment. Remove all existing electrical equipment that will be unused after the demolished equipment is removed. Remove conduits and wire back to source.

D. Construction Constraints:

1. Refer to specification 01010 and mechanical drawings for project sequence and construction constraints.

#### 1.04 SUBMITTALS

A. The following information shall be provided for all electrical equipment:

1. A copy of each specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check-marks (√) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the Contractor, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph. The remaining portions of the paragraph not underlined shall signify compliance on the part of the Contractor with the specifications. The submittal shall be accompanied by a detailed, written justification for each deviation.
2. Electrical equipment submittals shall be made by specification section. Submit one package per specification section and do not group multiple specification sections under one submittal package.
3. Provide complete conduit and equipment layouts: a scaled plan layout of the electrical room(s) showing spatial relationships of all equipment as well as the overall size of the room. Minimum scale shall be ¼"=1'-0".

- B. As part of the electrical submittal, the contractor shall provide a minimum of ¼"=1'-0" scaled layout of the electrical equipment in the electrical room or major electrical equipment in a mechanical room showing sizes of all equipment and their spatial relationship. Non-electrical equipment shall be approved before finalizing the electrical layout in mechanical rooms.

#### 1.05 ENVIRONMENTAL CONDITIONS

- A. All chemical rooms and areas shall be corrosive areas.



- B. All indoor chemical and process equipment areas shall be considered wet locations.

#### 1.06 INSPECTION OF THE SITE AND EXISTING CONDITIONS

- A. The Electrical Drawings were developed from past record drawings and information supplied by the OWNER. Verify all scaled dimensions prior to submitting bids.
- B. Before submitting a bid, visit the site and determine conditions at the site and at all existing structures in order to become familiar with all existing conditions and electrical system which will, in any way or manner, affect the work required under this Contract. No subsequent increase in Contract cost will be allowed for additional work required because of the CONTRACTOR's failure to fulfill this requirement.
- C. Carry out any work involving the shutdown of the existing services to any piece of equipment now functioning in existing areas at such time as to provide the least amount of inconvenience to the OWNER. Do such work when directed by the ENGINEER.

#### 1.07 RESPONSIBILITY

- A. The CONTRACTOR shall be responsible for:
  - 1. Complete systems in accordance with the intent of these Contract Documents.
  - 2. Coordinating the details of facility equipment and construction for all Specification Divisions that affect the work covered under Division 16, ELECTRICAL.
  - 3. Furnishing and installing all incidental items not actually shown or specified, but which are required by good practice to provide complete functional systems.

#### 1.08 INTENT OF DRAWINGS

- A. Electrical plan Drawings show only general location of equipment, devices, and raceway, unless specifically dimensioned. The CONTRACTOR shall be responsible for the proper routing of raceway, subject to the approval of the ENGINEER.

- B. If the CONTRACTOR chooses to and is allowed to substitute, the CONTRACTOR shall be responsible for fitting all the equipment in the available space as shown on the Drawings and providing any additional hardware and/or software for a fully functional system per the intent of the design. The CONTRACTOR shall be responsible for all costs associated with any modifications to the substitute in order to adhere to the intent of the design. The CONTRACTOR shall provide credit(s) to the OWNER for any cost savings associated with the substitute. No change orders shall be issued for the use of a substitute.

## PART 2 - PRODUCTS

### 2.01 GENERAL

- A. Provide materials and equipment listed by UL wherever standards have been established by that agency.
- B. Equipment Finish:
  - 1. Provide manufacturers' standard finish and color, except where specific color is indicated.
  - 2. If manufacturer has no standard color, provide equipment with ANSI No. 61, light gray color.

## PART 3 - EXECUTION

### 3.01 GENERAL

- A. Electrical Drawings show general locations of equipment, devices, and raceway, unless specifically dimensioned.
- B. Install work in accordance with NECA Standard of Installation, unless otherwise specified.

### 3.02 LOAD BALANCE

- A. Drawings and Specifications indicate circuiting to electrical loads and distribution equipment.

### 3.03 STARTUP

#### A. Startup:

1. Demonstrate satisfactory operation of all 480-volt electrical equipment. Participate with other trades in all startup activities.
2. Assist the PICS Contractor in verifying signal integrity of all control and instrumentation signals.

### 3.04 STANDARDS, CODES, PERMITS, AND REGULATIONS

#### A. Perform all work; furnish and install all materials and equipment in full accordance with the latest applicable rules, regulations, requirements, and specifications of the following:

1. Local Laws and Ordinances.
2. State and Federal Laws.
3. National Electrical Code (NEC).
4. State Fire Marshal.
5. Underwriters' Laboratories (UL).
6. National Electrical Safety Code (NESC).
7. American National Standards Institute (ANSI).
8. National Electrical Manufacturer's Association (NEMA).
9. National Electrical CONTRACTOR's Association (NECA) Standard of Installation.
10. Institute of Electrical and Electronics Engineers (IEEE).
11. Insulated Cable Engineers Association (ICEA).
12. Occupational Safety and Health Act (OSHA).
13. National Electrical Testing Association (NETA).

14. American Society for Testing and Materials (ASTM).
- B. Conflicts, if any, which may exist between the above items, will be resolved at the discretion of the ENGINEER.
  - C. Wherever the requirements of the Specifications or Drawings exceed those of the above items, the requirements of the Specifications or Drawings govern. Code compliance is mandatory. Construe nothing in the Contract Documents as permitting work not in compliance with these codes.
  - D. Obtain all permits and pay all fees required by any governmental agency having jurisdiction over the work. Arrange all inspections required by these agencies. On completion of the work, furnish satisfactory evidence to the ENGINEER that the work is acceptable to the regulatory authorities having jurisdiction.

END OF SECTION

## SECTION 16050

### BASIC ELECTRICAL MATERIALS AND METHODS

#### PART 1 - GENERAL

##### 1.01 REFERENCES

- A. The following is a list of standards that may be referenced in this section:
1. American National Standards Institute (ANSI):
    - a. C55, 1, Standard for Shunt Power Capacitors.
    - b. C62.11, Standard for Metal-Oxide Surge Arrestors for AC Circuits.
    - c. Z55.1, Gray Finishes for Industrial Apparatus and Equipment.
  2. American Society for Testing and Materials (ASTM):
    - a. A167, Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
    - b. A240, Standard Specification for Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels.
    - c. A570, Standard Specification for Steel, Sheet, and Strip, Carbon, Hot-Rolled, Structural Quality.
  3. Federal Specifications (FS):
    - a. W-C-596, Connector, Receptacle, Electrical.
    - b. W-S-896E, Switches - Toggle, Flush Mounted.
  4. National Electrical Contractor's Association, Inc. (NECA): 5055, Standard of Installation.
  5. National Electrical Manufacturers Association (NEMA):
    - a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
    - b. AB 1 Molded Case Circuit Breakers and Molded Case Switches.
    - c. CP I, Shunt Capacitors.
    - d. ICS 2, Industrial Control Devices, Controllers, and Assemblies.
    - e. KS 1, Enclosed Switches.
    - f. LA I, Surge Arrestors.
    - g. PB 1, Panelboards.
    - h. ST 20, Dry-Type Transformers for General Applications.
    - i. WD I, General Requirements for Wiring Devices.

6. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).
7. Underwriters Laboratories, Inc. (UL):
  - a. 67, Standard for Panelboards.
  - b. 98, Standard for Enclosed and Dead-Front Switches.
  - c. 198C, Standard for Safety High-Interrupting-Capacity Fuses, Current-Limiting Types.
  - d. 198E, Standard for Class Q Fuses.
  - e. 486E, Standard for Equipment Wiring Terminals.
  - f. 489, Standard for Molded Case Circuit Breakers and Circuit Breaker Enclosures.
  - g. 508, Standard for Industrial Control Equipment.
  - h. 810, Standard for Capacitors.
  - i. 943, Standard for Ground-Fault Circuit Interrupters.
  - j. 1059, Standard for Terminal Blocks.
  - k. 1561, Standard for Dry-Type General-Purpose and Power Transformers.

## 1.02 SUBMITTALS

### A. Shop Drawings:

1. Junction and pull boxes.
2. Hardware.
3. Circuit breaker data.
4. All other miscellaneous material part of this project.
5. Wire pulling compound.

### B. Quality Control Submittals:

1. Test Report: Sound test certification for dry type power transformers (0 to 600-volt, primary).

## 1.03 QUALITY ASSURANCE

- ### A. UL Compliance: Materials manufactured within scope of Underwriters Laboratories shall conform to UL Standards and have an applied UL listing mark.

## PART 2 - PRODUCTS

### 2.01 OUTLET AND DEVICE BOXES

- A. Sheet Steel: One-piece drawn type, zinc- or cadmium-plated.
- B. Cast Metal:
  - 1. Box: Cast ferrous metal.
  - 2. Cover: Gasketed, weatherproof, cast ferrous metal, with stainless steel screws.
  - 3. Hubs: Threaded.
  - 4. Lugs (Cast Mounting) Manufacturer:
    - a. Crouse-Hinds; Type FS or FD.
    - b. Appleton; Type FS or FD.
    - c. Or equal.
- C. Cast Aluminum:
  - 1. Material:
    - a. Box: Cast, copper-free aluminum.
    - b. Cover: Gasketed, weatherproof, cast copper-free aluminum with stainless steel screws.
  - 2. Hubs: Threaded.
  - 3. Lugs: Cast mounting.
  - 4. Manufacturers:
    - a. Crouse-Hinds; Type FS-SA or FD-SA
    - b. Appleton; Type FS or FD.
    - c. Or equal.
- D. PVC-Coated Sheet Steel:
  - 1. Type: One-piece.
  - 2. Material: Zinc- or cadmium-plated.
  - 3. Coating: All surfaces; 40-mil PVC.
  - 4. Manufacturer: Appleton, or equal.

## 2.02 JUNCTION AND PULL BOXES

- A. Outlet Boxes Used as Junction or Pull Box: As specified under 3.02 OUTLET AND DEVICE BOXES.
- B. Large Stainless Steel Box: NEMA 250, Type 4X.
  - 1. Box: 14-gauge, ASTM A240, Type 316 stainless steel.
  - 2. Cover: Hinged with screws.
  - 3. Hardware and Machine Screws: ASTM A167, Type 304 stainless steel.
  - 4. Manufacturers:
    - a. Hoffman Engineering Co.
    - b. Robroy Industries.
    - c. Or equal.
- C. Large Steel Box: NEMA 250, Type 4.
  - 1. Box: 12-gauge steel, with white enamel painted interior and gray primed exterior, over phosphated surfaces, with final ANSI Z55.1, No. 61 gray enamel on exterior surfaces.
  - 2. Cover: Hinged with screws.
  - 3. Hardware and Machine Screws: ASTM A167, Type 316 stainless steel.
  - 4. Manufacturers:
    - a. Hoffman Engineering Co.
    - b. Robroy Industries.
    - c. Or equal.

## 2.03 DEVICE PLATES

- A. General: Sectional type plates not permitted.
- B. Metal:
  - 1. Material: Specification grade, one-piece, 0.040-inch nominal thickness stainless steel.
  - 2. Finish: ASTM A167, Type 302/304, satin.
  - 3. Mounting Screw: Oval-head, finish matched to plate.
- C. Cast Metal:
  - 1. Material: Malleable ferrous metal, with gaskets.



2. Screw: Oval-head stainless steel.

#### 2.04 CIRCUIT BREAKER, INDIVIDUAL, 0 TO 600 VOLTS

- A. NEMA AB I, UL 489 listed for use at location of installation.
- B. Minimum Interrupt Rating: As shown or as required.
- C. Thermal-magnetic, quick-make, quick-break, indicating type, showing ON/OFF and TRIPPED indicating positions of the operating handle.
- D. Suitable for use with 75 degrees C wire at full NFPA 70, 75 degrees C ampacity.
- E. Locking: Provisions for padlocking handle.
- F. Multi-pole breakers to automatically open all poles when an overload occurs on one-pole.
- G. Enclosure: NEMA 250, Type 12, Industrial Use, 4X - outdoors, wet locations and corrosive areas, unless otherwise shown.
- H. Interlock: Enclosure and switch shall interlock to prevent opening cover with switch in the ON position.
- I. Do not provide single-pole circuit breakers with handle ties where multi-pole circuit breakers are shown.
- J. Manufacturers:
  - 1. Cutler-Hammer;
  - 2. Square D;
  - 3. GE;

#### 2.05 PUSHBUTTON, INDICATING LIGHT, AND SELECTOR SWITCHES

- A. Contact Rating: NEMA ICS 2, Type A600.
- B. Selector Switch Operating Lever: Standard.
- C. Indicating Lights: Push-to-test.
- D. Pushbutton Color:
  - 1. ON or START: Black.

2. OFF or STOP: Red.
- E. Pushbuttons and selector switches lockable in the OFF position where indicated.
- F. Legend Plate:
1. Material: Aluminum.
  2. Engraving: 11 character/spaces on one line, 14 character/spaces on each of two lines, as required, and indicating specific function.
  3. Letter Height: 7/64 inch.
- G. Manufacturers:
1. Heavy-Duty, Oil tight Type:
    - a. Square D; Type T.
    - b. Cutler-Hammer; Type CH10250T.
    - c. Or equal.
  2. Heavy-Duty, Watertight, and Corrosion-Resistant Type:
    - a. Square D; Type SK.
    - b. Cutler-Hammer; Type E34.
    - c. Or equal.

## 2.06 SUPPORT AND FRAMING CHANNELS

- A. Material:
1. All Areas: ASTM A167, Type 316 stainless steel or fiber-reinforced epoxy, as required.
- B. Finish:
1. All Areas: ASTM A167, Type 316 stainless steel or fiber-reinforced epoxy, as required.
- C. Inserts: Continuous.

D. Beam Clamps: Gray cast iron.

E. Manufacturers:

1. B-Line.
2. Unistrut.

## 2.07 NAMEPLATES

A. Material: Laminated plastic.

B. Attachment Screws: Stainless steel.

C. Color: White, engraved to a black core.

D. Engraving:

1. Pushbuttons/Selector Switches: Name of drive controlled on one, two, or three lines, as required.
2. Panelboards: Panelboard designation, service voltage, and phases.

E. Letter Height:

1. Pushbuttons/Selector Switches: 1/8 inch.
2. Panelboards: 1/4 inch.

## 2.08 TRANSIENT VOLTAGE SURGE SUPPRESSION

A. This section describes the material and installation requirements for transient voltage surge suppression devices (TVSS) in service entrance equipment, panelboards, and control panels for the protection of all AC electrical circuits.

B. TVSS shall be listed and component recognized in accordance with UL 1449, UL 1283 and ANSI/IEEE 62.41 testing.

C. TVSS shall be installed and warranted by and shipped from the electrical distribution equipment manufacturer's factory.

D. TVSS shall provide surge current diversion paths for all modes of protection; L-L, L-N, L-G, N-G in WYE systems, and L-L, L-G in DELTA systems.

E. TVSS shall be modular in design. Each module shall be fused with a surge rated fuse.

- F. A UL approved disconnect switch shall be provided as a means of disconnect in the switchboard device or any TVSS that is not connected thru a breaker.
- G. TVSS shall meet or exceed the following criteria:
1. Maximum surge current capability (single pulse rated) shall be:
    - a. Service entrance equipment: 150kA per mode or 300kA per phase
    - b. Branch panelboards: 80kA per mode or 160kA per phase
    - c. Control panels: 40kA per mode or 80kA per phase
  2. UL 1449 Listed and Recognized Component Suppression Voltage Ratings shall not exceed the following:
 

<u>Voltage</u>	<u>L-N</u>	<u>L-G</u>	<u>N-G</u>
208Y/120	400V	400V	400V
480Y/277	800V	800V	800V
- H. TVSS shall have a minimum EMI/RFI filtering of -44dB at 100kHz with an insertion ratio of 50:1 using MIL STD. 220A methodology.
- I. TVSS shall have a minimum warranty for a period of five years, incorporating unlimited replacements of suppressor parts if they are destroyed by transients during the warranty period. Warranty will be the responsibility of the electrical distribution equipment manufacturer.
- J. For any external TVSS, provide and install conduits/cables, indicated or not on drawings, as recommended by the TVSS supplier and place TVSS unit as close as possible to the equipment/panel to be protected.
- K. Approved manufactures are:
1. Surge Suppression Incorporated
  2. Current Technologies
  3. Joslyn/Total Protection Solutions

## PART 3 - EXECUTION

### 3.01 GENERAL

- A. Install equipment in accordance with NECA 5055.

- B. Open no more knockouts in sheet steel device boxes than are required; seal unused openings.
- C. Box Type (Steel Raceway System):
  - 1. Interior Wet Locations:
    - a. Exposed Raceways: Cast metal.
- D. Box Type (Rigid Aluminum Raceway System): Cast aluminum.
- E. Box Type, Corrosive Locations (PVC-Schedule 80 Raceway System): PVC Schedule 80.

### 3.02 JUNCTION AND PULL BOXES

- A. Install where shown and where necessary to terminate, tap-off, or redirect multiple conduit runs.
- B. Install pull boxes where necessary in raceway system to facilitate conductor installation.
- C. Install in conduit runs at least every 150 feet or after the equivalent of three right angle bends.
- D. Use outlet boxes as junction and pull boxes wherever possible and allowed by applicable codes.
- E. Installed boxes shall be accessible.
- F. Do not install on finished surfaces.
- G. Install plumb and level.
- H. Support boxes independently of conduit by attachment to building structure or structural member.
- I. Threaded studs driven in by powder charge and provided with lock washers and nuts are acceptable in lieu of expansion shields.
- J. Mounting Hardware:
  - 1. Non-corrosive Interior Areas: Galvanized.
  - 2. All Other Areas: Stainless steel.

K. Location/Type:

1. Unfinished, Indoor and Outdoor, Wet and Corrosive: NEMA 250, Type 4X Stainless Steel painted white.
2. Corrosive Locations: Nonmetallic.

3.03 PUSHBUTTON, INDICATING LIGHT, AND SELECTOR SWITCH

- A. Heavy-Duty, Oil tight Type: Locations (Unless Otherwise Shown): Non-hazardous, indoor, dry locations, including motor control centers, control panels, and individual stations.
- B. Heavy-Duty, Watertight, and Corrosion-Resistant Type:
1. Locations (Unless Otherwise Shown): Non-hazardous, outdoor, or normally wet areas.
  2. Mounting: NEMA 250, Type 4X enclosure.

END OF SECTION

## SECTION 16075

### ELECTRICAL IDENTIFICATION

#### PART 1 - GENERAL

##### 1.01 SUMMARY

- A. Section Includes: Identification of electrical materials, equipment, and installations. It includes requirements for electrical identification components including, but not limited to, the following:
1. Identification labeling for cables and conductors.
  2. Equipment labels and signs.

##### 1.02 SUBMITTALS

- A. Shop Drawings: Submit in accordance with Section 01340, Shop Drawings covering the items included under this Section. Shop Drawing submittals shall include:
1. Product Data for each type of product specified.

#### PART 2 - PRODUCTS

##### 2.01 ELECTRICAL IDENTIFICATION PRODUCTS

- A. Colored Adhesive Marking Tape for Wires and Cables: Self-adhesive, vinyl tape not less than 3 mils thick by 1 inch to 2 inches in width.
- B. Pre-tensioned Flexible Wraparound Colored Plastic Sleeves for Cable Identification: Flexible acrylic bands sized to suit raceway diameter and arranged to stay in place by pre-tensioned gripping action when coiled around the cable.
- C. Wire/Cable Designation Markers: Black on white shrink tube for cable/conductor markers with pre-printed numbers and letter.
- D. Aluminum, Wraparound Cable Marker Bands: Bands cut from 0.014-inch-thick aluminum sheet, fitted with slots or ears for securing permanently around wire or cable jacket or around groups of conductors. Provide for legend application with stamped letters or numbers.

- E. Engraved, Plastic Laminated Labels, Signs, and Instruction Plates: Engraving stock melamine plastic laminate, 1/16 inch minimum thick for signs up to 20 square inches or 8 inches in length; 1/8-inch thick for larger sizes. Engraved legend in white letters on black face and punched for mechanical fasteners.
- F. Cable Ties: Fungus-inert, self-extinguishing, one-piece, self-locking nylon cable ties, 0.18 inch minimum width, 50-pound minimum tensile strength, and suitable for a temperature range from minus 50 to 350 degrees F. Provide ties in specified colors when used for color coding.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Lettering and Graphics: Coordinate names, abbreviations, colors, and other designations used in electrical identification Work with corresponding designations specified or indicated. Install numbers, lettering, and colors as approved in submittals and as required by Code.
- B. Conductor Color Coding: Provide color coding for feeder, and branch circuit conductors throughout the Project secondary electrical system as follows:

<u>Phase</u>	<u>480/277 Volts</u>
A	Yellow
B	Brown
C	Orange
Neutral	Gray
Ground	Green

- C. Wiring Standards:
  1. 480/277 Volt, 3-Phase Power:
    - a. Brown.
    - b. Orange.
    - c. Yellow.
    - d. White Neutral.
  2. 208 Volt, 3-Phase Power:
    - a. Black.
    - b. Red.
    - c. Blue.



3. 240/120 Volt, 1-Phase Power:
    - a. Black.
    - b. Red.
    - c. White Neutral.
  4. Motor Leads, Control Cabinet/MCC:
    - a. Black, numbered L1-T1, etc.
  5. Control Wiring:
    - a. Red Control circuit wiring that is de-energized when the main disconnect is opened.
    - b. Yellow Control circuit wiring that remains energized when the main disconnect is opened.
    - c. Blue DC.
    - d. Green Ground.
- D. Use conductors with color factory applied entire length of conductors except as follows:
1. The following field applied color coding methods may be used in lieu of factory-coded wire for sizes larger than No. 10 AWG.
    - a. Apply colored, pressure-sensitive plastic tape in half-lapped turns for a distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last 2 laps of tape with no tension to prevent possible unwinding. Use 1-inch-wide tape in colors as specified. Do not obliterate cable identification markings by taping. Tape locations may be adjusted slightly to prevent such obliteration.
    - b. In lieu of pressure-sensitive tape, colored cable ties may be used for color identification. Apply 3 ties of specified color to each wire at each terminal or splice point starting 3 inches from the terminal spaced 3 inches apart. Apply with a special tool or pliers, tighten for snug fit, and cut off excess length.
- E. Power Circuit Identification: Securely fasten identifying metal tags of aluminum wraparound marker bands to cables, feeders, and power circuits in vaults, pull boxes, junction boxes, manholes, and switchboard rooms with 1/4-inch steel letter and number stamps with legend to correspond with designations on Drawings. If metal tags are provided, attach them with approximately 55-pound test monofilament line or one-piece self-locking nylon cable ties.

- F. Install wire/cable designation tape markers at termination points, splices, or junctions in each circuit. Circuit designations shall be as indicated on Drawings.

END OF SECTION

## SECTION 16110

### RACEWAYS

#### PART 1 - GENERAL

##### 1.01 REFERENCES

A. The following is a list of standards that may be referenced in this section:

1. American Association of State Highway and Transportation Officials (AASHTO): Division I, Standard Specifications for Highway Bridges, Fourteenth Edition.
2. American National Standards Institute (ANSI):
  - a. CS0.5, Rigid Aluminum Conduit.
3. National Electrical Contractor's Association, Inc. (NECA): 5055, Standard of Installation.
4. National Electrical Manufacturers Association (NEMA):
  - a. RN 1, Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
  - b. TC 2, Electrical Plastic Tubing (EPT) and Conduit (EPC-40 and EPC-80).
  - c. TC 3, PVC Fittings for Use with Rigid PVC Conduit and Tubing.
5. National Fire Protection Association (NFPA): 70, National Electrical Code. (NEC)
6. Underwriters Laboratories, Inc. (UL):
  - a. 1, Standard for Safety Flexible Metal Conduit.
  - b. 360, Standard for Safety Liquid-Tight Flexible Steel Conduit.
  - c. 514B, Standard for Safety Fittings for Conduit and Outlet Boxes.
  - d. 514C, Standard for Safety Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers.
  - e. 651, Standard for Safety Schedule 40 and 80 PVC Conduit.
  - f. 651A, Standard for Safety Type EB and Rigid PVC Conduit and HDPF Conduit.
  - g. 797, Standard for Safety Electrical Metallic Tubing.

- h. 1660, Standard for Safety Liquid-Tight Flexible Nonmetallic Conduit.

## 1.02 SUBMITTALS

### A Shop Drawings:

- 1. Manufacturer's Literature:
  - a. Rigid aluminum conduit.
  - b. PVC Schedule 40 conduits.
  - c. PVC-coated rigid galvanized steel conduit.
  - d. Flexible metal, liquid-tight conduit.
  - e. Conduit fittings.
- 2. Equipment and machinery proposed for bending metal conduit.

- B. Method for bending PVC conduit less than 30 degrees.

## 1.03 UL COMPLIANCE

- A. Materials manufactured within scope of Underwriters Laboratories shall conform to UL Standards and have an applied UL listing mark.

## PART 2 – PRODUCTS

### A. CONDUIT AND TUBING

#### B. Rigid Aluminum Conduit:

- 1. Meet requirements of ANSI C80.5 and UL 6.
- 2. Material: Type 6063, copper-free aluminum alloy.
- 3. 3/4" minimum.

#### C. PVC Schedule 40 or 80 Conduit:

- 1. Meet requirements of NEMA TC 2 and UL 651.
- 2. UL listed for underground direct burial, concealed or direct sunlight exposure, and 90 degrees C insulated conductors.
- 3. 3/4" minimum.

#### D. Flexible Metal, Liquid-Tight Conduit:

1. UL 360 listed for 105 degrees C insulated conductors.
2. Material: Galvanized steel, with an extruded PVC jacket.
3. ½” minimum.

## 2.02 FITTINGS

### A. Rigid Aluminum Conduit:

1. General:
  - a. Meet requirements of UL 514B.
  - b. Type: Threaded, copper-free. Set screw fittings not permitted.
2. Insulated Bushing:
  - a. Material: Cast aluminum, with integral insulated throat, rated for 150 degrees C.
  - b. Manufacturer: O.Z. Gedney; Type AB, or equal.
3. Grounding Bushing:
  - a. Material: Cast aluminum with integral insulated throat, rated for 150 degrees, with solderless lugs.
  - b. Manufacturer: O.Z. Gedney; Type ABLG, or equal.
4. Conduit Hub:
  - a. Material: Cast aluminum, with insulated throat.
  - b. Manufacturers:
    - 1) O.Z. Gedney; Type CHA.
    - 2) T & B; Series 370AL.
    - 3) Or equal.
5. Conduit Bodies:

### B. Manufacturers (For Normal Conditions):

- 1) Appleton; Form 85 threaded Unilets.
  - 2) Crouse-Hinds; Mark 9 or Form 7-SA threaded condulets.
  - 3) Killark; Series O Electrolets.
6. Couplings: As supplied by conduit manufacturer.

### C. PVC Conduit and Tubing:

1. Meet requirements of NEMA TC-3.
2. Type: PVC, slip-on.

D. PVC-Coated Rigid Galvanized Steel Conduit:

1. Meet requirements of UL 514B.
2. Type: Rigid galvanized steel, PVC coated by conduit manufacturer.
3. Overlapping pressure sealing sleeves.
4. Conduit Hangers, Attachments, and Accessories: PVC-coated.

E. Flexible Metal, Liquid-Tight Conduit:

1. Metal insulated throat connectors with integral nylon or plastic bushing rated for 105 degrees C.
2. Insulated throat and sealing O-rings.
3. Long design type extending outside of box or other device at least 2 inches.
4. Manufacturer: T & B; Series 5300, or equal.

F. Corrosive Locations:

1. Material: 40-mil PVC-coated rigid steel.
2. Manufacturers:
  - a. Robroy Industries.
  - b. Carlon.
  - c. Crouse-Hinds.

## 2.06 ACCESSORIES

A. Identification Devices:

1. Raceway Tags:
  - a. Material: Permanent, nylon.
  - b. Shape: Round.
  - c. Raceway Designation: Pressure stamped, embossed, or engraved.
  - d. Tags relying on adhesives or taped-on markers not permitted.

B. Raceway Coating:

1. Material: Bitumastic or plastic tape coating.
2. Manufacturers:

- a. Koppers bitumastic; No. 505.
  - b. Scotchwrap; No. 51, plastic tape.
  - c. Or approved equal.
- C. Wraparound Duct Band:
- 1. Material: Heat-shrinkable, cross-linked polyolefin, precoated with hot-melt adhesive.
  - 2. Manufacturer: Raychem; Type TWDB, or equal.
- D. All hardware shall be 316 Stainless Steel.

## PART 3 - EXECUTION

### 3.01 GENERAL

- A. Conduit and Tubing sizes shown are based on the use of copper conductors. Reference Section 16120, CONDUCTORS, concerning conduit sizing for aluminum conductors.
- B. All installed Work shall comply with NECA 5055.
- C. Crushed or deformed raceways not permitted.
- D. Maintain raceway entirely free of obstructions and moisture.
- E. Immediately after installation, plug or cap raceway ends with watertight and dust-tight seals until time for pulling in conductors.
- F. Aluminum Conduit: Do not install in direct contact with concrete.
- H. Avoid moisture traps where possible. When unavoidable in exposed conduit runs, provide junction box and drain fitting at conduit low point.
- I. Group raceways installed in same area.
- J. Follow structural surface contours when installing exposed raceways. Avoid obstruction of passageways.
- K. Run exposed raceways parallel or perpendicular to walls, structural members, or intersections of vertical planes.

- L. Block Walls: Do not install raceways in same horizontal course with reinforcing steel.
- M. Paint threads, before assembly of fittings, of galvanized conduit or IMC installed in exposed or damp locations with zinc-rich paint or liquid galvanizing compound.
- N. All metal conduit to be reamed, burrs removed, and cleaned before installation of conductors, wires, or cables.
- O. Do not install raceways in concrete equipment pads, foundations, or beams.

### 3.02 CONDUIT APPLICATION

- A. Diameter: Minimum 3/4 inch
- B. Interior, Exposed:
  - 1. Rigid aluminum.
- C. Interior, Concealed (Not Embedded in Concrete):
  - 1. Rigid aluminum.
  - 2. PVC Schedule 40.
- D. Corrosive Areas, Interior: PVC Schedule 80.

### 3.04 CONNECTIONS

- A. For motors, wall or ceiling mounted fans and unit heaters, dry type transformers, electrically operated valves, instrumentation, and other equipment where flexible connection is required to minimize vibration:
  - 1. Conduit Size 4 Inches or Less: Flexible metal, liquid-tight conduit.
  - 2. Corrosive Areas: Flexible, nonmetallic, liquid or PVC-coated metallic, liquid-tight.
  - 3. Length: 18-inch minimum, 60-inch maximum, of sufficient length to allow movement or adjustment of equipment.
- B. Transition From Underground to Exposed: PVC Coated Rigid aluminum conduit unless restricted by code.
- C. Under Equipment Mounting Pads: Rigid aluminum conduit.



### 3.05 PENETRATIONS

- A. Make at right angles, unless otherwise shown.
- B. Notching or penetration of structural members, including footings and beams, not permitted.
- C. Fire-Rated Walls, Floors, or Ceilings: Fire-stop openings around penetrations to maintain fire-resistance rating.
- D. Apply single layer of wraparound duct band to all metallic conduit in contact with concrete floor slabs to a point 2 inches above concrete surface.
- E. Concrete Walls, Floors, or Ceilings (Aboveground): Provide non-shrink grout dry-pack, or use watertight seal device.
  - 1. Corrosive-Sensitive Areas:
    - a. Seal all conduits passing through chlorine and ammonia room walls.
    - b. Seal all conduit entering equipment panel boards and field panels containing electronic equipment.
    - c. Seal penetration with silicone type sealant as specified in Section 07270, FIRE STOPPING.

### 3.06 SUPPORT

- A. Support from structural members only, at intervals not exceeding NFPA 70 requirements, and in any case not exceeding 10 feet. Do not support from piping, pipe supports, or other raceways.
- B. All supporting hardware shall be 316 stainless steel.
- C. Multiple Adjacent Raceways: Provide ceiling trapeze. For trapeze-supported conduit, allow 40 percent extra space for future conduit.
- D. Provide and attach wall brackets, strap hangers, or ceiling trapeze as follows:
  - 1. Hollow Masonry Units: Toggle bolts.
  - 2. Concrete or Brick: Expansion shields, or threaded studs driven in by powder charge, with lock washers and nuts.

### 3.07 BENDS

- A. Make bends and offsets of longest practical radius.

- B. Install with symmetrical bends or cast metal fittings.
- C. Avoid field-made bends and offsets, but where necessary, make with acceptable hickey or bending machine. Do not heat metal raceways to facilitate bending.
- D. Make bends in parallel or banked runs from same center or centerline with same radius so that bends are parallel.
- E. Factory elbows may be installed in parallel or banked raceways if there is change in plane of run, and raceways are same size.
- F. PVC Conduit:
  - 1. Bends 30-Degree and Larger: Aluminum conduit.
  - 2. 90-Degree Bends: Provide aluminum conduit elbows.
  - 3. Use manufacturer's recommended method for forming smaller bends.
- G. Flexible Conduit: Do not make bends that exceed allowable conductor bending radius of cable to be installed or that significantly restricts conduit flexibility.

### 3.08 EXPANSION/DEFLECTION FITTINGS

- A. Provide on all raceways at all structural expansion joints, and in long tangential runs.
- B. Provide expansion/deflection joints for 50 degrees F maximum temperature variation.
- C. Install in accordance with manufacturer's instructions.

### 3.09 PVC CONDUIT

- A. Solvent Welding:
  - 1. Provide manufacturer recommended solvent; apply to all joints.
  - 2. Install such that joint is watertight.
- B. Adapters:
  - 1. PVC to Metallic Fittings: PVC terminal type.
  - 2. PVC to Rigid Metal Conduit or IMC: PVC female adapter.
- C. Belied-End Conduit: Bevel the un-belled end of the joint prior to joining.

### 3.10 PVC-COATED RIGID STEEL CONDUIT

- A. Install in accordance with manufacturer's instructions.
- B. Provide PVC boot to cover all exposed threading.

### 3.16 EMPTY RACEWAYS

- A. Provide permanent, removable cap over each end.
- B. Provide PVC plug with pull-tab for underground raceways with end bells.
- C. Provide nylon pull cord.
- D. Identify, as specified in Paragraph IDENTIFICATION DEVICES, with waterproof tags attached to pull cord at each end, and at intermediate pull point.

### 3.17 IDENTIFICATION DEVICES

- A. Raceway Tags:
  - 1. Identify origin and destination.
  - 2. Install at each terminus, near midpoint, and at minimum intervals of every 50 feet of exposed Raceway, whether in ceiling space or surface mounted.
  - 3. Provide nylon strap for attachment.

### 3.18 PROTECTION OF INSTALLED WORK

- A. Protect products from effects of moisture, corrosion, and physical damage during construction.
- B. Provide and maintain manufactured watertight and dust-tight seals over all conduit openings during construction.
- C. Touch up painted conduit threads after assembly to cover nicks or scars.
- D. Touch up damage to coating on PVC-coated conduit with patching compound approved by manufacturer.

END OF SECTION

## SECTION 16120

### CONDUCTORS

#### PART 1 - GENERAL

##### 1.01 REFERENCES

- A. The following is a list of standards that may be referenced in this section:
1. American National Standards Institute (ANSI): 386, Standard for Separable Insulated Connector Systems for Power Distribution Systems Above 600V.
  2. American Society for Testing and Materials (ASTM):
    - a. A167, Standard Specification for Stainless and Heat Resisting Chromium-Nickel-Plated Steel Plate, Sheet, and Strip.
    - b. B3, Standard Specification for Soft or Annealed Copper Wire.
    - c. B8, Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.
    - d. B263, Standard Test Method for Determination of Cross- Sectional Area of Stranded Conductors.
  3. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
    - a. 48, Standard Test Procedures and Requirements or High-Voltage Alternating Current Cable Terminations.
    - b. 404, Standard for Cable Joints for Use with Extruded Dielectric Cable Rated 5,000V through 46,000V and Cable Joints for Use with Laminated Dielectric Cable Rated 2,500V through 500,000V.
  4. National Electrical Contractors Association, Inc. (NECA): 5055, Standard of Installation.
  5. National Electrical Manufacturers' Association (NEMA):
    - a. WC 3, Rubber-insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.
    - b. WC 5, Thermoplastic Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.
    - c. WC 55, Instrumentation Cables and Thermocouple Wire.
  8. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).
  9. Underwriters Laboratories, Inc. (UL):

- a. 13, Standard for Safety Power-Limited Circuit Cables.
- b. 44, Standard for Safety Rubber-Insulated Wires and Cables.
- c. 62, Standard for Safety Flexible Cord and Fixture Wire.
- d. 486A, Standard for Safety Wire Connector and Soldering Lugs for Use with Copper Conductors.
- e. 486B, Standard for Safety Wire Connectors and Soldering Lugs for Use with Aluminum Conductors.
- f. 510, Standard for Safety Insulating Tape.
- g. 854, Standard for Safety Service-Entrance Cables.
- h. 910, Standard for Safety Test Method for Fire and Smoke Characteristics of Electrical and Optical-Fiber Cables Used in Air Handling Spaces.
- i. 1072, Standard for Safety Medium-Voltage Power Cables.
- j. 1277, Standard for Safety Electrical Power and Control Tray Cables with Optional Optical-Fiber Members.
- k. 1581, Standard for Safety Reference Standard for Electrical Wires, Cables, and Flexible Cords.

## 1.02 SUBMITTALS

### A. Shop Drawings:

1. Wire and cable descriptive product information.
2. Wire and cable accessories descriptive product information.
3. Cable fault detection system descriptive product information.
4. Manufactured wiring systems descriptive product information.
5. Manufactured wire systems rating information.
6. Manufactured wire systems dimensional drawings.
7. Manufactured wire systems special fittings.

### B. Quality Control Submittals:

1. Certified Factory Test Report for conductors 600 volts and below.
2. Certified Factory Test Report per AEIC CS6, including AEIC qualification report for conductors above 600 volts.

## 1.03 UL COMPLIANCE

- ### A. Materials manufactured within scope of Underwriters Laboratories shall conform to UL Standards and have an applied UL listing mark.

## PART 2 - PRODUCTS

### 2.01 CONDUCTORS 600 VOLTS AND BELOW

- A. Conform to applicable requirements of NEMA WC 3, WC 5, and WC 7.
- B. Conductor Type:
  - 1. All Other Circuits: Stranded copper.
- C. Insulation: Type THHN/THWN, except for sizes No. 6 and larger, with XHHW insulation.

### 2.02 600-VOLT RATED CABLE

- A. General:
  - 1. Permanently and legibly marked with manufacturer's name, maximum working voltage for which cable was tested, type of cable, and UL listing mark.
  - 2. Minimum Temperature Rating: 90 degrees C dry locations, 75 degrees C wet locations.
  - 3. Overall Outer Jacket: PVC, flame-retardant, sunlight- and oil-resistant.
- B. Wire and Connectors
  - 1. Cable shall be rated for 600 volts and shall meet the requirements below:
  - 2. Conductors shall be stranded
  - 3. All wire shall be brought to the job in unbroken packages and shall bear the data of manufacturing; not older than 12 months.
  - 4. Type of wire shall be THHN/THWN, rated 75 degrees C suitable for wet locations except where required otherwise by the drawings.
  - 5. No wire smaller than No. 12 gauge shall be used unless specifically indicated.
  - 6. Conductor metal shall be copper.
  - 7. All conductors shall be megger tested after installation and insulation must be in compliance with the Insulated Power Cable Engineers Association Minimum Values of Insulation Resistance.
- C. No. 16 AWG, Twisted, Shielded Pair, Instrumentation Cable: Single pair, designed for noise rejection for process control, computer, or data log applications meeting NEMA WC 55 requirements.
  - 1. Outer Jacket: 45-mil nominal thickness.

2. Individual Pair Shield: 1.35-mil, double-faced aluminum/synthetic polymer overlapped to provide 100 percent coverage.
3. Dimension: 0.31-inch nominal OD.
4. Conductors:
  - a. Bare soft annealed copper, Class B, seven-strand concentric, meeting requirements of ASTM B8
  - b. 20 AWG, seven-strand tinned copper drain wire.
  - c. Insulation: 15-mil nominal PVC.
  - d. Jacket: 4-mil nominal nylon.
  - e. Color Code: Pair conductors black and red.
5. Manufacturers:
  - a. Okonite Co.
  - b. Alpha Wire Corp.
  - c. Rome Cable.
6. The following test shall be performed on instrumentation and control system cables. All tests shall be end-to-end test of installed cables with the ends supported in free air, not adjacent to any ground object. All test data shall be recorded on forms acceptable to the Engineer. Complete records of all tests shall be made and delivered to the Engineer.
  - a. Continuity tests shall be performed by measuring wire/shield loop resistances of signal cable as the wires, taken one at a time, are shorted to the channel shield. No loop resistance measurement shall carry by more than  $\pm 2$  ohms from the calculated average loop resistance value.
  - b. Insulation resistance tests shall be performed by using a 500 volt megohmmeter to measure the insulation resistance between each channel wire and channel shield, between individual channel shields in a multi-channel cable, between each individual channel and the overall cable shield in multi-channel cable, between each wire and ground, and between each shield and ground. Values of resistance less than 10 megohms shall be unacceptable.

## 2.03 GROUNDING CONDUCTORS

- A. Equipment: Stranded copper with green, Type THHN/THWN, insulation.

## 2.04 ACCESSORIES FOR CONDUCTORS 600 VOLTS AND BELOW

### A. Tape:

1. General Purpose, Flame Retardant: 7-mil, vinyl plastic, Scotch Brand 33, rated for 90 degrees C minimum, meeting requirements of UL 510.
2. Flame Retardant, Cold and Weather Resistant: 8.5-mil, vinyl plastic, Scotch Brand 88.
3. Arcs and Fireproofing:
  - a. 30-mil, elastomer
  - b. Manufacturers and Products:
    - 1) Scotch; Brand 77, with Scotch Brand 69 glass cloth tape binder.
    - 2) Plynount; Plyarc 30, with Plymount Plyglas glass cloth tape binder.

### B. Identification Devices:

1. Sleeve: Permanent, PVC, yellow or white, with legible machine-printed black markings.
2. Marker Plate: Nylon, with legible designations permanently hot stamped on plate.
3. Grounding Conductor: Permanent green heat-shrink sleeve, 2-inch minimum.

### C. Connectors and Terminations:

1. Nylon, Self-Insulated Crimp Connectors:
  - a. Manufacturers and Products:
    - 1) Thomas & Betts; Sta-Kon.
    - 2) Burndy; Insulink.
    - 3) ILSCO.
2. Nylon Self-Insulated, Crimp Locking-Fork, Torque-Type Terminator:
  - a. Manufacturers and Products:
    - 1) Thomas & Betts; Sta-Kon.
    - 2) Burndy; Insulink.



### 3) ILSCO.

#### D. Cable Lugs:

1. In accordance with NEMA CC I.
2. Rated 600 volts of same material as conductor metal.
3. Insulated, Locking-Fork, Compression Lugs:

##### a. Manufacturers and Products:

- 1) Thomas & Betts; Sta-Kon.
- 2) ILSCO; ILSCONS.
- 3) Or equal.

#### 4. Un-insulated Crimp Connectors and Terminators:

##### a. Manufacturers and Products:

- 1) Square D; Versitide.
- 2) Thomas & Betts; Color-Keyed.
- 3) ILSCO.

#### 5. Un-insulated, Bolted, Two-Way Connectors and Terminators:

##### a. Manufacturers and Products:

- 1) Thomas & Betts; Loctite.
- 2) Burndy; Quiklug.
- 3) ILSCO.

#### E. Cable Ties: Nylon, adjustable, self-locking, and reusable.

1. Manufacturers and Product: Thomas & Betts; TY-RAP, or equal.

#### F. Heat Shrinkable Insulation: Thermally stabilized, crosslinked polyofin.

1. Manufacturers and Product: Thomas & Betts; SHRINK-KON, or equal.

### 2.05 PULLING COMPOUND

- #### A. Nontoxic, non-corrosive, noncombustible, nonflammable, wax-based lubricant; UL listed.

- B. Suitable for rubber, neoprene, PVC, polyethylene, hypalon, CPE, and lead-covered wire and cable.
- C. Suitable for zinc-coated steel, aluminum, PVC, bituminized fiber, and fiberglass raceways.
- D. Manufacturers and Products:
  - 1. Ideal Co.; Yellow 77.
  - 2. Polywater, Inc.
  - 3. Cable Grip Co.

## 2.06 SOURCE QUALITY CONTROL

- A. Conductors 600-Volts and Below: Test in accordance with UL 44 and 854 Standards.

## PART 3 - EXECUTION

### 3.01 GENERAL

- A. Conductor installation to be in accordance with NECA 5055.
- B. Conductor and cable sizing shown is based on copper conductors, unless noted otherwise.
- C. Do not exceed cable manufacturer's recommendations for maximum pulling tensions and minimum bending radii.
- D. Tighten screws and terminal bolts in accordance with UL 486A for copper conductors.
- E. Cable Lugs: Provide with correct number of holes, bolt size, and center-to-center spacing as required by equipment terminals.
- F. Bundling: Where single conductors and cables in manholes, hand holes, vaults, and other indicated locations are not wrapped together by some other means, bundle conductors from each conduit throughout their exposed length with cable ties placed at intervals not exceeding 18 inches on center.
- G. Ream, remove burrs, and clear interior of installed conduit before pulling wires or cables.

### 3.02 POWER CONDUCTOR COLOR CODING

#### A. Conductors 600 Volts and Below:

1. No. 6 AWG and Larger: Apply general purpose, flame retardant tape at each end, and at accessible locations wrapped at least six full overlapping turns, covering an area 1-1/2 to 2 inches wide.
2. No. 8 AWG and Smaller: Provide colored conductors.
3. Colors:

System	Conductor	Color
All Systems	Equipment Grounding	Green
240/120 Volts Single-Phase, Three-Wire	Grounded Neutral One Hot Leg Other Hot Leg	White Black Red
208Y/120 Volts Three-Phase, Four-Wire	Grounded Neutral Phase A Phase B Phase C	White Black Red Blue
240/120 Volts Three-Phase, Four-Wire Delta, Center Tap Ground on Single-Phase	Grounded Neutral Phase A High (wild) Leg Phase C	White Black Orange Blue
480Y/277 Volts Three-Phase, Four-Wire	Grounded Neutral Phase A Phase B Phase C	Gray Brown Orange Yellow
NOTE: Phase A, B, C implies direction of positive phase rotation		

### 3.03 CIRCUIT IDENTIFICATION

A. Circuits Appearing in Circuit Schedules: identify power, instrumentation, and control conductor circuits, using circuit schedule designations, at each termination and in accessible locations such as manholes, hand holes, panels, switchboards, motor control centers, pull boxes, and terminal boxes.

#### B. Circuits Not Appearing in Circuit Schedules:

1. Assign circuit name based on device or equipment at load end of circuit.
2. Where this would result in same name being assigned to more than one circuit, add number or letter to each otherwise identical circuit name to make it unique.

C. Method:

1. Conductors No. 3 AWG and Smaller: Identify with sleeves.
2. Cables, and Conductors No. 2 AWG and Larger:
  - a. Identify with marker plates.
  - b. Attach marker plates with nylon tie cord.
3. Taped-on markers or tags relying on adhesives not permitted.

3.04 CONDUCTORS 600 VOLTS AND BELOW

- A. Install 10 AWG or 12 AWG conductors for branch circuit power wiring in lighting and receptacle circuits.
- B. Do not splice incoming service conductors and branch power distribution conductors No. 6 AWG and larger unless specifically indicated or approved by ENGINEER.
- C. Connections and Terminations:
  1. Install wire nuts only on solid conductors.
  2. Install nylon self-insulated crimp connectors and terminators for instrumentation, control, and power circuit conductors No. 6 AWG and smaller.
  3. Install un-insulated crimp connectors and terminators for instrumentation, control, and power circuit conductors No. 4 AWG through No. 2/0 AWG.
  4. Install un-insulated bolted two-way connectors for motor circuit conductors No. 12 and larger.
  5. Tape insulates all un-insulated connections.
  6. Place no more than one conductor in any single-barrel pressure connection.
  7. Install crimp connectors with tools approved by connector manufacturer.
  8. Install terminals and connectors acceptable for type of material used.
  9. Compression Lugs
    - a. Attach with a tool specifically designed for purpose.
    - b. Tool shall provide complete controlled crimp and shall not release until crimp is complete.
    - c. Do not use plier type crimpers.
- D. Do not use soldered mechanical joints.

E. Splices and Terminations:

1. Splices shall not be allowed unless approved on a case by case bases. All approved splices shall be witnessed by R.P.R. with electrician. Schedule splices 7 days advanced notice.
  - a. Indoors: Use general purpose, flame retardant tape.

F. Cap spare conductors with UL listed end caps.

G. Cabinets, Panels, and Motor Control Centers:

1. Remove surplus wire, bridle and secure.
2. Where conductors pass through openings or over edges in sheet metal, remove bums, chamfer edges, and install bushings and protective strips of insulating material to protect the conductors.

H. Control and Instrumentation Wiring:

1. Where terminals provided will accept such lugs, terminate control and instrumentation wiring, except solid thermocouple leads, with insulated, locking-fork compression lugs.
2. Terminate with methods consistent with terminals provided, and in accordance with terminal manufacturer's instructions.
3. Locate splices in readily accessible cabinets or junction boxes using terminal strips.
4. Where connections of cables installed under this section are to be made under Division 13, leave pigtails of adequate length for bundled connections.
5. Cable Protection:
  - a. Maintain integrity of shielding of instrumentation cables.
  - b. Ensure grounds do not occur because of damage to jacket over the shield.

I. Extra Conductor Length: For conductors to be connected by others, install minimum 6 feet of extra conductor in freestanding panels and minimum 2 feet in other assemblies. Coil and label conductors for easy identification.

J. Variable Frequency Drive (VFD) Output Power Cable:

1. Install cables in raceway.
2. Terminate the three ground conductors together at the motor and at the ground bus of the VFD.

3. Terminate aluminum armor at motor and at VFD. At motor, terminate shield with cable manufacturer recommended termination kit. Termination shall be to the motor junction box. At the VFD, terminate armor to the inverter drive frame. The termination kit must provide a 360-degree connection of the armor to frame and motor junction box.

### 3.05 CONDUCTOR ARC AND FIREPROOFING

- A. Install arc and fireproofing tape on 5 kV cables or 8 kV cables throughout their entire exposed length in manholes, hand holes, vaults, cable trays, and other indicated locations.
- B. Wrap conductors of same circuit entering from separate conduit together as a single cable.
- C. Follow tape manufacturer's installation instructions.
- D. Secure tape at intervals of 5 feet with bands of tape binder. Each tape band shall consist of a minimum of two wraps directly over each other.

### 3.06 BUSWAY

- A. Install in strict accordance with manufacturer's recommendations and NFPA 70.
- B. Maximum Support Spacing: 10 feet.

### 3.07 FIELD QUALITY CONTROL

- A. In accordance Section 16950, ELECTRICAL TESTING.

END OF SECTION

## SECTION 16405

### AC INDUCTION MOTORS

#### PART 1 - GENERAL

##### 1.01 RELATED SECTIONS

- A. This section applies only when referenced by a motor-driven equipment specification. Application, horsepower, enclosure type, mounting, shaft type, synchronous speed, and any deviations from this section will be listed in the equipment specification. Where such deviations occur, they shall take precedence over this section.

##### 1.02 REFERENCES

- A. The following is a list of standards that may be referenced in this section:
  - 1. Anti-Friction Bearing Manufacturers' Association (AFBMA):
    - a. 9, Load Ratings and Fatigue Life for Ball Bearings.
    - b. 11, Load Rating and Fatigue Life for Roller Bearings.
  - 2. American National Standards Institute (ANSI): C50.41, Polyphase Induction Motors for Power Generating Stations.
  - 3. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
    - a. 85, Test Procedure for Airborne Sound Measurements on Rotating Machines.
    - b. 112, Standard Test Procedures for Polyphase Induction Motors and Generators.
    - c. 114, Standard Test Procedures for Single-Phase Induction Motors.
    - d. 620, Guide for Construction and Interpretation of Thermal Limit Curves for Squirrel-Cage Motors Over 500 Horsepower.
    - e. 841, Recommended Practice for Chemical Industry Severe-Duty Squirrel-Cage Induction Motors, 600V and Below.
  - 4. National Electrical Manufacturers Association (NEMA):
    - a. MG 1, Motors and Generators.

- b. MG 13, Frame Assignments for Alternating Current Integral Horsepower Induction Motors.
  - c. 250, Enclosures for Electrical Equipment (1,000 Volts Maximum).
- 5. National Fire Protection Association (NFPA): 70, National Electrical Code. (NEC)
  - 6. Underwriters Laboratories (UL):
    - a. 547, Thermal Protectors for Electric Motors.
    - b. 674, Electric Motors and Generators Used in Hazardous (Classified) Locations.

### 1.03 DEFINITIONS

- A. CISD-TEFC: Chemical industry, severe-duty enclosure.
- B. TEFC: Totally enclosed, fan cooled enclosure.
- C. TENV: Totally enclosed, non-ventilated enclosure.
- D. Motor Nameplate Horsepower: That rating after any derating required to allow for extra heating caused by the harmonic content in the voltage applied to the motor by its controller.

### 1.04 SUBMITTALS

- A. Shop Drawings:
  - 1. Descriptive information.
  - 2. Nameplate data in accordance with NEMA MG 1.
  - 3. Additional Rating Information:
    - a. Service factor.
    - b. Locked rotor current.
    - c. No load current.
    - d. Safe stall time for motors 200 horsepower and larger.
    - e. Multispeed load classification (e.g., variable torque).
    - f. Adjustable frequency drive motor load classification (e.g., variable torque) and minimum allowable motor speed for that load classification.
  - 4. Enclosure type and mounting (e.g. horizontal, vertical).
  - 5. Dimensions and total weight.
  - 6. Conduit box dimensions and usable volume as defined in NEMA MG 1 and NFPA 70.



7. Bearing type.
8. Bearing lubrication.
9. Bearing life.
10. Space heater voltage and watts.
11. Description and rating of motor thermal protection.
12. Motor sound power level in accordance with NEMA MG 1.
13. Maximum brake horsepower required by the equipment driven by the motor.
14. Description and rating of submersible motor moisture sensing system.

B. Quality Control Submittals:

1. Factory test reports, certified.
2. Manufacturer's Certificate of Proper Installation, 100 horsepower and larger.
3. Operation and Maintenance Manual.

## PART 2 - PRODUCTS

### 2.01 MANUFACTURERS

- A. General Electric.
- B. U.S. Motors.
- C. Baldor.

### 2.02 GENERAL

- A. For multiple units of the same type of equipment, furnish identical motors and accessories of a single manufacturer.
- B. In order to obtain single source responsibility, the contractor shall utilize a single supplier to provide a drive motor, its driven equipment, and specified motor accessories.
- C. Meet requirements of NEMA MG 1.
- D. Frame assignments in accordance with NEMA MG 13.
- E. Provide motors for hazardous (classified) locations that conform to UL 674 and have an applied UL listing mark.

- F. Motors shall be specifically designed for the use and conditions intended, with a NEMA design letter classification to fit the application.
- G. Motors driven by variable frequency drives shall be inverter duty rated in compliance with NEMA MG1, Part 31.
- H. Operating Conditions:
  - 1. Maximum ambient temperature not greater than 50 degrees C.
  - 2. Motors shall be suitable for operating conditions without any reduction being required in the nameplate rated horsepower or exceeding the rated temperature rise.
  - 3. Overspeed in either direction in accordance with NEMA MG 1.

#### 2.03 HORSEPOWER RATING

- A. As designated in motor-driven equipment specifications.
- B. Constant Speed Applications: Brake horsepower of the driven equipment at any head capacity point on the pump curve not to exceed motor nameplate horsepower rating, excluding any service factor.
- C. Adjustable Frequency, Adjustable Speed Applications: Driven equipment brake horsepower at any head capacity point on the pump curve not to exceed motor nameplate horsepower rating, excluding any service factor.

#### 2.04 SERVICE FACTOR

- A. 1.15 minimum at rated ambient temperature, unless otherwise indicated.

#### 2.05 VOLTAGE AND FREQUENCY RATING

- A. System Frequency: 60-Hz.
- B. Voltage Rating: Unless otherwise indicated in motor-driven equipment specifications:
- C. Suitable for full voltage starting.
- D. Suitable for accelerating the connected load with supply voltage at motor starter supply terminals dipping to 90 percent of motor rated voltage.

## 2.06 EFFICIENCY AND POWER FACTOR

- A. For all motors except single-phase, under 1 horsepower, multispeed, short-time rated and submersible motors, or motors driving gates, valves, elevators, cranes, trolleys, and hoists:
  - 1. Efficiency:
    - a. Tested in accordance with NEMA MG 1, paragraph 12.54.1.
    - b. Guaranteed minimum at full load in accordance with Table 1 or as indicated in motor-driven equipment specifications.
  - 2. Power Factor: Guaranteed minimum at full load in accordance with Table 1 or as indicated in motor-driven equipment specifications.

## 2.07 LOCKED ROTOR RATINGS

- A. Locked rotor kVA Code F or lower if motor horsepower not covered by NEMA MG 1 tables.
- B. Safe stall time 15 seconds or greater.

## 2.08 INSULATION SYSTEMS

- A. Single-Phase, Fractional Horsepower Motors: Manufacturer's standard winding insulation system.
- B. Three-Phase and Integral Horsepower Motors, Unless Otherwise Indicated in Motor-Driven Equipment Specifications: Class F with Class B rise at nameplate horsepower and designated operating conditions, except EXP and DIP motors which must be Class B with Class B rise.

## 2.09 ENCLOSURES

- A. All enclosures to conform to NEMA MG 1.
- B. TEFC and TENV: Furnish with a drain hole with porous drain/weather plug.

## 2.10 TERMINAL (CONDUIT) BOXES

- A. Oversize main terminal boxes for all motors.

- B. Diagonally split, rotatable to each of four 90-degree positions. Threaded hubs for conduit attachment.
- C. Except ODP, furnish gaskets between box halves and between box and motor frame.
- D. Terminal for connection of equipment grounding wire in each terminal box.

## 2.11 BEARINGS AND LUBRICATION

- A. Horizontal Motors:
  - 1. 3/4 horsepower and Smaller: Permanently lubricated and sealed ball bearings, or regreasable ball bearings in labyrinth sealed end bells with removable grease relief plugs.
  - 2. 1 Through 400 horsepower: Regreasable ball bearings in labyrinth sealed end bells with removable grease relief plugs.
  - 3. Minimum 100,000 hours L-10 bearing life for ball and roller bearings as defined in AFBMA 9 and 11.
- B. Regreasable Antifriction Bearings:
  - 1. Readily accessible, grease injection fittings.
  - 2. Readily accessible, removable grease relief plugs.

## 2.12 NOISE

- A. Measured in accordance with IEEE 85 and NEMA MG 1.
- B. Motors controlled by adjustable frequency drive systems shall not exceed sound levels of 3 dBA higher than NEMA MG 1.

## 2.13 BALANCE AND VIBRATION CONTROL

- A. In accordance with NEMA MG 1-12.06.

## 2.14 EQUIPMENT FINISH

- A. External Finish: Prime and finish coat manufacturer's standard. Field painting in accordance with Sections 09900 PAINTING.
- B. Internal Finish: Bore and end turns coated with clear polyester or epoxy varnish.

## 2.15 SPECIAL FEATURES AND ACCESSORIES

### A. Winding Thermal Protection:

1. Thermostats, unless otherwise noted in the pump specification:
  - a. Motors for constant speed and adjustable speed application 30 through 75 horsepower.
  - b. Bi-metal disk or rod type thermostats embedded in stator windings (normally closed contact).
  - c. Automatic reset contacts rated 120 volts ac, 5 amps minimum, and opening on excessive temperature. (Manual reset will be provided at motor controller.)

### B. Nameplates:

1. Raised or stamped letters on stainless steel or aluminum.
2. Display all motor data required by NEMA MG 1-10.37 and NEMA MG 1-10.38 in addition to bearing numbers for both bearings.
3. Premium efficiency motor nameplates to also display NEMA nominal efficiency, full load power factor, and maximum allowable kVAR for power factor correction capacitors.

## 2.16 FACTORY TESTING

### A. Tests:

1. In accordance with IEEE 112 for polyphase motors and IEEE 114 for single-phase motors.
2. Routine (production) tests on all motors in accordance with NEMA MG 1, plus no load power at rated voltage and polyphase, rated voltage measurement of locked rotor current. Test multispeed motors at all speeds.
3. For energy efficient motors, test efficiency at 50, 75, and 100 percent of rated horsepower:
  - a. In accordance with IEEE 112, Test Method B, and NEMA MG 1, paragraphs 12.54 and 12.57.
4. Power factor:
  - a. Speed.
  - b. Current at rated horsepower.
  - c. kW input at rated horsepower.

- d. On motors of 100 horsepower and smaller, furnish a certified copy of a motor efficiency test report on an identical motor.

B. Test Report Forms:

- 1. Routine Tests: IEEE 112, Form A-1.

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. In accordance with manufacturer's instructions and recommendations.
- B. Align motor carefully and properly with driven equipment.
- C. Secure equipment to mounting surface with anchor bolts. Provide anchor bolts meeting manufacturer's recommendations and of sufficient size and number for the specified seismic conditions.

### 3.02 FIELD QUALITY CONTROL

- A. Refer to Section 16950, ELECTRICAL TESTING.

### 3.03 MANUFACTURER'S SERVICES

- A. Furnish manufacturer's representative at site in accordance with Section 01650, START-UP AND DEMONSTRATION, for installation assistance, inspection, equipment testing, and startup assistance for motors larger than 75 horsepower.
- B. Manufacturer's Certificate of Proper Installation.

### 3.04 SUPPLEMENTS

- A. Table supplements, following "END OF SECTION," are a part of this Specification.

END OF SECTION

## SECTION 16450

### GROUNDING

#### PART 1 - GENERAL

##### 1.01 REFERENCES

- A. The following is a list of standards that may be referenced in this section:
  - 1. American National Standards Institute (ANSI): C2, National Electrical Safety Code (NESC).
  - 2. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).

##### 1.02 SUBMITTALS

- A. Shop Drawings:
  - 1. Product Data:
    - a. Mechanical connectors.
    - b. Compression connectors.

##### 1.03 UL COMPLIANCE

- A. Materials manufactured within scope of Underwriters Laboratories shall conform to UL Standards and have an applied UL listing mark.

#### PART 2 - PRODUCTS

##### 2.01 GROUND CONDUCTORS

- A. As specified in Section 16120, CONDUCTORS.

##### 2.02 CONNECTORS

- A. Mechanical Type: Split-bolt, saddle, or cone screw type; copper alloy material.
  - 1. Manufacturers:
    - a. Burndy Corp.
    - b. Thomas and Betts Co.
    - c. Or equal.

## PART 3 - EXECUTION

### 3.01 GENERAL

- A. Grounding shall be in compliance with NFPA 70 and ANSI C2.
- B. Bond exposed non-current-carrying metal parts of electrical equipment, metal raceways, ground conductor in raceways, receptacle ground connections, and metal piping systems.
- C. Shielded Power Cables: Ground shields at each splice or termination in accordance with recommendations of splice or termination manufacturer.
- D. Shielded Control Cables:
  - 1. Ground shield to ground bus at power supply for analog signal.
  - 2. Expose shield minimum 1 inch at termination to field instrument and apply heat shrink tube.
  - 3. Do not ground control cable shield at more than one point.

### 3.02 WIRE CONNECTIONS

- A. Ground Conductors: Install in conduit containing power conductors and control circuits above 50 volts.
- B. Connect ground conductors to raceway grounding bushings.
- C. Extend and connect ground conductors to ground bus in all equipment containing a ground bus.
- D. Connect enclosure of equipment containing ground bus to that bus.
- E. Bolt connections to equipment ground bus.
- F. Bond grounding conductors to metallic enclosures at each end, and to intermediate metallic enclosures.
- G. Junction Boxes: Furnish materials and connect to equipment grounding system with grounding clips mounted directly on box, or with 3/8-inch machine screws.

### 3.03 SURGE PROTECTION EQUIPMENT GROUNDING

- A. Connect surge arrestor ground terminals to equipment ground bus.



3.04 INSTRUMENT GROUND - SURGE SUPPRESSION

- A. Connect all instrument surge protection with #6 insulated copper ground wire (in conduit where above grade) to closest plant ground system

3.05 FIELD QUALITY CONTROL

- A. As specified in Section 16950, ELECTRICAL TESTING.

END OF SECTION

## SECTION 16722

### ADDRESSABLE FIRE ALARM SYSTEM

#### PART 1 - GENERAL

##### 1.01 SCOPE OF WORK

- A. The Contractor shall furnish, test, install, and place in satisfactory operation a complete, addressable, microprocessor based fire detection and alarm system consisting of manual and automatic initiating devices, notification appliances, control panel, surge suppression, line isolators and all spare parts, accessories and appurtenances as herein specified and as shown on the Drawings. System shall electrically supervise all wires and both the alarm initiating devices and the audible and visual alarm devices. Contractor shall document the fire alarm monitoring & installation and transfer the documents to the Owner after testing.
- B. Fire alarm system is designed around manufacturer Siemens or approved equal. The fire alarm system shall be able to communicate with the Existing Main Fire Alarm Control Panel at the Administration Building. If the CONTRACTOR chooses to use another manufacturer for the designed system, the manufacturer shall secure the services of a Florida Registered Professional Engineer to become Engineer-Of-Record and shall notify current Engineer-Of-Record in accordance with Chapter 61G15-27 of the Florida Administrative Code (FAC) of assumption of the work. For the Authority Having Jurisdiction (AHJ), the CONTRACTOR/Manufacturer/New Engineer-of-Record shall meet all permit requirements, make all submittals necessary, resolve all issues, incorporate all comments, perform all tests and inspections and pay all fees necessary for a complete, working installation that is accepted by the AHJ.
- C. Fire alarm system shall meet the following criteria:
1. System shall be power limited.
  2. Secondary power shall be supplied by 24V DC batteries with capacity for 72 hours of continuous standby operation followed by 15 minutes of operation in alarm condition.
  3. Maximum voltage drop on 24V DC Notification Appliance Circuits (NAC) circuits shall not exceed the lowest rated voltage of all connected devices on that circuit.
  4. Maximum voltage drop on 24V DC Signaling Line Circuits (SLC) circuits shall not exceed the lowest rated voltage of all connected devices on that circuit.

5. Device locations and mounting heights shall be in accordance with ADA requirements.
  6. All flashing strobe or horn/strobe notification appliances located within the same area that can be seen in a 135° field of view and are within 55 feet of the next strobe or horn strobe shall be synchronized.
- D. Alarm, trouble and supervisory signals from all intelligent reporting devices shall be encoded on NFPA Style 6 (Class A) Signaling Line Circuits (SLC).
  - E. Initiation Device Circuits (IDC) shall be wired Class A (NFPA Style D) as part of an addressable device connected by the SLC Circuit.
  - F. Notification Appliance Circuits (NAC) shall be wired Class A (NFPA Style Z) as part of an addressable device connected by the SLC Circuit.
  - G. On Style 7 (Class A) configurations a single ground fault or open circuit on the system Signaling Line Circuit shall not cause system malfunction, loss of operating power or the ability to report an alarm.
  - H. Alarm signals arriving at the FACP shall not be lost following a primary power failure (or outage) until the alarm signal is processed and recorded.
  - I. The system and its components shall be Underwriters Laboratories, Inc. listed under the appropriate UL testing standard as listed herein for fire alarm applications and the installation shall be in compliance with the UL listing.
  - J. The CONTRACTOR shall employ NICET (minimum Level II Fire Alarm Technology) technicians for installation on site and to guide the final checkout and to ensure the systems integrity.
  - K. The FACP shall communicate to the owners monitoring system via fiber optic cable.
  - L. All necessary raceway/conduits and junction boxes shall be supplied by the Electrical Contractor. Fire Alarm System shall be installed fire alarm system under the supervision of the Electrical Contractor so that no additional low voltage permit is needed. Coordinate with Electrical Contractor to meet all requirements to fall under the Electrical Contractor's low voltage permit before bidding. If Fire Alarm System Supplier does not meet the requirements to fall under the Electrical Contractor's low voltage permit, he/she shall supply additional permit as needed with no additional cost to the Owner.

## 1.02 RELATED SECTIONS

- A. Section 16010 - Electrical General Requirements

B. Section 16050 - Basic Electrical Materials and Methods

1.03 REFERENCES

A. This section contains references to the following documents. They are part of this section as specified and modified. In situations of conflict between the requirements of his section and those of the listed documents, the requirements of this section shall prevail.

1. Florida Handicap Accessibility Code – Latest Edition.
2. UL – Underwriters Laboratories
3. NFPA 70 - 2011 National Electrical Code (NEC).
4. NFPA 72 - 2010 National Fire Alarm Code.
5. NFPA 101 – 2012 Life Safety Code.
6. UL 268 - Smoke Detectors for Fire Protective Signaling Systems.
7. UL 268A – Smoke Detectors for Duct Applications.
8. UL 521 - Heat Detectors for Fire Protective Signaling Systems.
9. UL 864 - Control Units for Fire Protective Signaling Systems.
10. UL 1971 – Visual Notification Appliances.
11. UL 464 - Audible Signaling Appliances.
12. UL 38 - Manually Actuated Signaling Boxes
13. UL 1481 - Power Supplies for Fire Protective Signaling Systems
14. Florida Building Code – 5th Edition
15. All Local Fire Codes.
16. All requirements of the Authority Having Jurisdiction (AHJ).

#### 1.04 WORK INCLUDED

- A. Provide all materials, equipment, labor, supervision and all related items necessary to complete this phase of the work as indicated on the drawings and specifications, including fire alarm control panel, manual stations, detectors, signal appliances and all other devices as required. Supply and install all conduits and wiring as required. The fire alarm system shall be complete and operable as required by the local Fire Marshall and state inspector.

#### 1.05 DEFINITIONS

- A. Alarm-Initiating Device: A manual station, smoke detector, heat detector, or sprinkler water-flow switch.
- B. Alarm Signal: Signifies a state of emergency requiring immediate action. Pertains to signals such as the operation of an alarm-initiating device.
- C. Class A Wiring: Circuits arranged and electrically supervised so a single break or single ground fault condition will be indicated by a trouble signal at the fire alarm control panel (FACP) and the circuit will continue to be capable of operation for its intended service in the faulted condition no matter where the break or ground fault condition occurs.
- D. Multiplex System: One using signaling method characterized by the simultaneous or sequential transmission, or both, and the reception of multiple signals in a communication channel, including means for positively identifying each signal.
- E. Notification Appliance: Audio and/or visual indicating device such as a strobe or horn/strobe.
- F. Supervisory Signal: Indicates abnormal status or need for action regarding fire suppression or other protective system.
- G. Trouble Signal: Indicates that a fault, such as an open circuit or ground, has occurred in the system.
- H. SPD: Surge Protection Device

#### 1.06 SYSTEM DESCRIPTION

- A. Signal Transmission: Multiplex signal transmission dedicated to fire alarm service only.
- B. Functional Description: The following are required system functions and operating features:

1. Priority of Signals: Accomplish automatic response functions by the first device initiated. Alarm functions resulting from initiation by the first device are not altered by subsequent alarms. The highest priority is an alarm signal. Supervisory and trouble signals have second- and third-level priority. Signals of a higher-level priority take precedence over signals of lower priority even though the lower-priority condition occurred first. Annunciate all alarm signals regardless of priority or order received.
2. Non-interfering: Design, power, wire, and supervise the system so a signal one device does not prevent the receipt of signals from any other device. All alarms are manually resettable from the FACP after the initiating device or devices are restored to normal. Systems that require the use of batteries or battery backup for the programming function are not acceptable.
3. Signal Initiation: The manual or automatic operation of an alarm-initiating or supervisory-operating device causes the FACP to activate all audible and visual alarm devices. The signals shall include, but not be limited to, the following:
  - a. Pull Station.
  - b. Smoke detector alarm.
  - c. Heat detector alarm.
  - d. System trouble.
  - e. Fire flow detection.
4. Silencing at FACP: Keypad provides capability for acknowledgment of alarms; supervisory, trouble, and other specified signals at the FACP; and capability to silence the local audible signal. Subsequent alarms cause the audible signal to sound again until silenced in turn by keypad operation.
5. A single ground or open on any system signaling line circuit, initiating device circuit or notification appliance circuit shall not cause system malfunction, loss of operating power or the ability to report an alarm.
6. Loss of primary power at the FACP sounds trouble signal at the FACP. An emergency power light is illuminated at both locations when the system is operating on an alternate power supply.
7. Annunciation: Manual and automatic operation of alarm- and supervisory-initiating devices is annunciated on the FACP indicating the location and type device.
8. Alarm: A system alarm includes:
  - a. Indicating the alarm condition at the FACP.

- b. Identifying the device that is the source of the alarm at the FACP.
  - c. Initiating audible and visible alarm signals throughout the building.
  - d. Recording the event on the system printer.
9. Manual station alarm operation initiates an alarm.
  10. Smoke detection initiates an alarm.
  11. Duct smoke detectors initiate alarm and air handler or fan shutdown.
  12. Alarm signals arriving at the main FACP shall not be lost following a power failure (or outage) until the alarm signal is processed and recorded.
  13. Remote Detector Sensitivity Adjustment: Manipulation of controls at the FACP causes the selection of specific addressable smoke detectors for adjustment, display of their current status and sensitivity settings, and control of changes in those settings. The same controls can be used to program repetitive, scheduled, automated changes in sensitivity of specific detectors.
  14. Digitized electronic signals shall employ check digits or multiple polling.
  15. Any device in the system may be enabled or disabled through the system keypad. Any system output may be turned on or off from the system keypad.
  16. Addressable devices shall provide an address-setting means using rotary decimal switches.
  17. Isolator modules shall be provided to automatically isolate wire-to-wire short circuits on a loop. The isolator module shall limit the number of modules or detectors that may be rendered inoperative by a short circuit fault on the loop. If a wire-to-wire short occurs, the isolator module shall automatically disconnect the loop. When the short circuit condition is corrected, the isolator module shall automatically reconnect the isolated section. The isolator module shall not require any address setting, and its operations shall be totally automatic. It shall not be necessary to replace or reset an isolator module after normal operation.
- C. Recording of Events: Record all alarm, supervisory, and trouble events. Records are by device, and function. When the FACP receives a signal, the alarm, supervisory, and trouble conditions are stored. The record shall include the type of signal (alarm, supervisory, or trouble) the device address, date, and the time of the occurrence. The record differentiates alarm signals from all other printed, indications. When the system is reset, this event is also recorded, including the same information concerning device, location, date, and time. A command

initiates the listing of existing alarm, supervisory, and trouble conditions in the system.

1. Permissible Signal Time Elapse: The maximum permissible elapsed time between the actuation of any fire alarm or fire-detection system alarm-initiating device and its indication at the FACP is ten seconds.
2. Independent System Monitoring: Supervise each independent smoke detection system and duct detector system for both normal operation and trouble.
3. Circuit Supervision: Indicate circuit faults by means of both a zone and a trouble signal at the FACP. Provide a distinctive indicating audible tone and (LED) indicating light. The maximum elapsed time between the occurrence of the trouble condition and its indication at the FACP is 200 seconds

## 1.07 SUBMITTALS

- A. General: Submit the following according to Conditions of Contract and Division 1 Specification Sections.
  1. Eight copies of all submittals shall be submitted to the Architect/Engineer for review. Shop drawings shall mirror design drawings for design and technical data, but not necessarily in appearance.
  2. All references to manufacturer's model numbers and other pertinent information herein is intended to establish minimum standards of performance, function and quality.
  3. Equivalent compatible UL-listed equipment from other manufacturers may be substituted for the specified equipment as long as the minimum standards are met.
  4. For equipment other than that specified, the contractor shall supply proof that such substitute equipment equals or exceeds the features, functions, performance, and quality of the specified equipment.
  5. Product data for system components. Include dimensioned plans and elevations showing minimum clearances and installed features and devices. Include list of materials and NRTL-listing data.
  6. Wiring diagrams from manufacturer differentiating between factory- and field-installed wiring. Include diagrams for equipment and for system with all terminals and interconnections identified. Indicate components for both field and factory wiring.



7. System operation description covering this specific Project including method of operation and supervision of each type of circuit and sequence of operations for all manually and automatically initiated system inputs and outputs. Manufacturer's standard descriptions for generic systems are not acceptable.
8. Operating instructions for mounting at the FACP.
9. Operation and maintenance data for inclusion in Operating and Maintenance Manual specified in Division 1. Include data for each type product, including all features and operating sequences, both automatic and manual. Include recommendations for spare parts to be stocked at the site. Provide the names, addresses, and telephone numbers of service organizations that carry stock of repair parts for the system to be furnished.
10. Product certification signed by the manufacturer of the fire alarm system components certifying that their products comply with indicated requirements.
11. Fire alarm shop drawings shall be approved by the AHJ prior to submittal for review and approval of the Engineer. Shop drawings shall include, but shall not be limited to, all of the following in compliance with the Florida Building Code:
  - (a) A floor plan that indicates the use of all rooms
  - (b) Locations of alarm-initiating devices
  - (c) Locations of alarm notification appliances, including candela ratings for visible alarm notification appliances.
  - (d) Location of fire alarm control unit, transponders and notification power supplies.
  - (e) Annunciators.
  - (f) Power connections.
  - (g) Battery calculations.
  - (h) Conductor types and sizes.
  - (i) Voltage drop calculations.
  - (j) Manufacturers' data sheets indicating model numbers and listing information for equipment, devices and materials.

- (k) Details of ceiling height and construction.
- (l) The interface of fire safety control functions.
- (m) Classification of the supervising station.

12. Record of field tests of system.

1.08 QUALITY ASSURANCE

- A. The fire alarm system shall comply with the applicable provisions of the NFPA Standard 72 "National Fire Alarm Code" and meet all the requirements of NEC 760. All equipment and devices shall be listed by the Underwriters' Laboratories or approved by the Factory Mutual Laboratories.
- B. Installation shall meet Class A requirements. Fire alarm system shall require supervision of installation by authorized factory representative or agency.
- C. After installation, the fire alarm system shall be balanced, checked, tested, operated and certified in writing as operational by factory representative or agency. Test each smoke and heat detector individually for operation.
- D. Testing shall be performed in the presence of the plant chief operator and Fire Marshall, or his designated assistant.
- E. Contractor shall obtain a written approval of the installed fire alarm system from the Fire Chief and send one (1) copy to the Owner and one (1) copy to the Engineer.
- F. Installer Qualifications: A certified or qualified Installer is to perform the Work of this Section.
- G. Compliance with Local Requirements: Comply with the applicable building code, local ordinances, and regulations, and the requirements of the authority having jurisdiction.
- H. Comply with NFPA 70, "National Electrical Code."
- I. NFPA Compliance: Provide fire alarm and detection systems conforming to the requirements of the following publications:
  - 1. NFPA 72, "Installation, Maintenance, and Use of Protective Signaling Systems."
  - 2. NFPA 72 Appendix B, "Automatic Fire Detectors."

- J. NRTL Listing: Provide systems and equipment that are listed and labeled.
  - 1. Terms "Listed" and "Labeled": As defined in the "National Electrical Code," Article 100.
  - 2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.
- K. UL Compliance: Provide fire alarm systems and components that are UL-listed.
- L. Single-Source Responsibility: Obtain fire alarm components from a single source that assumes responsibility for compatibility for system components.
- M. Certifications:
  - 1. Together with the shop drawing submittal, submit a certification from the major equipment manufacturer indicating that the proposed supervisor of the installation and the proposed performer of contract maintenance is an authorized representative of the major equipment manufacturer. Include names and addresses in the certification.

#### 1.09 EXTRA MATERIALS

- A. General: Furnish extra materials, matching products installed (as described below), and packaging with protective covering for storage, and identifying with labels clearly describing contents.
- B. Glass Rods for Manual Stations: Furnish quantity equal to 15 percent of the number of manual stations installed: minimum of 6 rods.
- C. Lamps for Strobe Units: Furnish quantity equal to 10 percent of the number of units installed, but not less than one.
- D. Smoke Detectors: Furnish quantity equal to 10 percent of the number of units of each type installed but not less than one of each type.
- E. Detector Bases: Furnish quantity equal to 2 percent of the number of units of each type installed but not less than one of each type.

#### 1.10 GUARANTY

- A. All work performed and all material and equipment furnished under this contract shall be free from defects and shall remain so for a period of one (1) year from the date of final completion. The full cost of maintenance, labor and materials required to correct any defect during this one year period shall be included in the submittal bid.

## PART 2 - PRODUCTS

### 2.01 MANUFACTURERS

- A. All equipment in the system shall be the product of a single manufacturer and shall be marketed as a complete and functioning system. The addition of any components, systems and/or panels required, but not a product of the manufacturer, shall require certification of compatibility by the manufacturer.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Siemens
  - 2. Equal approved prior to bid.

### 2.02 EQUIPMENT

#### A. GENERAL

- 1. All equipment and components shall be new, and the manufacturer's current model. The materials, appliances, equipment and devices shall be tested and listed by a nationally recognized approvals agency for use as part of a protective signaling system, meeting the National Fire Alarm Code.
- 2. All equipment and components shall be installed in strict compliance with manufacturers' recommendations. Consult the manufacturer's installation manuals for all wiring diagrams, schematics, physical equipment sizes, etc., before beginning system installation.
- 3. All equipment shall be attached to walls and ceiling/floor assemblies and shall be held firmly in place (e.g., detectors shall not be supported solely by suspended ceilings). Fasteners and supports shall be adequate to support the required load.
- 4. Addressable devices shall use simple to install and maintain decade, decimal address switches. Devices shall be capable of being set to an address in a range of 001 to 127.
- 5. Addressable devices, which use a binary-coded address setting method, such as a DIP-switch, are not an allowable substitute.
- 6. Detectors shall be intelligent (analog) and addressable, and shall connect with two wires to the fire alarm control panel Signaling Line Circuits. Detectors shall use Flash Scan technology.

7. Addressable devices shall store an internal identifying code that the control panel shall use to identify the type of device.

B. FIRE ALARM CONTROL PANEL (FACP)

1. FACP shall be an intelligent analog/addressable fire control panel and shall contain a microprocessor based Central Processing Unit (CPU) and power supply in an economical space saving single board design. The CPU shall communicate with and control the following types of equipment used to make up the system: intelligent addressable smoke and thermal (heat) detectors, addressable modules and other system controlled devices as shown on drawings.
2. Operator Control
  - a. Acknowledge Switch:
    1. Activation of the control panel acknowledge switch in response to new alarms and/or troubles shall silence the local panel piezo electric signal and change the alarm and trouble LEDs from flashing mode to steady-ON mode. If multiple alarm or trouble conditions exist, depression of this switch shall advance the LCD display to the next alarm or trouble condition.
    2. Depression of the Acknowledge switch shall also silence all remote annunciator piezo sounders.
  - b. Alarm Silence Switch:
    1. Activation of the alarm silence switch shall cause all programmed alarm notification appliances and relays to return to the normal condition after an alarm condition. The FACP software shall include silence inhibit and auto-silence timers.

- c. Alarm Activate (Drill) Switch:
    - 1. The Alarm Activate switch shall activate all notification appliance circuits. The drill function shall latch until the panel is silenced or reset.
  - d. System Reset Switch:
    - 1. Activation of the System Reset switch shall cause all electronically-latched initiating devices, appliances or software zones, as well as all associated output devices and circuits, to return to their normal condition.
  - e. Lamp Test:
    - 1. The Lamp Test switch shall activate all local system LEDs, light each segment of the liquid crystal display and display the panel software revision for service personal.
3. System Capacities and General Operation
- a. The control panel shall provide, or be capable of a minimum of 127 SLC intelligent/addressable devices.
  - b. The control panel shall include Form-C alarm, trouble, supervisory, and security relays rated at a minimum of 2.5 amps @ 24 VDC. It shall also include four Class B (NFPA Style Y) or two Class A (NFPA Style Z) programmable Notification Appliance Circuits.
  - c. The system shall include a full featured operator interface control and annunciation panel that shall include a backlit 80 character Liquid Crystal Display (LCD), individual color coded system status LEDs, and a keypad with easy touch rubber keys for the field programming and control of the fire alarm system.
  - d. The system shall be programmable, configurable, and expandable in the field without the need for special tools, PROM programmers or PC based programmers. It shall not require replacement of memory ICs to facilitate programming changes.
  - e. The system shall allow the programming of any input to activate any output or group of outputs. Systems that have limited programming (such as general alarm), have complicated programming (such as a diode matrix), or require a laptop personal computer are not considered suitable substitutes.

- f. The FACP shall provide the following features:
1. Drift compensation to extend detector accuracy over life. Drift compensation shall also include a smoothing feature, allowing transient noise signals to be filtered out.
  2. Detector sensitivity test, meeting requirements of NFPA 72, Chapter 7.
  3. Maintenance alert, with two levels (maintenance alert/maintenance urgent), to warn of excessive smoke detector dirt or dust accumulation.
  4. The ability to display or print system reports.
  5. Alarm verification, with counters and a trouble indication to alert maintenance personnel when a detector enters verification 20 times.
  6. PAS pre-signal, meeting NFPA 72 3-8.3 requirements.
  7. Rapid manual station reporting (under 3 seconds) and shall meet NFPA 72 Chapter 1 requirements for activation of notification circuits within 10 seconds of initiating device activation.
  8. Periodic detector test, conducted automatically by the software.
  9. Self-optimizing pre-alarm for advanced fire warning, which allows each detector to learn its particular environment and set its pre-alarm level to just above normal peaks.
  10. Walk test, with a check for two detectors set to same address.
- g. The FACP shall be capable of coding main panel node notification circuits in March Time (120 PPM), Temporal (NFPA 72 A-2-2.2.2), and California Code. Panel notification circuits (NAC 1, 2, 3 and 4) shall also support Two-Stage operation, Canadian Dual Stage (3 minutes) and Canadian Dual Stage (5 minutes). Two stage operation shall allow 20 Pulses Per Minute (PPM) on alarm and 120 PPM after 5 minutes or when a second device activates. Canadian Dual stage is the same as Two-Stage except will only switch to second stage by activation of Drill Switch 3 or 5 minute timer. The panel shall also provide a coding option that will synchronize specific strobe lights designed to accept a specific "sync pulse."

#### 4. Central Microprocessor

- a. The microprocessor shall be a state-of-the-art, high speed, 16-bit RISC device and it shall communicate with, monitor and control all external interfaces. It shall include an EPROM for system program storage, Flash memory for building-specific program storage, and a "watch dog" timer circuit to detect and report microprocessor failure.
- b. The microprocessor shall contain and execute all control-by-event programs for specific action to be taken if an alarm condition is detected by the system. Control-by-event equations shall be held in non-volatile programmable memory, and shall not be lost even if system primary and secondary power failure occurs.
- c. The microprocessor shall also provide a real-time clock for time annotation of system displays, printer, and history file. The time-of-day and date shall not be lost if system primary and secondary power supplies fail. The real time clock may also be used to control non-fire functions at programmed time-of-day, day-of-week, and day-of-year.
- d. A special program check function shall be provided to detect common operator errors.
- e. An auto-program (self-learn) function shall be provided to quickly install initial functions and make the system operational.
- f. For flexibility and to ensure program validity, an optional Windows(TM) based program utility shall be available. This program shall be used to off-line program the system with batch upload/download, and have the ability to upgrade the manufacturers (FLASH) system code changes. This program shall also have a verification utility, which scans the program files, identifying possible errors. It shall also have the ability to compare old program files to new ones, identifying differences in the two files to allow complete testing of any system operating changes. This shall be in compliance with the NFPA 72 requirements for testing after system modification.

#### 5. System Display

- a. The system shall support the following display mode options:
  1. 80 character display option. The display shall include an 80-character backlit alphanumeric Liquid Crystal Display (LCD).



- b. The display shall provide all the controls and indicators used by the system operator:
    - 1. The 80-character display shall include the following operator control switches: ACKNOWLEDGE, ALARM SILENCE, ALARM ACTIVATE (drill), SYSTEM RESET, and LAMP TEST.
  - c. The display shall annunciate status information and custom alphanumeric labels for all intelligent detectors, addressable modules, internal panel circuits, and software zones.
    - 1. The display shall also provide Light-Emitting Diodes.
  - d. The 80-character display shall provide 8 Light-Emitting-Diodes (LEDs) that indicate the status of the following system parameters: AC POWER, FIRE ALARM, PREALARM WARNING, SECURITY ALARM, SUPERVISORY SIGNAL, SYSTEM TROUBLE, DISABLED POINTS, and ALARM SILENCED.
  - e. The LCD-80 display:
    - 1. This shall be part of the standard system and have the capability to command all system functions, entry of any alphabetic or numeric information, and field programming. Two different password levels shall be provided to prevent unauthorized system control or programming.
  - f. The system shall support the display of battery charging current and voltage on the 80-character LCD display.
6. Signaling Line Circuits (SLC)
- a. Each FACP shall support one SLC interface and shall provide power to and communicate with intelligent detectors (ionization, photoelectric or thermal), intelligent modules (monitor or control) for a loop capacity of 127 devices. Each SLC shall be capable of NFPA 72 Style 4, Style 6, or Style 7 (Class A or B) wiring.
  - b. CPU shall receive analog information from all intelligent detectors to be processed to determine whether normal, alarm, pre-alarm, or trouble conditions exist for each detector. The software shall automatically maintain the detector's desired sensitivity level by adjusting for the effects of environmental factors, including the accumulation of dust in each detector. The analog information shall

also be used for automatic detector testing and for the automatic determination of detector maintenance requirements.

7. Notification Appliance Circuit (NAC) Module

- a. The Notification Appliance Circuit module shall provide four fully supervised Class A or B (NFPA Style Z or Y) notification circuits.
- b. The notification circuit capacity shall be 3.0 amperes maximum per circuit.
- c. The module shall not affect other module circuits in any way during a short circuit condition.
- d. The module shall provide four green ON/OFF LEDs and four yellow trouble LEDs.
- e. The module shall also provide a momentary switch per circuit that may be used to manually turn the particular circuit on or off or to disable the circuit.
- f. Each notification circuit shall have a custom label to identify each circuit's location.
- g. The notification circuit module shall have terminal strips UL listed for use with up to 12 AWG wire.
- h. Each circuit shall be capable of, through system programming, deactivating upon depression of the signal silence switch.

8. Control Relay Module

- a. The control relay module assembly shall provide two Form-C auxiliary relay circuits rated at 2.5 amperes, 24 VDC.
- b. Each relay circuit shall be capable of being activated (change in state) by any initiating device or from any combination of initiating devices.
- c. The module shall provide a momentary switch per relay circuit that may be used to manually turn the relay ON/OFF or to disable the relay.
- d. Each relay circuit shall include a custom label to identify its location.
- e. The control relay module shall have terminal blocks UL listed for use with up to 12 AWG wire.

9. Enclosures:

- a. The control panel shall be housed in a UL-listed cabinet suitable for surface or semi-flush mounting. The cabinet and front shall be corrosion protected, given a rust-resistant prime coat, and manufacturer's standard finish.
- b. The back box and door shall be constructed of 0.060 steel with provisions for electrical conduit connections into the sides and top.
- c. The door shall provide a key lock and shall include a glass or other transparent opening, as applicable, for viewing of all indicators. For convenience, the door may be site configured for either right or left hand hinging.

10. Power Supply:

- a. A high tech off-line switching power supply shall be available for the fire alarm control panel or network node and provide 6.0 amps of available power for the control panel and peripheral devices.
- b. Provisions will be made to allow the audio-visual power to be increased as required by adding modular expansion audio-visual power supplies.
- c. Positive-Temperature-Coefficient (PTC) thermistors, circuit breakers, or other over-current protection shall be provided on all power outputs. The power supply shall provide an integral battery charger for use with batteries up to 33 AH or may be used with an external battery and charger system. Battery arrangement may be configured in the field.
- d. The power supply shall continuously monitor all field wires for earth ground conditions, and shall have the following LED indicators:
  - 1) Ground Fault LED
  - 2) AC Power Fail LED
  - 3) NAC on indication
- e. The main power supply shall operate on 120 VAC, 60 Hz, and shall provide all necessary power for the FACP.
- f. The main power supply shall provide a battery charger using dual-rate charging techniques for fast battery recharge and be capable of charging batteries up to 33 AH.

- g. All circuits shall be power-limited, per UL864 requirements.

## 11. Specific System Operations

- a. **Smoke Detector Sensitivity Adjust:** A means shall be provided for adjusting the sensitivity of any, or all, addressable intelligent detectors in the system from the system keypad. Sensitivity range shall be within the allowed UL window.
- b. **Alarm Verification:** Each of the intelligent addressable smoke detectors in the system may be independently selected and enabled to be an alarm verified detector. The alarm verification delay shall be programmable from 5 to 30 seconds and each detector shall be able to be selected for verification.
- c. **The FACP shall keep a count of the number of times that each detector has entered the verification cycle. These counters may be displayed and reset by the proper operator commands.**
- d. **Point Disable:** Any addressable device or conventional circuit in the system may be enabled or disabled through the system keypad.
- e. **Point Read:** The system shall be able to display or print the following point status diagnostic functions:
  - 1. Device status
  - 2. Device type
  - 3. Custom device label
  - 4. View analog detector values
  - 5. Device zone assignments
  - 6. All program parameters
- f. **System Status Reports:** Upon command from an operator of the system, a status report will be generated and printed, listing all system status.
- g. **System History Recording and Reporting:** The fire alarm control panel shall contain a history buffer that will be capable of storing up to 200 events minimum. Up to 50 events shall be dedicated to alarm and the remaining events are general purpose. Systems that do not have dedicated alarm storage, where events are overridden by non-alarm type events, are not suitable substitutes. Each of these activations will be stored and time and date stamped with the actual time of the activation. The contents of the history buffer may be manually reviewed, one event at a time, or printed in its entirety. The

history buffer shall use non-volatile memory. Systems that use volatile memory for history storage are not acceptable substitutes.

- h. Automatic Detector Maintenance Alert: The fire alarm control panel shall automatically interrogate each intelligent detector and shall analyze the detector responses over a period of time. If any intelligent detector in the system responds with a reading that is above or below normal limits, then the system will enter the trouble mode, and the particular detector will be annunciated on the system display, and printed on the optional printer. This feature shall in no way inhibit the receipt of alarm conditions in the system, nor shall it require any special hardware, special tools or computer expertise to perform.
  - i. Pre-Alarm Function: The system shall provide two levels of pre-alarm warning to give advance notice of a possible fire situation. Both pre-alarm levels shall be fully field adjustable. The first level shall give an audible indication at the panel. The second level shall give an audible indication and may also activate control relays. The system shall also have the ability to activate local detector sounder bases at the pre-alarm level, to assist in avoiding nuisance alarms.
  - j. Software Zones: The FACP shall provide 100 software zones, 10 additional special function zones, 10 releasing zones, and 20 logic zones.
  - k. The fire alarm control panel shall include a walk test feature. It shall include the ability to test initiating device circuits and notification appliance circuits from the field without returning to the panel to reset the system. Operation shall be as follows:
    - 1. Alarming an initiating device shall activate programmed outputs, which are selected to participate in walk test, for 3 seconds.
    - 2. Introducing a trouble into the initiating device shall activate the programmed outputs for 8 seconds.
    - 3. All devices tested in walk test shall be recorded in the history buffer.
12. Supervisory Operation
- a. An alarm from a supervisory device shall cause the appropriate indication on the system display, light a common supervisory LED, but will not cause the system to enter the trouble mode.

13. Signal Silence Operation

- a. The FACP shall have the ability to program each output circuit (notification, relay, speaker etc) to deactivate upon depression of the signal silence switch.

C. INITIATING DEVICES

1. General: Comply with UL 268. Include the following features:

- a. Factory Nameplate: Serial number and type identification.
- b. Operating Voltage: 24-V DC, nominal.
- c. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
- d. Plug-In Arrangement: Detector and associated encapsulated electronic components are mounted in a module that connects to a fixed base with a twist-locking plug connection. The plug connection requires no springs for secure mounting and contact maintenance. Terminals in the fixed base accept building wiring. Design detector for mounting on interchangeable type base, capable of operating on either 2-wire or 4-wire loop. For Class A Style 7 systems, base shall contain internal isolation so that no external isolation device is necessary.
- e. Visual Indicator: Connected to indicate detector has operated. Provide flashing LED indicator for normal operation, which changes to steady on alarm condition.
- f. Addressability: Detectors include a communication transmitter and receiver having a unique identification and capability for status reporting to the FACP.
- g. Remote Controllability: Individually monitor detectors at the FACP for calibration, sensitivity, and alarm condition, and individually adjust for sensitivity from the FACP.
- h. Each of the intelligent addressable detector in the system may be independently selected and enabled to be an alarm verified detector. The FACP shall keep count of the number of times each detector has entered the verification cycle. These counters may be displayed and reset by the proper operator commands.

- i. Detectors shall automatically compensate for dust accumulation and other slow environmental changes that may affect their performance. The detectors shall be listed by UL as meeting the calibrated sensitivity test requirements of NFPA Standard 72, Chapter 7.
  - j. The detectors shall provide a test means whereby they will simulate an alarm condition and report that condition to the control panel. Such a test may be initiated at the detector itself (by activating a magnetic switch) or initiated remotely on command from the control panel.
  - k. Detectors will operate in an analog fashion, where the detector simply measures its designed environment variable and transmits an analog value to the FACP based on real-time measured values.
2. Addressable Photoelectric Smoke Detectors:
- a. Detector Sensitivity: Between 2.5- and 3.5-percent-per-foot smoke obscuration when tested according to UL 268.
  - b. Sensor: An infrared or LED light source with matching photo diode receiver.
  - c. Furnish with isolator integral to base for Class A Style 7.
3. Addressable Photoelectric Duct Smoke Detector:
- a. Photoelectric-type, with sampling tube of design and dimensions as recommended by the manufacturer for the specific duct size and installation conditions where applied shall be used within the duct housing mounted in the proper location as per NFPA 72 and 90A. When sufficient smoke is sensed, an alarm signal is initiated at the FACP, and appropriate action taken to take over air handling systems to help prevent the rapid distribution of toxic smoke and fire gases throughout the areas served by the duct system. Fan shutdown shall occur throughout the entire building on a general basis. Duct sampling tubes shall extend the entire width of the A/C ductwork. Remote test stations shall be provided for each duct mounted smoke detector.
  - b. Furnish housing with detector, sampling tube and remote test switch. Coordinate exact sampling tube size with HVAC.
4. Addressable Manual Pull Stations
- a. Description: U.L. Listed, double-action or single action type, fabricated of metal or plastic, and finished in red with molded,

raised-letter operating instructions of contrasting color. Stations requiring the breaking of a glass panel are not acceptable. Stations requiring the breaking of a concealed glass rod may be provided.

- b. Station Reset: Key-operated, double-pole, double-throw, switch-rated for the voltage and current at which it operates. The key shall operate a test-reset lock, and shall be designed so after actual emergency operation, they cannot be restored to normal use except by the use of a key.
- c. Addressable pull stations shall on command from the control panel, send data to the panel representing the state of the manual switch and the addressable communication module status.
- d. Indoor general use: provide manufacturer's standard unit. Outdoor, weather resistant and corrosion resistant use: furnish a die cast metal manual pull station with addressable monitor module.

#### D. NOTIFICATION APPLIANCES

##### 1. Horn/Strobe

- a. Horn/strobe shall be UL 1971 and UL 464 listed, operates on 24VDC, and shall be approved for fire protective service. Unit shall be wired as a primary signaling notification appliance and shall comply with ADA requirements for visible signaling appliances, flashing at 1 Hz over the strobes entire operating voltage range. Operating voltage range shall be 17-33VDC.
- b. The strobe light shall consist of a xenon flash tube and associated lens/reflector system. The horn shall be temporal 3 pattern at 24 VDC. Strobes shall be powered independently of the sounder with the removal of factory installed jumper wires. The horn shall operate on a coded or non-coded power supply.
- c. Supply appliances rated for the conditions in which installation will take place. Appliances to be used in outdoor, wet or corrosive locations shall have appropriate materials of construction and degradation resistance.

##### 2. Synchronization Module

- a. Synchronization Module shall be UL 464 listed and shall be approved for fire protective service. The unit shall synchronize strobes at 1 Hz and horns at temporal 3. Also, the module shall silence the horns on horn/strobe units, while operating the strobes, over a single pair of



wires. The module shall control two Class B (Style Y) or one Class A (Style Z) circuit. Module shall be capable of multiple-zone synchronizing by daisy chaining multiple modules together and re-synchronizing each other along the chain.

## E. ACCESSORIES

### 1. Addressable Input Module

- a. Addressable input modules shall be provided to connect one supervised alarm initiating device circuit zone of conventional, dry contact, alarm initiating devices (or single non-addressable conventional alarm initiating device) to one of the fire alarm control panel SLC'S. Unit shall operate on Class A, Style 7. Unit shall fit in a standard 4" square box.
- b. The alarm-initiating device shall be suitable for Style D or Style B operation. An LED shall be provided that shall flash under normal conditions, indicating that the monitor module is operational and in regular communication with the control panel.
- c. For difficult to reach areas, the input module shall be available in a miniature package that shall fit in a single gang box.

### 2. Addressable Relay Module

- a. Addressable Relay Module assemblies shall be used for HVAC control, elevator recall, exhaust fan operation and other building functions. The relay shall be form C and rated for a minimum of 2.0 Amps @ 30V DC or 0.6A @120VAC. The relay coil shall be magnetically latched to reduce wiring connection requirements, and to insure that 100% of all auxiliary relay or NAC'S may be energized at the same time on the same pair of wires. Unit shall mount in a 4" square box.

### 3. Line Isolator Module

- a. Line isolator modules shall isolate a short circuit fault on a Class A Style 7 SLC without disrupting the communication on the remainder of the circuit. Unit shall operate on mount in a standard 4" box.

### 4. Batteries

- a. The battery shall be rechargeable sealed lead-acid type with sufficient capacity to power the fire alarm system for not less than twenty-four hours plus five minutes of alarm upon a normal AC power failure.

- b. The batteries are to be completely maintenance free. No liquids are required. Fluid level checks for refilling, spills, and leakage shall not be required.
- c. If necessary to meet standby requirements, external battery and charger systems may be used.
- d. Battery enclosures shall be ventilated if necessary to meet standby requirements.
- e. Provide material safety data sheets for all batteries supplied.

5. Surge Suppression Device (SPD)

- a. SPD protection shall be provided to protect the electronic components from induced surges propagating along the signal and power supply lines. The protection systems shall be such that the protective level shall not interfere with normal operation, but shall be lower than the device surge withstand level, and be maintenance free and self-restoring.
- b. Devices shall be housed in a suitable case, properly grounded. Ground wires for all SPD's shall be connected to the building grounding counterpoise and where practical, each ground wire run individually and insulated from each other. These protectors shall be mounted within the device enclosure or a separate junction box next to the enclosure.
- c. Power Supply:
  - 1. Protection of all 120 VAC FACP power supply lines shall be provided.
- d. Signal Line and Notification Appliance Circuits
  - 1. Protection of SLCs and NACs originating and terminating not in the same building shall be provided by TVSS.

2.03 CONDUIT AND WIRE:

A. Conduit:

- 1. Conduit shall be in accordance with The National Electrical Code (NEC), local and state requirements.

2. All conductors shall be installed in conduit or raceway. Conduit fill shall not exceed 40 percent of interior cross sectional area where three or more cables are contained within a single conduit.
3. Fire alarm conductors shall be separate from any open conductors of power, or Class 1 circuits, and shall not be placed in any conduit, junction box or raceway containing these types of conductors, per NEC Article 760-29.
4. Wiring for 24 volt DC control, alarm notification, emergency communication and similar power-limited auxiliary functions may be run in the same conduit as initiating and signaling line circuits. All circuits shall be provided with transient suppression devices and the system shall be designed to permit simultaneous operation of all circuits without interference or loss of signals.
5. Conduit shall not enter the fire alarm control panel, or any other remotely mounted control panel equipment or backboxes, except where conduit entry is specified by the FACP manufacturer.
6. Conduit shall be 3/4-inch (19.1 mm) minimum painted red.
7. Exposed conduits installed indoors shall be as per specification 16110.

B. Wire:

1. All fire alarm system wiring shall be new.
2. Wiring shall be in accordance with state and national codes (e.g., NEC Article 760) and as recommended by the manufacturer of the fire alarm system. Number and size of conductors shall be as recommended by the fire alarm system manufacturer, but not less than 16 AWG (1.29 mm) for Initiating Device Circuits and Signaling Line Circuits, and 14 AWG (1.63 mm) for Notification Appliance Circuits.
3. All wire and cable shall be listed and/or approved by a recognized testing agency for use with a protective signaling system.
4. Wiring used for the multiplex communication circuit (SLC) shall be twisted and unshielded and support a minimum wiring distance of 6,000 feet. The design of the system shall permit use of NAC wiring in the same conduit with the SLC communication circuit.
5. All field wiring shall be electrically supervised for open circuit and ground fault.
6. Class A: 4-wire initiating and 2-wire alarm indicating circuits with electrical supervision for shorts and open conditions.

C. Terminal Boxes, Junction Boxes and Cabinets:

1. All boxes and cabinets shall be UL listed for their use and purpose. All junction boxes must be painted red and identified as fire alarm.
2. Initiating circuits shall be arranged to serve like categories (manual, smoke, waterflow). Mixed category circuitry shall not be permitted except on signaling line circuits connected to intelligent reporting devices.
3. The fire alarm control panel shall be connected to a separate dedicated branch circuit, minimum 20 amperes. This circuit shall be labeled at the main power distribution panel as FIRE ALARM. Fire alarm control panel primary power wiring shall be 12 AWG. The control panel cabinet shall be grounded securely to either a cold water pipe or grounding rod.
4. Provide basic wiring materials that comply with Division 16.

2.04. TAGS

- A. Tags For Identifying Tested Components: Comply with NFPA 72.
- B. Test Chart Instructions: Provide fire alarm system test instructions chart mounted in lexan enclosed frame assembly on control cabinet hinged door or adjacent to control panel.

PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL

- A. Installation shall be in accordance with the NEC, NFPA 72, Local County and state codes, as shown on the drawings, and per the major equipment manufacturer specifications.
- B. All conduit, junction boxes, conduit supports and hangers shall be concealed in finished areas and may be exposed in unfinished areas. Smoke detectors shall not be installed prior to the system programming and test period. If construction is ongoing during this period, measures shall be taken to protect smoke detectors from contamination and physical damage.
- C. All fire detection and alarm system devices, control panels and remote annunciators shall be flush mounted when located in finished areas and may be surface mounted when located in unfinished areas.
- D. Manual pull stations shall be suitable for surface mounting or semi-flush mounting as shown on the plans, and shall be installed not less than 42 inches (1067 mm), nor more than 48 inches (122 mm) above the finished floor.

- E. Install in accordance with plans and supplier's data sheets. Provide "as-built" data to Engineer upon completion.
- F. After installation, the fire alarm system shall be balanced, checked, operated and certified in writing as operational by factory representative or agency. Certify by letter that system is installed in accordance with data sheets and conforms to plans and specifications. CONTRACTOR shall obtain a written approval of the installed fire alarm system from the Fire Chief and send one (1) copy to the Owner and one (1) copy to the Engineer.
- G. Installation and maintenance manuals shall be provided on all components and the system.
- H. Number, size and type of wires shall be as specified by Equipment Manufacturer. Conduit type and size shall be as per NEC.
- I. Submit as-built drawings including, but not limited to, dimensional drawings, installation instructions, operation instructions, and wiring diagram for all fire alarm equipment and wiring diagrams for all fire alarm equipment and wiring.
- J. Fire Alarm Power Supply Disconnect: Paint red and label "FIRE ALARM." Provide with lockable handle or cover.

### 3.02 EQUIPMENT INSTALLATION

- A. Manual Pull Stations: Surface mount with operating handles in accordance with ADA requirements.
- B. Smoke Detectors: Install ceiling-mounted detectors not less than 4 inches from a sidewall to the near edge. Install detectors located on the wall at least 4 inches but not more than 12 inches below the ceiling. For exposed solid joist construction, mount detectors on the bottoms of the joists. On smooth ceilings, install detectors not over 30 feet apart in any direction. Install detectors no closer than 5 feet from air registers. Detectors installed in suspended ceiling tiles shall be supported from structure above using T-bar hangers per NEC article 300.
- C. Audible Alarm-Indicating Devices: Install not less than 80 inches above the finished floor nor less than 6 inches below the ceiling. Install bells and horns on surface mounted boxes with the device-operating mechanism concealed behind a grille or as indicated. Combine audible and visual alarms at the same location into a single unit. In process areas, mounting height shall be between 80 inches and 96 inches as necessary depending upon process equipment layout.
- D. Visual Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and not less than 80 inches above the finished floor and at least 6 inches below the

ceiling. In process areas, mounting height shall be between 80 inches and 96 inches as necessary depending upon process equipment layout.

- E. Device Location-Indicating Lights: Locate in the public space immediately adjacent to the device they monitor.
- F. Fire Alarm Control Panel (FACP) and/or Remote Annunciator Panel: Surface mount with tops of cabinets not more than 6 feet above the finished floor.

### 3.03 WIRING INSTALLATION

- A. Wiring Method: Install wiring in metal raceway according to Division 16 Section "Raceways." Conceal raceway except in unfinished spaces and as indicated.
- B. Wiring Within Enclosures: Install conductors parallel with or at right angles to the sides and back of the enclosure. Bundle, lace, and train the conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with the fire alarm system to terminal blocks. Mark each terminal according to the wiring diagrams of the system. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.
- C. Cable Taps: Use numbered terminal strips in junction, pull or outlet boxes, cabinets, or equipment enclosures where any circuit tap is made.
- D. System Wiring: For the low-voltage portion of the fire alarm system, install No. 18 VNTC conductors for SLC and 75-deg C THWN insulation in wet or damp locations. For NAC wiring, install No. 12 AWG THWN with insulation rated 75 deg C minimum in wet or damp locations.
- E. Risers: Install at least 2 vertical cable risers to serve the fire alarm system. Separate risers in close proximity to each other with a minimum two-hour-rated wall or a minimum of 10 feet of separation, so the loss of one riser does not prevent the receipt or transmission of signal from other floors or zones.

### 3.04 GROUNDING

- A. Ground equipment and conductor and cable shields. Provide 5-ohm ground at main equipment location. Measure, record, and report ground resistance.

### 3.05 FIELD QUALITY CONTROL

- A. Manufacturer's Field Services: Provide services of a factory-authorized service representative to supervise the field assembly and connection of components and the pre-testing, testing, and adjustment of the system.

- B. Pre-testing: Upon completing installation of the system, align, adjust, and balance the system and perform complete pre-testing. Determine, through pre-testing, the conformance of the system to the requirements of the Drawings and Specifications. Correct deficiencies observed in pre-testing. Replace malfunctioning or damaged items with new and retest until satisfactory performance and conditions are achieved. Prepare forms for systematic recording of acceptance test results.
- C. Report of Pre-testing: After pre-testing is complete, provide a letter certifying the installation is complete and fully operable, including the names and titles of the witnesses to the preliminary tests.
- D. Final Test Notice: Provide a 10-day minimum notice in writing when the system is ready for final acceptance testing.
- E. Minimum System Tests: Test the system according to the procedures outlined in NFPA 72 Chapter 7. All testing shall be completed by a factory-trained/certified technician authorized by the manufacturer of the fire alarm equipment. The CONTRACTOR shall technically supervise and participate during all of the adjustments and tests for the system. All testing shall be in accordance with NFPA 72, Chapter 7 and shall meet all city requirements to the satisfaction of the Fire Marshall. Minimum required tests are as follows:
  - 1. Verify the absence of unwanted voltages between circuit conductors and ground.
  - 2. Megger test all conductors other than those intentionally and permanently grounded with electronic components disconnected. Test for resistance to ground and conductor to conductor. Report readings less than 100-megohm for evaluation.
  - 3. Test all conductors for short circuits utilizing an insulation-testing device.
  - 4. With each circuit pair, short circuit at the far end of the circuit and measure the circuit resistance with an ohmmeter. Record the circuit resistance of each circuit on the record drawings.
  - 5. Verify the control unit is in the normal condition as detailed in the manufacturer's operating and maintenance manual.
  - 6. Test initiating and indicating circuits for proper signal transmission under open circuit conditions. One connection each should be opened at not less than 10 percent of the initiating and indicating devices. Observe proper signal transmission according to class of wiring used.

7. Test each initiating and indicating device for alarm operation and proper response at the control unit. Test smoke detectors with actual products of combustion.
  8. Test the system for all specified functions according to the manufacturer's operating and maintenance manual. Systematically initiate specified functional performance items at each station including making all possible alarm and monitoring initiations and using all communications options. For each item, observe related performance at all system devices, affected by the item, under all system sequences. Observe indicating lights, displays, signal tones, and annunciator indications. Observe all voice audio for routing, clarity, and quality, freedom from noise and distortion, and proper volume level.
  9. Test both primary power and secondary power. Verify, by test, the secondary power system is capable of operating the system for the period and in the manner specified.
  10. Open initiating device circuits and verify that the trouble signal actuates.
  11. Open and short signaling line circuits and verify that the trouble signal actuates.
  12. Open and short notification appliance circuits and verify that trouble signal actuates.
  13. Ground all circuits and verify response of trouble signals.
  14. Check presence and audibility of tone at all alarm notification devices.
  15. Check installation, supervision, and operation of all intelligent smoke detectors using the walk test.
- F. Retesting: Correct deficiencies indicated by tests and completely retest work affected by such deficiencies. Verify by the system test that the total system meets the Specifications and complies with applicable standards.
- G. Report of Tests and Inspections: Provide a written record of inspections, tests, and detailed test results in the form of a test log. Submit log upon the satisfactory completion of tests.
- H. Tag all equipment, stations, and other components at which tests have been satisfactorily completed.



### 3.06 CLEANING AND ADJUSTING

- A. Cleaning: Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish. Clean unit internally using methods and materials recommended by the manufacturer.
- B. Occupancy Adjustments: When requested within one year of date of Substantial Completion, provide on-site assistance in adjusting sound levels and adjusting controls and sensitivities to suit actual occupied conditions. Provide up to three visits to the site for this purpose.

### 3.07 DEMONSTRATION

- A. Provide the services of a factory-authorized service representative to demonstrate the system and train Owner's maintenance personnel as specified below.
  - 1. Train Owner's maintenance personnel in the procedures and schedules involved in operating, troubleshooting, servicing, and preventive maintaining of the system. Provide a minimum 24-hour training sessions.
  - 2. Schedule training with the Owner at least seven days in advance

### 3.08 WARRANTY

- A. Provide (3) Three years on all related components.

### 3.09 MAINTENANCE & TESTING CERTIFICATION AGREEMENT

- A. Provide in bid a (5) Five year Maintenance and Testing Certification Agreement covering full maintenance and recommended system testing on an annual basis for the period of the agreement.
- B. Maintenance Agreement shall provide 24 Hour on call maintenance for the period of the agreement.

END OF SECTION

## **APPENDIX A**

# **APPENDIX A**

## **LIST OF APPROVED** **PRODUCTS**



**ORANGE COUNTY UTILITIES  
LIST OF APPROVED PRODUCTS  
(February 11, 2011)**



APPENDIX D LIST OF APPROVED PRODUCTS - TRANSMISSION SYSTEMS

FEBRUARY 11, 2011

Cat.	Desc	Manufacturer	Water Model #	Water Comments	Reclaimed Water Model #	Reclaimed Water Comments	Wastewater Model #	Wastewater Comments
Air Release	ARV Enclosure	Water Plus Polyethylene Enclosure	131632 H30-B	Blue 44" Tall	131632 H30-P	Pantone 44"	131632 H30-G	Green 44" Tall
			171730 H40-B	Blue 30" Tall	171730 H40-P	Pantone 30"	171730 H40-G	Green 30" Tall
			AVG2036 Encl	Blue 36" Tall	AVG2036 Encl	Pantone 36" Tall	AVG2036 Encl	Green 36" Tall
			GP3232 Base		GP3232 Base		GP3232 Base	
			AVG2041 Encl	Blue 41" Tall	AVG2041 Encl	Pantone 41" Tall	AVG2041 Encl	Green 41" Tall
			GP3232 Base		GP3232 Base		GP3232 Base	
	Safety-Guard/Hydro Guard		Blue 34" Tall	15100 Encl	Pantone 34" Tall	15100 Encl	Green 34" Tall	
Air Release	Air Release Valves	ARI	<b>Air Release Valves shall be Combination Type, 316 SS</b>					
			D-040SS	Combination	D-040SS	Combination	D-020 (SS)	Combination
			NA	NA	NA	NA	986 (316SS)	Combination
			Series RBX DN50	2"	Series RBX DN50	2"	RGX series	
ARV Valve	Air Release Valve Frame and Cover	US Foundry	NA	NA	NA	NA	USF 7665-HH-HJ	
			<b>Automatic Blow Off Valve</b>					
Blow Off	Auto Blow Off Valve	Hydro Guard	HG-1 Standard Unit	Automatic	NA	NA	NA	NA
			<b>Blow Off Valve - Fits standard 5-1/4 inch Valve Box</b>					
			Truflo Series TF #550		Truflo Series TF #550		NA	NA
Blow Off	Water Plus Corp	Kupferle Foundry Co	The Hydrant Plus Series		The Hydrant Plus Series		NA	NA
			VB 2000B		VB 2000B		NA	NA
			<b>Casing End Seals. Annular space between pipe and steel casing shall be brick and mortar with end seals to secure ends.</b>					
Casing Seals / Spacers	Casing End Seals	Advance Products	Model AC and AW		Model AC and AW		Model AC and AW	
			Model WR and PO		Model WR and PO		Model WR and PO	
			Model CCES		Model CCES		Model CCES	
			Model ESW and ESC		Model ESW and ESC		Model ESW and ESC	
			Model C and W		Model C and W		Model C and W	
			Model 4810ES		Model 4810ES		Model 4810ES	

APPENDIX D LIST OF APPROVED PRODUCTS - TRANSMISSION SYSTEMS

FEBRUARY 11, 2011

Cat.	Desc	Manufacturer	Water Model #	Water Comments	Reclaimed Water Model #	Reclaimed Water Comments	Wastewater Model #	Wastewater Comments	
Casing Seals / Spacers	Casing spacer	Advance Products	SSI8 / SSI12		SSI8 / SSI12		SSI8 / SSI12		
		BWM Company	BWM-SS-8 / SS-12		BWM-SS-8 / SS-12		BWM-SS-8 / SS-12		
		Cascade Water Works	Series CCS 8" / 12"		Series CCS 8" / 12"		Series CCS 8" / 12"		
		CCI Pipeline	Model CCS8 / CSS12		Model CCS8 / CSS12		Model CCS8 / CSS12		
		Pipeline Seal & Insulator, Inc. (PSI)	Series S8G-2 / S12G-2		Series S8G-2 / S12G-2		Series S8G-2 / S12G-2		
		<b>Casing spacers shall be a min. 8-inches wide for pipe 12" Dia or less or min. 12-inches wide for pipe 16 or greater, shall have a minimum 14 gauge 304 stainless steel shell/band, minimum 10 gauge 304 reinforced risers; minimum thickness of 0.090 EPDM or PVC interior liners, glass reinforces polymer or ultra high molecular weight polyethylene and 304 stainless bolts, nuts and washers.</b>							
Coatings	Exterior Coatings for Exposed Metal Assets	Carboline	Carbozinc 621	3.0 - 8.0 mils	Carbozinc 621	3.0 - 8.0 mils	Carbozinc 621	3.0 - 8.0 mils	
			Carbothane 133 HB	3.0 -5.0 mils	Carbothane 133 HB	3.0 -5.0 mils	Carbothane 133 HB	3.0 -5.0 mils	
			Carboxane 950	2.0 - 3.0 mils	Carboxane 950	2.0 - 3.0 mils	Carboxane 950	2.0 - 3.0 mils	
			Zinc Series 90-97	2.5 - 3.5 mils	Zinc Series 90-97	2.5 - 3.5 mils	Zinc Series 90-97	2.5 - 3.5 mils	
		Tnemec	Typoxy Series 27WB	4.0 -14.0 mils	Typoxy Series 27WB	4.0 -14.0 mils	Typoxy Series 27WB	4.0 -14.0 mils	
		EnduraShield Series73	2.0 - 3.0 mils	EnduraShield Series73	2.0 - 3.0 mils	EnduraShield Series73	2.0 - 3.0 mils		
		Hydroflon Series 700	2.0 - 3.0 mils	Hydroflon Series 700	2.0 - 3.0 mils	Hydroflon Series 700	2.0 - 3.0 mils		
	<b>Coatings: Aerial pipe, hydrants, above ground piping, fittings, valves and Appurtenances - System 1 Zinc / Urethane / Fluoropolymer application and color code per Section 3119 Coatings &amp; Linings. Coating shall not be in contact with Potable water unless NSF 61 approved.</b>								
	Exterior Coatings for Exposed Metal Assets	Carboline	Carbozinc 621	3.0 - 8.0 mils	Carbozinc 621	3.0 - 8.0 mils	Carbozinc 621	3.0 - 8.0 mils	
			Carboguard 60	4.0 -6.0 mils	Carboguard 60	4.0 -6.0 mils	Carboguard 60	4.0 -6.0 mils	
		Carboxane 950	2.0 - 3.0 mils	Carboxane 950	2.0 - 3.0 mils	Carboxane 950	2.0 - 3.0 mils		
		Zinc Series 90-97	2.5 - 3.5 mils	Zinc Series 90-97	2.5 - 3.5 mils	Zinc Series 90-97	2.5 - 3.5 mils		
Tnemec		Typoxy Series 27WB	4.0 -14.0 mils	Typoxy Series 27WB	4.0 -14.0 mils	Typoxy Series 27WB	4.0 -14.0 mils		
	Hi-Build Epoxoline II Series N69	4.0 - 10.0 mils	Hi-Build Epoxoline II Series N69	4.0 - 10.0 mils	Hi-Build Epoxoline II Series N69	4.0 - 10.0 mils			
	EnduraShield Series73	2.0 - 3.0 mils	EnduraShield Series73	2.0 - 3.0 mils	EnduraShield Series73	2.0 - 3.0 mils			
	Amercoat 68HS	Min 3.0 mils	Amercoat 68HS	Min 3.0 mils	Amercoat 68HS	Min 3.0 mils			
	Amercoat 385	4.0 - 6.0 mils	Amercoat 385	4.0 - 6.0 mils	Amercoat 385	4.0 - 6.0 mils			
	Amercoat 450H	2.0 - 3.0 mils	Amercoat 450H	2.0 - 3.0 mils	Amercoat 450H	2.0 - 3.0 mils			
<b>Coatings: Aerial pipe, hydrants, above ground piping, fittings, valves and Appurtenances - System 2 Zinc / Epoxy / Urethane application and color code per Section 3119 Coatings &amp; Linings. Coating shall not be in contact with Potable water unless NSF 61 approved.</b>									



APPENDIX D LIST OF APPROVED PRODUCTS - TRANSMISSION SYSTEMS

FEBRUARY 11, 2011

Cat.	Desc	Manufacturer	Water Model #	Water Comments	Reclaimed Water Model #	Reclaimed Water Comments	Wastewater Model #	Wastewater Comments
Fittings	Ductile Iron Fittings C153 SSB / C110 FLG: (Water & Reclaimed Water fittings shall cement lined or holiday free fusion bonded epoxy lined) (Wastewater fittings interior shall be Protecto 401 and holiday free)	American	30" & up	FBE / Cement	30" & up	FBE / Cement	30" & up	Protecto 401
		Sigma		FBE / Cement		FBE / Cement		Protecto 401
		Star		FBE / Cement		FBE / Cement		Protecto 401
		Tyler Union & Clow		FBE / Cement		FBE / Cement		Protecto 401
		Flow Meters With Replaceable Sensors						
Flow	Flow Meters	EMCO	NA	NA	NA	NA	Unimag 4411E	
Hydrants	Hydrants Shall open left, 1-1/2 Pentagon operating nut, NST hose & pumper thread, rotate 360 degrees, closed drains, epoxy on shoe in & out and 304 SS nuts & bolts below ground.	American Flow Control	B-84-B (6 inch)		NA	NA	NA	NA
		Clow	Medallion 2545		NA	NA	NA	NA
		Mueller	Super Centurion 250		NA	NA	NA	NA
		Mechanical Joint Wedge-action Restraining Gland, Epoxy Coated						
Joint Restraints	Ductile iron pipe Mechanical Joint Restraints for Ductile Iron Pipe (4"-12") (New & Existing) - All restraints split serrated on bell and spigot ends. Pipe 16" and greater shall have restraint gaskets or locking bells. (Wastewater only for restraint of existing DIP FM)	EBAA Iron Inc	Megalug Series 1100		Megalug Series 1100		Megalug Series 1100	
		Ford / Uni-Flange	UFR-1400		UFR-1400		UFR-1400	
		Sigma	OneLok Series SLD/SLDE		OneLok Series SLD/SLDE		OneLok Series SLD/SLDE	
		Smith Blair	Cam Lok Series 111		Cam Lok Series 111		Cam Lok Series 111	
		Star	Star Grip Series 3000		Star Grip Series 3000		Star Grip Series 3000	
		Tyler Union	TufGrip Series TLD		TufGrip Series TLD		TufGrip Series TLD	
		EBAA Iron Inc	Tru-Dual Series 1500TD		Tru-Dual Series 1500TD		Tru-Dual Series 1500TD	
		Ford / Uni-Flange	Uni-Flange Series 1390C		Uni-Flange Series 1390C		Uni-Flange Series 1390C	
DIP Bell Joint Restraints (Greater)	DIP Bell Joint Restraints for Ductile Iron Pipe (16" & Greater) - All restraints shall have a split back-up ring for the bell and a serrated or wedge action gland for the spigot end. New installation for water & reclaimed water piping 16" and greater shall have restraint gaskets or locking bells.	Sigma	PV-Lok Series PWP-C		PV-Lok Series PWP-C		PV-Lok Series PWP-C	
		Smith Blair	Bell-Lock Series 165		Bell-Lock Series 165		Bell-Lock Series 165	
		Star	StarGrip Series 3100S		StarGrip Series 3100S		StarGrip Series 3100S	
		Tyler Union	TufGrip-Series 300C		TufGrip-Series 300C		TufGrip-Series 300C	
		EBAA Iron Inc	Series 1100HD	Existing Only	Series 1100HD	Existing Only	Series 1100HD	Existing Only
		Sigma	Series SSLDH	Existing Only	Series SSLDH	Existing Only	Series SSLDH	Existing Only
		Star	Series 3100S	Existing Only	Series 3100S	Existing Only	Series 3100S	Existing Only

APPENDIX D LIST OF APPROVED PRODUCTS - TRANSMISSION SYSTEMS

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Cat.	Desc	Manufacturer	Water Model #	Water Comments	Reclaimed Water Model #	Reclaimed Water Comments	Wastewater Model #	Wastewater Comments
	Locking Bell (4" & Above)	American	Fast Grip Gasket	Gasket	Fast Grip Gasket	Gasket	NA	NA
	Locking Bell (4" & Above)	Griffin	Flex-Ring Joint	Bell Lock	Flex-Ring Joint	Bell Lock	NA	NA
	Locking Bell (4" & Above)	Griffin	Lok-Ring Joint	Bell Lock	Lok-Ring Joint	Bell Lock	NA	NA
	Locking Bell (4" & Above)	Griffin	Talon RJ Gasket	Gasket	Talon RJ Gasket	Gasket	NA	NA
	Locking Bell (4" & Above)	Griffin	Snap-Lok	Bell Lock	Snap-Lok	Bell Lock	NA	NA
	Locking Bell (4" & Above)	Griffin	Sure Stop 350 Gasket	Gasket	Sure Stop 350 Gasket	Gasket	NA	NA
	Locking Bell (4" & Above)	Griffin	Thrust-Lock	Bell Lock	Thrust-Lock	Bell Lock	NA	NA
	Locking Bell (4" & Above)	Griffin	TR-Flex	Bell Lock	TR-Flex	Bell Lock	NA	NA
	Locking Bell (4" & Above)	Griffin	Super-Lock	Bell Lock	Super-Lock	Bell Lock	NA	NA
	Locking Bell (4" & Above)	Griffin	Field Lok 350 Gasket	Gasket	Field Lok 350 Gasket	Gasket	NA	NA
	Locking Bell (4" & Above)	Griffin	Field Lok Gasket	Gasket	Field Lok Gasket	Gasket	NA	NA
	Locking Bell (4" & Above)	Griffin	TR-Flex	Bell Lock	TR-Flex	Bell Lock	NA	NA
	Locking Bell (4" & Above)	Griffin	HP Lok Restraint Joint	Bell Lock	HP Lok Restraint Joint	Bell Lock	NA	NA
	Ductile iron pipe Bell Joint Restraint Gaskets and							
	SS to DIP Transition Restraint	EBAA Iron Inc	NA	NA	NA	NA	Megaflange 2100	(epoxy coated, SS hardware) Fig x PE RJ.
	SS to DIP Transition Restraint	Sigma	NA	NA	NA	NA	SigmaFlange with One Lock SLDE	
	SS to DIP Transition Restraint	Smith Blair	NA	NA	NA	NA	911 Flange - Lock Restrained FCA	
	PVC Pipe MJ Restraints							
	PVC Pipe MJ Restraints	EBAA Iron Inc	Mega-lug Series 2000PV	NA	Mega-lug Series 2000PV	NA	Mega-lug Series 2000PV	
	PVC Pipe MJ Restraints	Ford / Uni-Flange	NA	NA	NA	NA	Megalug Series 2200 (42"-48")	
	PVC Pipe MJ Restraints	Sigma	UFR 1500 Series	NA	UFR 1500 Series	NA	UFR 1500 Series	
	PVC Pipe MJ Restraints	Sigma	One Lok Series SLC/SLCE	NA	One Lok Series SLC/SLCE	NA	One Lok Series SLC/SLCE	
	PVC Pipe MJ Restraints	Smith Blair	Cam Lok Series 120	NA	Cam Lok Series 120	NA	Cam Lok Series 120	
	PVC Pipe MJ Restraints	Star	Star Grip Series 4000	NA	Star Grip Series 4000	NA	Star Grip Series 4000	
	PVC Pipe MJ Restraints	Tyler Union	TufGrip Series TLP	NA	TufGrip Series TLP	NA	TufGrip Series TLP	
	PVC Bell Joint Restraints (4" - 12") (New & Existing)							
	PVC Bell Joint Restraints (4" - 12") (New & Existing)	EBAA Iron Inc	Tru-Dual Series 1500TD	NA	Tru-Dual Series 1500TD	NA	Tru-Dual Series 1500TD	
	PVC Bell Joint Restraints (4" - 12") (New & Existing)	Ford / Uni-Flange	Uni-Flange Series 1390	NA	Uni-Flange Series 1390	NA	Uni-Flange Series 1390	
	PVC Bell Joint Restraints (4" - 12") (New & Existing)	Sigma	PV-Lok Series PWP	NA	PV-Lok Series PWP	NA	PV-Lok Series PWP	
	PVC Bell Joint Restraints (4" - 12") (New & Existing)	Smith Blair	Bell-Lock Series 165	NA	Bell-Lock Series 165	NA	Bell-Lock Series 165	
	PVC Bell Joint Restraints (4" - 12") (New & Existing)	Star	Series 1100C	NA	Series 1100C	NA	Series 1100C	
	PVC Bell Joint Restraints (4" - 12") (New & Existing)	Tyler Union	TufGrip 300C	NA	TufGrip 300C	NA	TufGrip 300C	

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Cat.	Desc	Manufacturer	Water Model #	Water Comments	Reclaimed Water Model #	Reclaimed Water Comments	Wastewater Model #	Wastewater Comments	
Joint Restraints	PVC Bell Joint Restraints (16" & Greater)	Ford / Uni-Flange	Series 1390	Existing Only	Series 1390	Existing Only	Series 1390		
			JCM	Sur-Grip Series 621	Existing Only	Sur-Grip Series 621	Existing Only	Sur-Grip Series 621	
PVC Bell Joint Restraints	(16" & Greater)	Sigma	PV-Lok PWP	Existing Only	PV-Lok PWP	Existing Only	PV-Lok PWP		
			Smith Blair	Bell-Lock Series 165	Existing Only	Bell-Lock Series 165	Existing Only	Bell-Lock Series 165	
PVC C900 DR 18	Bell & Spigot (4" - 12")	National Pipe & Plastics Inc	Series 1100C	Existing Only	Series 1100C	Existing Only	Series 1100C		
			Star	Existing Only	Existing Only	Existing Only	Existing Only		
Pipe	PVC C905 DR 18	National Pipe & Plastics Inc	<b>C900 Bell &amp; Spigot PVC Pipe: 4 to 12-inch - AWWA C-900, Minimum DR18 for Water, Reclaimed and Wastewater. DR14 for Fire Lines. Manufacturers shall be members in good standing with Uni-Bell to maintain approval status.</b>						
			Certa-Lok C900/RJ	Blue	Certa-Lok C900/RJ	Pantone Purple	Pantone Purple	Certa-Lok C900/RJ	Green
			C-900	Blue	C-900	Pantone Purple	Pantone Purple	Diamond C900	Green
			C-900 Blue Brute	Blue	C-900	Pantone Purple	Pantone Purple	C900 Blue Brute	Green
			C-900	Blue	C-900	Pantone Purple	Pantone Purple	C-900	Green
			C-900 Dura- Blue	Blue	C-900	Pantone Purple	Pantone Purple	C-900 Pipe	Green
			C-900	Blue	C-900	Pantone Purple	Pantone Purple	C-900	Green
			C-900	Blue	C-900	Pantone Purple	Pantone Purple	C-900	Green
			C-900	Blue	C-900	Pantone Purple	Pantone Purple	C-900	Green
			C-900	Blue	C-900	Pantone Purple	Pantone Purple	C-900	Green
Pipe	PVC C905 DR 18	National Pipe & Plastics Inc	<b>C905 Bell &amp; Spigot PVC Pipe 16" and Larger: AWWA C-905, Minimum DR18 for all Force Mains up to 24". Minimum DR21/DR25 for 30" and greater. Manufacturers shall be members in good standing with Uni-Bell to maintain approval status.</b>						
			NA	NA	NA	NA	NA	NA	NA
			NA	NA	NA	NA	NA	Trans-21 DR18	Green
			NA	NA	NA	NA	NA	IPEX Centurion	Green
			NA	NA	NA	NA	NA	C905 Big Blue	Green
			NA	NA	NA	NA	NA	C905	Green
			NA	NA	NA	NA	NA	C905 Big Blue	Green
			NA	NA	NA	NA	NA	C905 Big Blue	Green
			NA	NA	NA	NA	NA	C905 Big Blue	Green
			NA	NA	NA	NA	NA	C905 Big Blue	Green
HDPE C906 DR11	HDPE C906 DR11	PolyPipe, Inc.	<b>HDPE Pipe DR11 AWWA C906 shall be Ductile Iron Pipe Size, PE 3408/3608/4710 DIPS manufactured in accordance with ASTM F-714 and listed with NSF. Pipe shall be marked in accordance with either AWWA C901, AWWA C906. Compression type connections are not acceptable in new installations. Pipe joints shall be butt fusion or electro-fusion with flange or adapter. All HDPE shall be color coded to the Utility. Color identifications are in accordance with the APWA/ULCC Uniform Color Code. Manufacturers shall be members in good standing with PPI to maintain approval status.</b>						
			HDPE	DR11 Blue	HDPE	DR11 Pantone	DR11 Pantone	HDPE	DR11 Green
			Driscoplex 4000	DR11 Blue	Driscoplex 4000	DR11 Pantone	Driscoplex 4300	DR11 Green	
			EHMW Poly Pipe	DR11 Blue	EHMW	DR11 Pantone	EHMW	DR11 Green	

Cat.	Desc	Manufacturer	Water Model #	Water Comments	Reclaimed Water Model #	Reclaimed Water Comments	Wastewater Model #	Wastewater Comments
Pipe	Ductile Iron Pipe	American	Cement Lined	Blue	Cement Lined	Pantone Purple	Protecto 401	Pump Station
		Griffin	Cement Lined	Blue	Cement Lined	Pantone Purple	Protecto 401	Pump Station
		McWane Inc. DI Pipe Group	Cement Lined	Blue	Cement Lined	Pantone Purple	Protecto 401	Pump Station
		US Pipe	Cement Lined	Blue	Cement Lined	Pantone Purple	Protecto 401	Pump Station
Sample	Sample Station	<b>Sample Stations - Bacteriological Sample Station with built in flush system, all internal piping to be 2", brass and includes lockable green enclosures.</b>						
		Safety-Guard	SG-BSS-05 pedestal #77	green enclosure	NA	NA	NA	NA
Services	Brass Service Saddles	Water Plus Corp	Model 5000	green	NA	NA	NA	NA
		<b>Brass Service Saddles for 1" &amp; 2" water &amp; reclaimed water services on 4" through 12" Mains - Service saddles can be hinge or bolt controlled OD saddles to be used on C-900 and existing IPS OD PVC pipe.</b>						
		Ford	Series S-70, S-90	4"-12"	Series S-70, S-90	4"-12"	NA	NA
Services	Service Saddles	AY McDonald	Model 3891 / 3895,3801 / 3805	4"-12"	Model 3891 / 3895,3801 / 3805	4"-12"	NA	NA
		Mueller	Series S-13000/H-13000	4"-12"	Series S-13000/H-13000	4"-12"	NA	NA
		<b>Service Saddles for 1" (CC) &amp; 2" (Iron pipe threads) Water &amp; Reclaimed Water services on mains greater than 12". Service saddles for 2" taps (iron pipe threads) on 4" mains and greater for Waste Water. : Epoxy or nylon coated stainless steel 18-8-type 304 double straps, controlled O.D. saddles to be used on C-900 / C905 or DI for all 1-in and -2in taps on pipes over 12in.</b>						
		Ford	Series FC202	16" & greater	Series FC202	16" & greater	Series FC202	4" & greater
		JCM	Series 406	16" & greater	Series 406	16" & greater	Series 406	4" & greater
		Mueller	DR2S	16" & greater	DR2S	16" & greater	DR2S	4" & greater
Services	Service Saddles for HDPE	Romac	Series 202NS	16" & greater	Series 202NS	16" & greater	Series 202NS	4" & greater
		Smith Blair	Series 317	16" & greater	Series 317	16" & greater	Series 317	4" & greater
		<b>Service Saddles for 1" (CC) &amp; 2" (Iron Pipe threads) Water and Reclaimed Water Services: Epoxy or nylon coated stainless steel 18-8-type 304 double straps, controlled O.D. saddles to be used on HDPE for all 1-in and -2in taps. Taps to HDPE pipe shall be approved on a case by case basis.</b>						
Corporation	Stops Ball Type	Ford	Series FCP202		Series FCP202		Series FCP202	
		Romac	Series 202N-H		Series 202N-H		Series 202N-H	
		Smith Blair	Series 317-1 for HDPE		Series 317-1 for HDPE		Series 317-1 for HDPE	
Corporation	Stops Ball Type	<b>Corporation Stops Ball Type (1-inch with AWWA taper C threads only/pack joint outlet for CTS) 2" Corporation Stop Ball Type shall be 2" MIP X FIP threads.</b>						
		Ford	FB1000, FB1700-7		FB1000, FB1700-7		FB1700-7	2" ARV
		AY McDonald	4701B-22, 3149B2		4701B-22, 3149B2		3149B2	2" ARV
		Mueller	P25008, B-20046		P25008, B-20046		B-20046	2" ARV

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Cat.	Desc	Manufacturer	Water Model #	Water Comments	Reclaimed Water Model #	Reclaimed Water Comments	Wastewater Model #	Wastewater Comments	
Services	Curb Stops		<b>Curb Stops - Straight Valves: Ball type compression 2" cts O.D. tubing by 2" FIP</b>						
		Ford	B41-777W		B41-777W		NA	NA	
		A Y McDonald	6102W-22		6102W-22		NA	NA	
		Mueller	P25172		P25172		NA	NA	
	Curb Stops		<b>Curb Stops - Straight Valves: ball type compression x compression</b>						
		Ford	B44-444W		B44-444W		NA	NA	
		A Y McDonald	6100W-22		6100W-22		NA	NA	
		Mueller	P25146		P25146		NA	NA	
	PE tubing		<b>Polyethylene tubing: AWWA C901. UV protection (SDR-9) 1-inch and 2-inch only. PE 3408 / PE 4710</b>						
		Charter Plastics	Blue Ice		Blue Ice		NA	NA	
	Endot	Endopure Blue		Endopure Blue		NA	NA		
	JM Eagle	Pure-Core		Pure-Core		NA	NA		
Line Stops		<b>Line Stops</b>							
	JCM								
	Romac								
	Smith Blair								
Tapping Sleeves and Valves	Tapping Sleeves		<b>Tapping Sleeves: (Mechanical joint for taps on cast iron, ductile iron, PVC &amp; AC pipe, including size on size) with stainless steel nuts and bolts.</b>						
		American Flow Control	Series 2800		Series 2800		Series 2800		
		Clow	Series 1004		Series 1004		Series 1004		
		JCM	Series F-5205	DIP/PVC	Series F-5205	DIP/PVC	Series F-5205	DIP/PVC	
		Mueller	Series F-5207	A/C Pipe	Series F-5207	A/C Pipe	Series F-5207	A/C Pipe	
		Smith Blair	Series 414	FBE	Series 414	FBE	Series 414	FBE	
			Series H-615	DIP/PVC	Series H-615	DIP/PVC	Series H-615	DIP/PVC	
			Series H-619	A/C Pipe	Series H-619	A/C Pipe	Series H-619	A/C Pipe	
			Style 623	FBE	Style 623	FBE	Style 623	FBE	
	Tapping Valves: 12" and smaller		<b>Tapping Valves: 12" and smaller - Tapping Valves shall be furnished with an alignment lip and installed in the vertical position for Water and Reclaim Water. Wastewater shall be installed horizontally and abandoned in the open position. Tapping valves shall be resilient seated only and meet the requirements of AWWA C509 or C515</b>						
	American Flow Control	Series 2500	Alignment Lip	Series 2500	Alignment Lip	Series 2500	Alignment Lip		
	Clow	Series F-6114	Alignment Lip	Series F-6114	Alignment Lip	Series F-6114	Alignment Lip		
	Mueller	Series T2360 (4"-12")	Alignment Lip	Series T2360 (4"-12")	Alignment Lip	Series T2360 (4"-12")	Alignment Lip		

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Cat.	Desc	Manufacturer	Model #	Water Comments	Reclaimed Water Model #	Reclaimed Water Comments	Wastewater Model #	Wastewater Comments
Tapping Sleeves and Valves	Tapping Valves: 16" and Larger	American Flow Control	Series 2500	Alignment Lip & flushing port	Series 2500	Alignment Lip & flushing port	Series 2500	Alignment Lip & flushing port
		Clow	Series F-6114	Alignment Lip & flushing port	Series F-6114	Alignment Lip & flushing port	Series F-6114	Alignment Lip & flushing port
		Mueller	Series T2361 (14"&up)	Alignment Lip & flushing port	Series T2361 (14"&up)	Alignment Lip & flushing port	Series T2361 (14"&up)	Alignment Lip & flushing port
Valves	Butterfly Valve 42" and Above	<b>Butterfly Valves 42" and above, AWWA C504. Actuators input torques based on 150 psi valve pressure and 16 fps velocity with a maximum input of 80 ft-lb on 2" nuts and shall withstand 250 ft-lbs. Valve seats shall be leak-tight in both directions at 150 psi.</b>						
		Clow	Style #1450		Style #1450		NA	NA
		Dezurik	BAW		BAW		NA	NA
Valves	Check Valves 4" - 12"	Mueller / Pratt	LINSEAL III / Groundhog		LINSEAL III / Groundhog		NA	NA
		<b>Valves (Check) 4-inch and Larger (8 mil epoxy lined)</b>						
		American Flow Control	NA		NA		Series 600 or 50 line	
Valves	Gate Valves 16" and Larger	Clow / M&H / Kennedy	NA		NA		106	
		Mueller	NA		NA		Series 2600	
		<b>Gate Valves 12" and smaller - resilient seated only AWWA C509 or C515. Valve seat shall be leak-tight in both directions at 150 psi.</b>						
Valves	Gate Valves 4" - 12"	American Flow Control	Series 2500		Series 2500		NA	NA
		Clow	Series F-6100		Series F-6100		NA	NA
		Mueller	Series A-2360		Series A-2360		NA	NA
Valves	Gate Valves (Vertical) 16" and Up	<b>Gate Valves 16" and larger (Vertical Installation) AWWA C515 resilient seated only (16" and 24" no gearing required) above 24" shall be installed vertically with a gear actuator unless noted by the engineer. Valve seat shall be leak-tight in both directions at 150 psi.</b>						
		American Flow Control	Series 2500		Series 2500		NA	NA
		Clow	Series F-6100		Series F-6100		NA	NA
Valves	Gate Valves (Vertical) 16" and Up	Mueller	Series A-2361		Series A-2361		NA	NA

Cat.	Desc	Manufacturer	Water Model # Comments	Reclaimed Water Model # Comments	Wastewater Model # Comments	
Valves	Plug Valves	Clow Dezurik Millikan / Pratt Val-Matic	NA	NA	F-5412 FLG	4" & up
			NA	NA	F-5413 MJ	4" & up
			NA	NA	Series PEF or PEC	4" & up
			NA	NA	Eccentric / Ballcentric	4" & up
			NA	NA	5600 or 5800 (FLG)	4" & up
			NA	NA	5700 or 5900 (MJ)	4" & up
Valve Boxes	Valve Boxes with Locking Lids (Cast Iron)	Bingham/Taylor Sigma Star Tyler Union	Two piece standard screw type Heavy Duty Valve Boxes with Locking Lids (Cast Iron) and type of service cast in heavy duty traffic lid (H20 loading) ASTM A48			
			Series 4905	NA	Series 4905	Box
			4905-X	NA	4905-X	Extension
			4904-L	NA	4904-L	Green Sewer locking Lid
			Series VB 261X-267X	VB-25031LK-VB-2612	Series VB 261X-267X	Box
			VB 6302	VB-6302	VB 6302	Extension
			VB 4650W	VB2503LK	VB 4650S	Green Sewer locking Lid
			Series VB-0002	NA	Series VB-0002	Box
			VBEX 12-24S	NA	VBEX 12-24S	Extension
			VBLIDLOCK	NA	VBLIDLOCK	Green Sewer locking Lid
			Series 6850	NA	Series 6850	Box
			58, 59, 60	NA	58, 59, 60	Extension
			Locking Lid	NA	Locking Lid	Green Sewer locking Lid
			Valve Box	Valve Box	American Flow Control Mueller Company	For mains equal to, or greater than, 16" diameter or equal to greater than 6' feet deep
# 2A - 9A Retrofit Valve	NA	2A - 9A Retrofit Valve				Green Sewer locking Lid
Box Insert	MVB050CR thru	Box Insert				Green Sewer locking Lid
MVB050C thru	MVB130CR thru	MVB050C thru				Green Sewer locking Lid
			MVB130C with Extension Stem	MVB130C with Extension Stem	Green Sewer locking Lid	
			MVB875 Guide Plate	MVB875 Guide Plate	Green Sewer locking Lid	

APPENDIX D LIST OF APPROVED PRODUCTS - GRAVITY SYSTEMS

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Cat.	Desc	Manufacturer	Water Model # Comments	Reclaimed Water Model # Comments	Wastewater Model # Comments
Coatings	Anti-Graffiti Paint	<b>Block Walls-Anti-Graffiti Paint per Section 3119 Coatings &amp; Linings</b>			
		American Building Restoration Products	NA NA	NA NA	Polyshield Graffiti Preventer for Unpainted Masonry Type B
		Themec / Chemprobe	NA NA	NA NA	626 DUR A PEL
	Coatings for Existing Manholes	Professional Products of Kansas, Inc	NA NA	NA NA	Professional Water Seal & Anti-Graffiti (PWS-15 Super Strength)
		<b>Rehabilitation corrosion protection system per Section 3119 Coatings &amp; Linings. Interior coating for force main connections to existing concrete manholes only. New precast structures and existing pump stations shall be lined.</b>			
		CCI Spectrum, Inc	NA NA	NA NA	Spectrashield
		Kerneos Aluminate Technologies	NA NA	NA NA	Sewpercoat
	Pipe SDR 35 Gravity Mains	Raven Lining System	NA NA	NA NA	Raven 155 Primer
		Sauereisen	NA NA	NA NA	Raven 405
		Themec	NA NA	NA NA	210 Series Topcoat Glaze 210G Series 434 Topcoat Glaze 435
PVC Pipe and fittings	<b>PVC Pipe for Gravity SDR26/SDR 35 (Green in color) ASTM-D034. Manufacturers shall be members in good standing with Uni-Bell to maintain approval status.</b>				
	Pipe SDR 35 Gravity Mains	Certainteed	NA NA	NA NA	Gravity Sewer Pipe
		Diamond Plastics Corp	NA NA	NA NA	Sani-21 SDR-35
		JM Eagle	NA NA	NA NA	Gravity Sewer
		National Pipe & Plastics, Inc.	NA NA	NA NA	Ever-Green Sewer Pipe
		North American Pipe Corp (NAPCO)	NA NA	NA NA	Gravity Sewer
		Sanderson Pipe Corp	NA NA	NA NA	Gravity Sewer
	Locate Balls	<b>Locating Marker Systems - Wastewater Locator balls placed at all sanitary sewer cleanouts</b>			
		3M	NA NA	NA NA	3M™ EMS 4" Extended Range 5" Ball Marker 1404-XR
	Fittings SDR 35	<b>Fittings, Adapters and Plugs - Gravity PVC ASTM-D3034, Min SDR26/SDR 35</b>			
GPk Products, Inc.		NA NA	NA NA	SDR26/SDR35 Gasketed sewer fittings	
Harrington Corporation (HARCO)		NA NA	NA NA	SDR26/SDR35 Gasketed sewer fittings	
Multi Fittings Corp.		NA NA	NA NA	SDR26/SDR 35 Trench Tough Sewer Fittings	
JM Eagle		NA NA	NA NA	SDR26/SDR35 Gasketed sewer fittings	
Plastic Trends Inc		NA NA	NA NA	SDR26/SDR35 Gasketed sewer fittings	
TIGRE USA, Inc.	NA NA	NA NA	SDR26/SDR35 Gasketed sewer fittings		



APPENDIX D LIST OF APPROVED PRODUCTS - GRAVITY SYSTEMS

FEBRUARY 11, 2011

Cat.	Desc	Manufacturer	Water Model # Comments	Reclaimed Water Model # Comments	Wastewater Model #	Comments	
PVC Pipe a	Flexible Pipe Connectors	<b>Flexible Pipe Connectors and Transitions</b>					
		Fernco	NA NA	NA NA	1002, 1051, 1056 Series		
		Indiana Seal	NA NA	NA NA	102, 151, 156 Series		
		Mission Rubber	NA NA	NA NA	MR02, MR51, MR 56 Series		
	MH Lids	<b>Frame and Cover</b>					
		USF Fabrication Inc.	NA NA	NA NA	USF 225-AS		
	Adj Ring	<b>Top Adjusting Rings - HDPE with heavy duty loading (H-20)</b>					
		Ladtech, Inc	NA NA	NA NA	24R, 24S with Rope Sealant CS2455		
	Hatches	<b>Wet Well and Valve Vault Access Frames and Covers (Include the term "Confined Space" etched or cast into the cover with recessed lock &amp; hasp. Frames and covers per manufacturers specifications.</b>					
		Holiday Products	NA NA	NA NA	SIR or S2R Series		
	USF Fabrication Inc.	NA NA	NA NA	APS or APD Series			
	<b>Precast Manhole and Wetwell Structures ASTM C478. Precast concrete shall be batched with concrete dyed crystalline waterproofing admixture with corrosion protection. Concrete without admixture or without color tint /tracer shall be rejected.</b>						
Precast Concrete Structures		Allied Precast	NA NA	NA NA		Dyed Admix	
		Atlantic Concrete Products, Inc.	NA NA	NA NA		Dyed Admix	
		Delzotto Products, Inc.	NA NA	NA NA		Dyed Admix	
		Dura Stress Underground Inc.	NA NA	NA NA		Dyed Admix	
		Hanson Pipe & Product	NA NA	NA NA		Dyed Admix	
		Mack Concrete	NA NA	NA NA		Dyed Admix	
		Oldcastle Precast	NA NA	NA NA		Dyed Admix	
	Standard Precast Inc.	NA NA	NA NA		Dyed Admix		
Concrete Admix	<b>Crystalline Waterproofing Concrete Admix with color dye shall be added to all concrete structures (precast and cast-in-place) to provide waterproofing and corrosion resistance. Concrete without admixture or without color tint / tracer shall be rejected. % concentration of admix with colored dye added to the mix shall be based on weight of cement.</b>						
		Kryton International	NA NA	NA NA	KIM K-301R (with red dye)	2%	
		Xypex Chemical Corp	NA NA	NA NA	Xypex Admix C-1000Red (with red dye)	3.0 - 3.5%	
Liners	<b>Interior Liner for New or existing Precast Manhole and Precast Wetwell Structures per Section 3119 Coatings &amp; Linings</b>						
		AFE	NA NA	NA NA	Fiberglass Liner		
		AGRU Liner	NA NA	NA NA	HDPE Liner (Min 2 mm for Manhole / Min 5 mm for Pump Station)		
		Containment Solutions Inc. (Flowtite)	NA NA	NA NA	Fiberglass Liner		
		GSE Studliner	NA NA	NA NA	HDPE Liner (Min 2 mm for Manhole / Min 5 mm for Pump Station)		
		GU Liner	NA NA	NA NA	Reinforced Plastic Liner		
		L & F Manufacturing	NA NA	NA NA	Fiberglass Liner		

**APPENDIX D LIST OF APPROVED PRODUCTS - GRAVITY SYSTEMS**

**FEBRUARY 11, 2011**

Cat.	Desc	Manufacturer	Water		Reclaimed Water		Wastewater	
			Model #	Comments	Model #	Comments	Model #	Comments
Precast Concrete Structures	Heat Shrink Seal		NA	NA	NA	NA		
	Jointing Material	Canusa-CPS	NA	NA	NA	NA	Wrapid Seal with WrapidSeal Primer (Canusa G Primer)	
		Pipeline Seal & Insulator, Inc (PSI)	NA	NA	NA	NA	Riser Wrap with Polyken 1027 or 1039 primer	
		<b>Jointing Material Min. 2" width for all products to ensure squeeze out with manufacturer approved primer.</b>						
	Pipe Seals Gravity	Henry Company	NA	NA	NA	NA	Ram-Nek	with Primer
		Martin Asphalt Company	NA	NA	NA	NA	Evergrip 990	with Primer
		Trelleborg Pipe Seals	NA	NA	NA	NA	NPC – Bidco C-56	with Primer
		<b>Resilient Connector Pipe Seals, Manhole - Gravity less than 12-inch and less than 15-ft deep</b>						
	Pipe Seals Gravity	Atlantic Concrete	NA	NA	NA	NA	A-Lok (cast-in-place)	
		Hail Mary Rubber	NA	NA	NA	NA	Star Seal (cast-in-place)	
IPS		NA	NA	NA	NA	Wedge Style		
NPC		NA	NA	NA	NA	Kor-N-Seal Model WS		
Press seal gasket		NA	NA	NA	NA	PSX Direct Drive		
<b>Cast in Place Pipe Seals, Manhole - Gravity Greater Than or Equal to 12-inch and all pipe sizes greater than 15-ft deep</b>								
FM Pipe Seals	Atlantic Concrete	NA	NA	NA	NA	A-Lok	cast in place	
	Hail Mary Rubber	NA	NA	NA	NA	Star Seal	cast in place	
	<b>Modular Pipe Seals for Wet Well and Valve Box penetrations and all forcemain connections to existing and new precast concrete structures. EPDM Rubber with 316 SS Hardware</b>							
FM Pipe Seals	CCI Pipeline Systems	NA	NA	NA	NA	Wrap-It Link WL-SS Series		
	Pipeline Seal & Insulator, Inc / Link Seal	NA	NA	NA	NA	Link-Seal S-316 Modular Seal		
	Proco Products, Inc	NA	NA	NA	NA	PenSeal ES-PS Series		

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APPENDIX D LIST OF APPROVED PRODUCTS - PUMP STATION SYSTEMS

FEBRUARY 11, 2011

Cat.	Desc	Manufacturer	Water Model #	Comments	Reclaimed Water Model #	Comments	Wastewater Model #	Comments	
Generator	Gen	<b>Generator Systems, Fixed Shall be UL 2200 Certified.</b>							
		Caterpillar	NA	NA	NA	NA	CAT Diesel Generator Set		
		Cummins Power Generation	NA	NA	NA	NA	Diesel Generator Set		
	Fuel Tanks	<b>Generator Fuel Tanks. Shall be UL2085 certified.</b>							
		Convault	NA	NA	NA	NA	CVT-3SF or CVT-3FF		
		Phoenix	NA	NA	NA	NA	Envirovault		
	GR	<b>Generator Receptacle (GR)</b>							
		Cooper Crouse-Hinds	NA	NA	NA	NA	AR2042 (230V, 200A, 3P, 4W)	With AJAI Angle Adaptor	
		Cooper Crouse-Hinds	NA	NA	NA	NA	AR2042-S22 (460V, 200A, 3P, 4W)	With AJAI Angle Adaptor	
		Pyle National	NA	NA	NA	NA	JRE-4100 (230V, 100A, 3P, 4W)		
ATS	<b>Generator Transfer Switch</b>								
	Russelectric	NA	NA	NA	NA	RMTD Series with model 2000 controller	NEMA 12/3R 316SS Enclosure		
Odor Control Units	Biotrickling Filters	<b>Biotrickling filters</b>							
		BioAir	NA	NA	NA	NA			
		Bioem	NA	NA	NA	NA	Biosorbens BTF		
		Envirogen	NA	NA	NA	NA	BTF		
		Siemens	NA	NA	NA	NA	Zabocs BTF		
Carbon Adsorption Units	<b>Carbon Adsorption Units</b>								
		Calgon	NA	NA	NA	NA			
		Pure Air Filtration	NA	NA	NA	NA			
		Siemens	NA	NA	NA	NA			
Pressure Gauges	<b>Pressure Gauges shall have Diaphragm Seals. Oil filled.</b>								
		Ashcroft	NA	NA	NA	NA	10 1008SL 02L 60# 25 200SS 02T XYTSE	Gauge Diaphragm Seal	
		Terice	NA	NA	NA	NA	D83LFSS4002LA100 - Gauge M51001SSSS - Diaphragm Seal D99100 Fill and Mount Charge		
		Winter Gauges	NA	NA	NA	NA	PFQ770 0-60 PSI D70950 top D70954 Bottom		
		<b>Submersible Pumps</b>							
Pumps		<b>Submersible Pumps</b>							
		ABS	NA	NA	NA	NA			
	Flygt	NA	NA	NA	NA				

APPENDIX D LIST OF APPROVED PRODUCTS - PUMP STATION SYSTEMS

FEBRUARY 11, 2011

Cat.	Desc	Manufacturer	Water Model # Comments	Reclaimed Water Model # Comments	Wastewater Model #	Comments	
Pumps	Floats	Atlantic Scientific	NA NA	NA NA	Roto-Float		
	Radar	<b>Radar - Pulse Burst Radar Transmitter. Input 24 VDC and Output 4-20 mA</b>					
Main Svc Disc		Magnetrol	NA NA	NA NA	R82-520A-011		
		<b>Main Service Disconnect Breaker</b>					
Surge Protector Device		Square D	NA NA	NA NA	H or J Frame 3 Pole 600 Volt (HGL or JGL determined by amperage)		
		<b>Surge Protector - UL 1449, 3rd Edition listed and labeled, minimum 10 year warranty, NEMA LS-1 and IEEE C62, 41/45 tested with NEMA 4X enclosure, internal fusing, voltage and phase to match service. Rated 80,000 amps per mode for Duplex &amp; Triplex stations and 150,000 Amperes per mode for Master Stations. All devices shall be provided with a NEMA 4X Plastic enclosure which is approved in lieu of stainless steel.</b>					
		Current Technology (Power & Systems)	NA NA	NA NA	XN-80, TG-150 or CurrentGuard 150 Plus Series		
		Joslyn AKA (Total Protection Solutions)	NA NA	NA NA	TSS-ST 160 Series, ST 300 Series or JSP-300 Series		
Sub Panel		Surge Suppressors, Inc	NA NA	NA NA	LSE Series or SHL Series		
		<b>Sub-Panel Enclosure - NEMA 12/3R Enclosure 316SS, white polyester Powder coated -finish inside and out, With 3 Point Pad lockable Handle, and Door Stop</b>					
		Hoffman	NA NA	NA NA			
		Schaefer	NA NA	NA NA			
Control Panel		Universal enclosure systems	NA NA	NA NA			
		<b>Control Panel Supplier</b>					
Enclosure		ECS	NA NA	NA NA			
		Sta-Con Inc	NA NA	NA NA			
Mnts		<b>Enclosure - NEMA 12/3R Enclosure 316SS, white polyester Powder coated finish inside and out, With 3 Point Pad lockable Handle, and Door Stop</b>					
		Hoffman	NA NA	NA NA			
		Schaefer	NA NA	NA NA			
		Universal enclosure systems	NA NA	NA NA			
Seal-off		<b>Mounting Channel for Enclosures</b>					
		Unistrut Stainless Steel	NA NA	NA NA	1" 5/8 x 1" 5/8 316 SS		
FL		<b>Explosion-Proof Sealoff</b>					
		Cooper Crouse-Hinds	NA NA	NA NA	EYSR - 2 Inch Min.		
FL		<b>Flasher (FL)</b>					
		MPE	NA NA	NA NA	025-120-105		
		SSAC	NA NA	NA NA	FS-126		

APPENDIX D LIST OF APPROVED PRODUCTS - PUMP STATION SYSTEMS

FEBRUARY 11, 2011

Cat.	Desc	Manufacturer	Water		Reclaimed Water		Wastewater	
			Model #	Comments	Model #	Comments	Model #	Comments
AL	Alarm Light / With Base and Globe (AL)	American Electric	NA	NA	NA	NA	F32552	
		Red Dot Globe	NA	NA	NA	NA	VGLR-01	
		Red Dot Base					VA-01	
AH	Alarm Horn (AH)	Wheelock	NA	NA	NA	NA	3IT-115-R	
		Fuses (F)						
Fuse	Bussmann		NA	NA	NA	NA	FNQ-R or KTK-R	
		Hand-Auto-Off Selector (HOA)						
HOA	Square D	NA	NA	NA	NA	9001-SKS43B		
HSS	Horn Silence Button (HSS)	Square D	NA	NA	NA	NA	9001-SKR 1RH5	
Inter-lock	Mechanical Interlock	Square D	NA	NA	NA	NA	S29354	
		Control Panel Main Circuit Breaker (MCB) With S29450 Circuit Breaker Auxiliary Switch						
Breakers	Emergency Circuit Breaker (ECB) With S29450 Circuit Breaker Auxiliary Switch	Square D	NA	NA	NA	NA	H or J Frame 3 Pole 600 Volt (HGL or JGL determined by amperage)	
		Square D	NA	NA	NA	NA	H or J Frame 3 Pole 600 Volt (HGL or JGL determined by amperage)	
		Motor Circuit Breaker (MB)						
MS	Motor Starter (MS)	Square D	NA	NA	NA	NA	H or J Frame 3 Pole 600 Volt (HGL or JGL determined by amperage)	
		Control Circuit Breaker/ GFCI Receptacle Breaker/ SCADA Breaker						
		Square D	NA	NA	NA	NA	QOU120	
OL	Overload Heater(OL)	Square D	NA	NA	NA	NA	Type S Class 8536	
		Overload Reset						
		Square D	NA	NA	NA	NA	Part number will vary with size needed	
Transforme r	Control Circuit Transformer (XMFR)	Square D	NA	NA	NA	NA	9066-RA1	
		Main Circuit Transformer (MCT)						
		Square D	NA	NA	NA	NA	9070TF75D23	120/24 Volt .075 KVA
SPB	Supplemental Protector Breaker - 3 pole, 1-amp for Phase Monitor	Square D	NA	NA	NA	NA	9070T2000D1	480/120 2KVA
		Square D	NA	NA	NA	NA	MG24532	

APPENDIX D LIST OF APPROVED PRODUCTS - PUMP STATION SYSTEMS

FEBRUARY 11, 2011

Cat.	Desc	Manufacturer	Water		Reclaimed Water		Wastewater	
			Model #	Comments	Model #	Comments	Model #	Comments
PM	Phase Monitor (PM)	MPE 240 V.	NA	NA	NA	NA	001-230-118-OVG5	
			NA	NA	NA	NA	002-480-123-OVG5	
			Pump Automatic Alternator (PAA)		NA	NA	NA	NA
Pump Alternator	Diversified Duplex	Diversified Triplex	NA	NA	NA	NA	ARA-120-AME	
			NA	NA	NA	NA	008-120-13SP	
			NA	NA	NA	NA	009-120-23P	
Alt. Test Switch	Alt. Test Switch	Carling Technologies	NA	NA	NA	NA	SD-12-PC	
			NA	NA	NA	NA	6GG5E-78	
			NA	NA	NA	NA	2TL1-50	
Relay	Relay	Potter Brumfield 24 Volt	NA	NA	NA	NA	KRPA-11AN-24	
			NA	NA	NA	NA	KRPA-11AN-120	
			NA	NA	NA	NA	8501KPI2P14V14	
			NA	NA	NA	NA	8501KPI2P14V20	
Relay Base	Relay Base	IEDC 8 Pin Relay Base 600 Volt	NA	NA	NA	NA	SR2P-06	
			Duplex Receptacle/GFCI (DR) Upgraded to 20 Amp		NA	NA	NA	NA
Duplex Receptacle/GFCI	Hubbell	Pass & Seymour	NA	NA	NA	NA	GFTR20BK	
			NA	NA	NA	NA	2095TRBK	
ETM	Elapse Time Meter (ETM)	Reddington	NA	NA	NA	NA	711-0160	
			Grounding System		NA	NA	NA	NA
Grounding	Marathon	Panduit	NA	NA	NA	NA	Neutral Isolation Block 1421570	
			NA	NA	NA	NA	Ground Lug LAM2A 1/0 - 014 -6Y	
			NA	NA	NA	NA	Ground Buss PK7GTA	
TS	Terminal Strip (TS)	Marathon	NA	NA	NA	NA	Series 200	
			NA	NA	NA	NA	9080GR6	
			Terminal Strip End Blocks and End Clamps		NA	NA	NA	NA
TS	Square D	Square D	NA	NA	NA	NA	NA	
			NA	NA	NA	NA	NA	NA

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APPENDIX D LIST OF APPROVED PRODUCTS - PUMP STATION SYSTEMS FEBRUARY 11, 2011

Cat.	Desc	Manufacturer	Water		Reclaimed Water		Wastewater		
			Model #	Comments	Model #	Comments	Model #	Comments	
Pump Station Control Panel	PL	<b>Pilot Light (PL) 24 Volt with 1819 Bulb</b>							
		Dialight	NA	NA	NA	NA	803-1710		
		Lighting Components & Design	NA	NA	NA	NA	Littlelight 930507X		
VFD	RL	<b>Run Indicator Light (RL) 120 Volt</b>							
		Dialight	NA	NA	NA	NA	803-1710		
		Lighting Components & Design	NA	NA	NA	NA	Littlelites 930507X With 120MB Bulb		
Sluice Gate	MT	<b>Moisture and Temperature Failure Light (MT) 120 Volt with 120MB Bulb</b>							
		Dialight	NA	NA	NA	NA	803-1710		
		Lighting Components & Design	NA	NA	NA	NA	Littlelites 930507X		
Sluice Gate	VFD	<b>Sluice Gate for Wet Well with Motorized Operator</b>							
		BNW	NA	NA	NA	NA	Model 77 - 316 SS		
		Fontaine	NA	NA	NA	NA	Model 20 - 316 SS		
VFD	VFD	<b>Variable Frequency Drives</b>							
		Square D	NA	NA	NA	NA	NA	NA	





## **APPENDIX B**

# **APPENDIX B**

## **LED-BASED PAINT AND ASBESTOS SURVEY**



Project Number: 06634510  
July 11, 2019

Professional Service Industries, Inc.  
1748 33rd Street, Orlando, Florida 32839  
Phone: (407) 304-5560  
Fax: (407) 304-5561

Ms. Lucia Lettie  
Engineer II  
ORANGE COUNTY UTILITIES  
9150 Curry Ford Road  
Orlando, Florida 32825

**Re: Limited NESHAP Asbestos Renovation Survey and Lead-Based Paint Testing Report**  
Eastern Regional Water Supply Facility  
Buildings P-50 and P-75  
9100 Curry Ford Road  
Orlando, Orange County, Florida

Dear Ms. Lettie

In accordance with PSI Proposal No. 0663-276692 (revised) dated May 9, 2019, and your authorization, Professional Service Industries, Inc. (PSI), an Intertek Company, performed Industrial Hygiene Services consisting of a Limited National Emission Standards for Hazardous Air Pollutants (NESHAP) Asbestos Renovation Survey and testing for Lead-based Paint (LBP) at the referenced facility. Please find attached, one electronic copy of the final report.

PSI appreciates this opportunity to serve as your environmental consultant on this project and looks forward to our continued association. After your review, if you have any questions or concerns, please do not hesitate to contact the undersigned at (407) 645-5560.

Respectfully submitted,

**PROFESSIONAL SERVICE INDUSTRIES, INC.**

John H. Clary  
EPA Accredited Asbestos Inspector  
EPA Certified Lead Inspector

Scott S. Crandall, P.E.  
Florida Licensed Asbestos Consultant #EA0000060

Stephen A. Ungaro  
Principal Consultant, Lead



**LIMITED NESHAP ASBESTOS RENOVATION SURVEY  
AND  
LEAD-BASED PAINT TESTING REPORT**

For

EASTERN REGIONAL WATER SUPPLY FACILITY  
Buildings P-50 and P-75  
9100 Curry Ford Road  
Orlando, Orange County, Florida

Prepared for

ORANGE COUNTY UTILITIES  
9150 Curry Ford Road  
Orlando, Florida 32825

Prepared by

PROFESSIONAL SERVICE INDUSTRIES, INC.  
1748 33<sup>rd</sup> Street  
Orlando, Florida 32839

July 11, 2018

PSI Project No. 06634510



A handwritten signature in blue ink that reads "John H. Clary".

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John H. Clary  
EPA Accredited Asbestos Inspector  
EPA Certified Lead Inspector

A handwritten signature in blue ink that reads "Stephen Ungaro".

---

Stephen Ungaro  
Principal Consultant - Lead

---

Scott S. Crandall  
Florida Licensed Asbestos  
Consultant  
License No. EA0000060

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**APPENDIX B – PERSONNEL AND LABORATORY CERTIFICATIONS**





## 1 EXECUTIVE SUMMARY

Professional Service Industries, Inc. (PSI), an Intertek company, was retained by Orange County Utilities (OCU) to conduct a limited survey for suspect asbestos-containing materials (ACMs) and testing for lead-based paint (LBP) of Buildings P-50 and P-75 within the Eastern Regional Water Supply Facility (ERWSF) located at 9100 Curry Ford Road in Orlando, Orange County, Florida.

The limited asbestos survey was conducted to assist the client in complying with requirements of the National Emission Standards for Hazardous Air Pollutants (NESHAP), established by the U.S. Environmental Protection Agency (EPA) in 40 Code of Federal Regulations (CFR), Part 61, Final Rule and the U.S. Occupational Safety and Health Administration (OSHA) Asbestos Construction Standard, found in 29 CFR 1926.1101.

The limited LBP testing was conducted in general accordance with the U.S. Department of Housing and Urban Development (HUD) “Guidelines for the Evaluation and Control of Lead-Based Paint Hazards in Housing”, 2012 Edition. However, the survey was not intended to meet the full definition of a LBP inspection as defined in the guidelines. The survey was intended to assist the client in identifying areas containing LBP that may be impacted by the planned demolition of the structure.

The ACM and LBP surveys were conducted on June 28, 2019 by Mr. John Clary and Mr. Jeffrey Townsend of PSI, both of whom are EPA accredited asbestos inspectors, and EPA certified LBP inspectors.

### 1.1 ASBESTOS

A total of 26 samples of suspect ACM were collected from the two (2) buildings during this survey. The EPA considers a homogeneous material to be an ACM if it is determined to contain greater than one percent (>1%) asbestos. Results of laboratory analysis determined that none of the sampled materials that will be impacted by the renovation activities were determined to contain >1% asbestos:

### 1.2 LEAD-BASED PAINT - XRF

The EPA, U.S. Department of Housing & Urban Development (HUD) “Guidelines for the Evaluation and Control of Lead-Based Paint Hazards in Housing”, 2012 Revision and Title XXIX – Public Health, Chapter 381.983 of the Florida Statutes have defined LBP as any paint or coating found to contain equal to or in excess of 1.0 milligrams lead per square centimeter (mg/cm<sup>2</sup>) by X-ray fluorescence (XRF) testing, and greater than or 0.5% by weight if analyzing paint chip samples.

For this survey, a total of 90 readings were taken of representative surface coatings, including calibration check tests, utilizing an XRF device. No lead was found to be present at concentrations above the HUD definition for LBP of 1.0 mg/cm<sup>2</sup> in any of the collected readings.



## 2 INTRODUCTION

### 2.1 PURPOSE

As reported by the client, Orange County Utilities (OCU) will be making improvements to Building P-50 and Building P-75 at the ERWSF which will include the partial demolition of these buildings. PSI further understands that the roof on Building P-50 will be impacted while no work is planned on the Building P-75 roof. As such, OCU requested that PSI perform a limited NESHAP Asbestos Renovation Survey, and testing to identify the presence of LBP in the components that will be impacted during renovations.

### 2.2 SCOPE OF WORK

The scope for the Limited NESHAP Asbestos Survey portion of this project included the following task:

- An on-site survey of exposed and accessible suspect asbestos-containing materials (ACMs) was conducted by an U.S. Environmental Protection Agency (EPA) Asbestos Hazard Emergency Response Act (AHERA) accredited inspector. Building material samples were collected according to EPA guidelines, which dictates the number and location of samples to be collected.
- The samples collected were analyzed for asbestos content by polarized light microscopy (PLM). PSI conducted analysis for asbestos on each sample collected up to the first positive sample in a sample group using EPA “Method for the Determination of asbestos in Bulk Building Materials” EPA/600/R-93/116, July 1993.
- PSI developed an estimated quantity of each building material laboratory analyzed as containing asbestos. The quantity was listed with the material. Quantities were given in square feet for surfacing materials, linear feet for piping insulation, and each for mudded joints and other single item materials

The scope for the LBP scope of work included the following:

- PSI provided an EPA Lead Inspector to conduct the LBP inspection of the areas in question to provide information on the presence of LBP.
- The LBP inspection was performed in general accordance with the HUD 24 CFR Part 35 and the EPA 40 CFR Part 745 regulations.
- The scope of work for the LBP inspection included the use of an RMD Model LPA-1 X-ray Fluorescence (XRF) Lead Paint Analyzer to test building components (interior and exterior) for the presence of LBP, in general accordance with EPA and HUD regulations and guidelines and collect soil samples in proximity to the subject area.
- The project included testing accessible interior and exterior building components and fixtures, such as walls, doors, door jambs, floors, piping, mechanical equipment, structural steel etc.

### 2.3 AUTHORIZATION

Authorization to perform this work was provided on June 6, 2019 by OCU via Purchase Order No. C17903C019 in reference to PSI Proposal No. 0663-276692 dated May 9, 2019.



## 3 METHODOLOGY

### 3.1 ASBESTOS

#### 3.1.1 VISUAL INSPECTIONS

EPA accredited asbestos inspectors John H. Clary and Jeffrey Townsend performed the asbestos survey.

An initial walkthrough of the subject buildings accessed was conducted to determine the presence and condition of suspect materials which were accessible and/or exposed. Materials which were similar in general appearance were grouped into homogeneous sampling from both interior and exterior.

#### 3.1.2 ASSESSMENT STUDY GENERAL ORGANIZATION

The study consisted of three major activities: Homogeneous materials classification, sampling procedures and quantification. Although these activities are listed separately, they are integrated tasks. Functional spaces were also identified.

#### 3.1.3 HOMOGENEOUS MATERIAL CLASSIFICATIONS

PSI did not review drawings, floor plans, historical data, maintenance records, previous survey reports, laboratory reports or other documents for information regarding construction history and building materials.

A preliminary walkthrough of the buildings was conducted to determine areas of materials which were visually similar in color, texture, general appearance, and which appeared to have been installed at the same time. Such materials are termed "homogeneous materials" by the EPA. During this walkthrough, the approximate locations of these homogeneous materials were also noted.

Following the EPA inspection protocol, each identified suspect homogeneous material was placed in one of the following EPA classifications:

**Surfacing Materials** (spray or trowel applied to building members)

**Thermal System Insulation** (materials generally applied to various mechanical system[s]).

**Miscellaneous Materials** (any materials which do not fit either of the above categories)

#### 3.1.4 SAMPLING PROCEDURES

EPA guidelines were used to determine the sampling protocol. Sampling locations were chosen to be representative of each homogeneous material.

Each sample location was sprayed with amended water and was kept wet during the entire sampling process. Samples were collected by coring through the material from the surface down to the base substrate. All layers of the material were extracted in placed into a sample container for transport to the laboratory. Sample containers were sealed and labeled with a unique sample identification. Restoration of finishes and materials to their pre-sampling condition was not provided.





### **3.1.5 QUANTIFICATION**

Quantities of surveyed building materials, which were suspected of containing asbestos, were estimated by taking approximate measurements in the field.

## **3.2 LEAD-BASED PAINT**

### **3.2.1 VISUAL INSPECTIONS**

EPA certified lead inspectors John Clary and Jeffrey Townsend performed the lead testing.

An initial walk-through of the facilities was conducted to determine the presence of paint films which were accessible and/or exposed. Following the walk-through, the certified lead inspectors tested representative painted surfaces on interior and exterior components.

### **3.2.2 XRF TESTING PROCEDURES**

The XRF testing was performed with the LPA-1, manufactured by Radiation Monitoring Devices (RMD), operated in the quick mode. A validation check against known LBP standards were performed before and after the testing was completed, to ensure proper operation of the XRF device.

Test values are collected by placing the LPA-1 scanner on the surface to be tested and exposing the paint film to gamma radiation. XRF analyzers are usually capable of penetrating up to 3/8" of paint to determine lead content. At the conclusion of each test, the shutter closes and the display on the control console shows the lead concentration in mg/cm<sup>2</sup> for manual tabulation.

The accuracy and precision of any measurement is determined by the length of each test, instrument validation checks against known standards or control blocks, measurement conditions, and mathematical laws of random error. Even when XRF equipment is properly operated within the manufacturer's specification, unusual substrates, paint additives, uneven paint applications, electrical fields, lead components in wall cavities and many other variables may cause significant fluctuations in apparent test values. Due to the limitations and inherent problems associated with XRF field-testing, confirmation sampling and assessment of XRF data may be recommended before major abatement activities are started.

### **3.2.3 TESTING STRATEGIES**

In general, XRF testing was performed in representative areas which have painted surfaces both inside and outside the building.



## 4 LABORATORY

### 4.1 ASBESTOS

#### 4.1.1 POLARIZED LIGHT MICROSCOPY ACCREDITATION

Bulk samples of these materials were collected and sent to PSI's laboratory in Pittsburgh, Pennsylvania for analysis by phase light microscopy (PLM) and the EPA "Method for the Determination of Asbestos in Bulk Building Materials (EPA/600/R-93/116 July 1993). The U. S. National Institute of Standards and Technology (NIST) accredits PSI's laboratory under the National Voluntary Laboratory Accreditation Program (NVLAP) for the analysis of bulk asbestos. Accreditation certificates are included in Appendix B for your review.

#### 4.1.2 METHOD OF ANALYSIS

Analysis was performed by using the bulk sample for visual observation and slide preparation(s) for microscopic examination and identification. The samples were mounted on slides and then analyzed for asbestos (chrysotile, amosite, crocidolite, anthophyllite, and actinolite/tremolite), fibrous non-asbestos constituents (mineral wool, cellulose, etc.) and non-fibrous constituents. Asbestos was identified by refractive indices, morphology, color, pleochroism, birefringence, extinction characteristics, and signs of elongation. The same characteristics were used to identify the non-asbestos constituents.

Using a stereoscope, the microscopist visually estimated relative volumes of each constituent in proportion to the total volume of the sample. The test results are based on a visual determination of relative volume of the bulk sample components. The EPA considers a homogeneous material to be an ACM if it is determined to contain greater than one percent (>1%) asbestos.

The EPA method allows samples which are visually determined to have 10% or less asbestos to be quantified using a Point Count procedure. An ocular reticule (cross hair or point array) is used to visually superimpose a point or points on the microscope field of view. A total of 400 points superimposed on either asbestos fibers or non-asbestos matrix material must be counted over at least eight different preparations of representative subsamples. If an asbestos fiber and matrix particle overlap so that a point is superimposed on their visual intersection, a point is scored for both categories. Point counting provides a quantification of the area percent asbestos. Point counted results supersede the results of the visual estimation. One sample was point counted for this survey.

### 4.2 LEAD-BASED PAINT

#### 4.2.1 METHODOLOGIES

XRF testing results are based upon the published Performance Characteristic Sheet (PCS) for the RMD LPA-1 device. The PCS lists the performance parameters as determined by a joint EPA/HUD evaluation.

- Test results of 0.9 mg/cm<sup>2</sup> or below are reported as negative for lead-based paint.
- Test results of 1.0 mg/cm<sup>2</sup> or above are reported as positive for lead-based paint.



## 5 FINDINGS AND OBSERVATIONS

### 5.1 ASBESTOS

During the inspections, a total of nine (9) samples representing four (4) homogenous materials of suspect ACMs were collected and submitted for analysis of which all samples were analyzed on a first positive stop basis for each homogeneous group of materials analyzed. The following table lists each material sampled, sample location, approximate quantity of suspect material located throughout the surveyed areas and percentage of asbestos fibers found in materials sampled with ACM noted in bold print:

Sample No.	Material Description	Sampled Location	Approximate Quantity	Percent Asbestos (%) – Type
<b>BUILDING P-50 Roof (East Section only)</b>				
R-1	Rolled Roofing - Field	West Central Side	NQ <sup>(1)</sup>	NAD <sup>(2)</sup>
R-2		East Central Side		NAD
R-3	Parapet Wall Flashing	East Wall, North End	NQ	NAD
R-4		East Wall, Central		NAD
R-5	Caulking at Parapet Wall Coping Seams	East Wall, North End	NQ	NAD
R-6		East Wall, Central		NAD
R-7	Caulking below Drip Edge	West Wall, Central	NQ	NAD
R-8		North Wall, South End		NAD
R-9	Light Gray Caulking around Scuppers	West Wall, South End	NQ	NAD
R-10		East Wall, North End		NAD
R-11	Dark Gray Caulking around Scuppers	West Wall, South End	NQ	NAD
R-12		East Wall, North End		NAD
<b>BUILDING P-50 Interior</b>				
13	Caulking around Floor Pipe Penetrations	East Side, Abandoned Equipment Slab	NQ	NAD
14		East Section, East Wall, Central		NAD
15	White HVAC Mastic on Fiberglass Ducts	East Section, South Side	NQ	NAD
16		East Section, North Side		NAD
17	Tan HVAC Mastic on Fiberglass Ducts	East Section, South Side	NQ	NAD
18		East Section, North Side		NAD
19	Vibration Damper Cloth	AHU at East Side Exterior	NQ	NAD
20		AHU at East Side Exterior		NAD
<b>BUILDING P-75 Interior</b>				
21	White Firestop Caulking	South Side, East Wall Pipe	NQ	NAD
22		South Side, Louver Frame		NAD
23	White HVAC Duct Mastic	Northeast Room, Vertical Duct	NQ	NAD
24		Northeast Room, Horizontal Duct		NAD
25	Vibration Damper Cloth	Northeast AHU	NQ	NAD
26		Northeast AHU		NAD
(1)	NQ – Not quantified based on no asbestos detected in the sampled material			
(2)	NAD – No asbestos detected			



## 5.2 LEAD-BASED PAINT

The following chart list locations where XRF testing took place, material description of the material tested, color and substrate of material tested and test results in mg/cm<sup>2</sup>:

Test No.	Location	Color	Material/ Substrate	Condition	Test Results mg/cm <sup>2</sup>
<b>BUILDING P-50</b>					
1	Reference Calibration Test Block				1.0
2	Reference Calibration Test Block				0.8
3	Reference Calibration Test Block				0.9
4	North Wall Exterior	Light Beige	Wall/Concrete	Intact	-0.3
5	North Wall Exterior	Light Beige	Wall/Concrete	Intact	-0.2
6	North Side	White	Roll-up Door/Metal	Intact	-0.6
7	North Side	White	Roll-up Door Frame/Metal	Intact	0.2
8	East Side	White	Duct/Metal	Intact	0.1
9	East Side	Green	Duct/Metal	Intact	-0.1
10	East Wall	Green	Duct/Metal	Intact	-0.2
11	East Wall	White	Door/Metal	Intact	-0.7
12	East Wall	White	Door Frame/Metal	Intact	-0.5
13	East Side Exterior	White	AHU Frame/Metal	Intact	-0.2
14	East Roof	Green	Coping/Metal	Intact	-0.2
15	East Room	White	Ceiling/Concrete	Intact	-0.4
16	East Room, South Wall	Gray	Duct/Metal	Intact	-0.0
17	East Room, South Wall	Green	Window Frame/Metal	Intact	-0.3
18	East Room, East Side	White	Door/Metal	Intact	-0.5
19	East Room, East Side	White	Door Frame/Metal	Intact	-0.5
20	East Room, East Side	White	Wall/Masonry Block	Intact	-0.5
21	East Room, East Wall	White	Duct Support/Metal	Intact	-0.2
22	East Room, North Side	Brown	Roll-up Door Frame/Metal	Intact	-0.4
23	East Room, North Side	Brown	Roll-up Door/Metal	Intact	-0.0
24	East Room, North Side	Brown	Louver/Metal	Intact	-0.2
<b>BUILDING P-75</b>					
1	Reference Calibration Test Block				1.0
2	Reference Calibration Test Block				0.9
3	Reference Calibration Test Block				0.8
4	North Side, East Room	White	Door/Metal	Intact	0.4
5	North Side, East Room	White	Door Frame/Metal	Intact	-0.3
6	North Side, East Room	White	Wall/Masonry Block	Intact	-0.2



Test No.	Location	Color	Material/ Substrate	Condition	Test Results mg/cm <sup>2</sup>
<b>BUILDING P-75 (continued)</b>					
7	North Side, East Room	Gray	Floor/Concrete	Intact	-0.3
8	North Side, Exterior Northeast	White	Door/Metal	Intact	-0.5
9	North Side, Exterior Northeast	White	Door Frame/Metal	Intact	0-.3
10	North Side, Exterior Northeast	White	Wall/Masonry Block	Intact	0.3
11	North Side, Exterior Northeast	Tan	Wall/Masonry Block	Intact	0.7
12	North Side, East Room	White	Duct/Metal	Intact	-0.2
13	North Side, East Room	Gray	Floor/Concrete	Intact	-0.1
14	Northeast Room	White	Door Frame/Metal	Intact	-0.5
15	Northeast Room	White	Door/Metal	Intact	-0.4
16	Northwest Room, East Side	White	Wall/Concrete	Intact	-0.2
17	Northwest Room, East Side	Gray	Wall/Concrete	Intact	-0.3
18	Northwest Room, East Side	Gray	Floor/Concrete	Intact	-0.0
19	Northwest Room, Northeast Corner	White	I-Beam/Metal	Intact	-0.2
20	Northwest Room, Northeast Corner	Gray	Motor/Metal	Intact	-0.3
21	Northwest Room, Northeast Corner	Yellow	Piping/Metal	Intact	-0.3
22	Northwest Room, Northeast Corner	Orange	Motor Guard/Metal	Intact	-0.4
23	Northwest Room, Northeast Corner	Gray	Motor Base/Metal	Intact	-0.3
24	Northwest Room, Northeast Corner	Gray	Motor Slab/Concrete	Intact	-0.3
25	Northwest Room, Northeast Corner	Gray	Motor/Metal	Intact	-0.4
26	Northwest Room, Northeast Corner	Gray	Motor Support/Metal	Intact	-0.4
27	Northwest Room, Northeast Corner	Blue	Motor/Metal	Intact	-0.1
28	Northwest Room, Northeast Corner	Gray	Motor Slab/Concrete	Intact	-0.1
29	Northwest Room, Northeast Corner	Gray	Slab/Concrete	Intact	-0.3
30	Northwest Room, Northeast Corner	Tan	Pipe/Metal	Intact	-0.1
31	Northwest Room, Northwest Area	Green	Impellor Housing/Metal	Intact	-0.5



Test No.	Location	Color	Material/ Substrate	Condition	Test Results mg/cm <sup>2</sup>
<b>BUILDING P-75 (continued)</b>					
32	Northwest Room, Northwest Area	Blue	Motor/Metal	Intact	-0.1
33	Northwest Room, Northwest Area	White	Column/Metal	Intact	-0.2
34	Northwest Room, Northwest Area	White	Wall/Masonry Block	Intact	-0.1
35	Northwest Room, Northwest Area	Gray	Wall/Masonry Block	Intact	-0.2
36	Northwest Room, Northwest Area	White	Door Frame/Metal	Intact	-0.3
37	Northwest Room, Northwest Door	White	Door/Vinyl	Intact	-0.5
38	West Exterior Wall	White	Wall/Concrete Block	Intact	0.7
39	West Exterior Wall	Brown	Wall/Concrete Block	Intact	0.0
40	South Room, East Wall	White	Wall/Concrete Block	Intact	-0.1
41	South Room, East Wall	Gray	Wall/Concrete Block	Intact	-0.4
42	South Room, East Wall	Black	Roll-Up Door Frame/Metal	Intact	-0.2
43	South Room, East Wall	White	Roll-Up Door/Metal	Intact	-0.1
44	South Room, Southeast	Gray	Floor/Concrete	Intact	-0.3
45	South Room, Southeast	White	Column/Metal	Intact	-0.3
46	South Room, South	Yellow	Ladder/Metal	Intact	-0.7
47	South Room, South	Gray	Tank Support/Concrete	Intact	-0.5
48	South Room, South	White	Tank Support/Fiberglass	Intact	-0.5
49	South Room, South	White	Tank/Metal	Intact	-0.4
50	South Room, Southeast Area	Gray	Steps/Concrete	Intact	-0.3
51	South Room, South	Gray	Floor/Concrete	Intact	-0.5
52	South Room, South	Gray	Side of Slab/Concrete	Intact	-0.5
53	South Room, South	White	Pipe Support/Metal	Intact	-0.6
54	South Room, South	White	Pipe/Metal	Intact	-0.8
55	South Room, South	Yellow	Pipe Flange/Metal	Intact	-0.7
56	South Room, South	Gray	Pump Housing/Metal	Intact	-0.5
57	South Room, South	Blue	Pump Housing/Metal	Intact	-0.2
58	South Room, South	Light Brown	Pipe/PVC	Intact	-0.1
59	South Room, South	Yellow	Pipe/PVC	Intact	-0.5
60	South Room, Southwest	Yellow	Stair Tread/Metal	Intact	-0.5



Test No.	Location	Color	Material/ Substrate	Condition	Test Results mg/cm <sup>2</sup>
<b>BUILDING P-75 (continued)</b>					
61	South Room, Southeast	Red	Pipe/Metal	Intact	-0.2
62	South Room, Southeast	Gray	Tank Slab/Concrete	Intact	-0.1
63	South Room, Southeast	White	Tank Support/Vinyl	Intact	-0.2
64	South Room, Southeast	White	Tank/Metal	Intact	-0.5
65	Reference Calibration Test Block				0.9
66	Reference Calibration Test Block				0.8
67	Reference Calibration Test Block				1.1

Please note that none of the tested components in the two (2) buildings exhibited LBP above regulatory thresholds.



## 6 CONCLUSIONS AND RECOMMENDATIONS

### 6.1 ASBESTOS

Results of laboratory analysis determined that none of the sampled materials for the scope of this project contained asbestos fibers >1% asbestos. However, in the event that additional materials are discovered during the renovations, these materials should be sampled and laboratory analyzed.

### 6.2 LEAD BASED PAINT

Results of the Testing with the XRF device indicated none of the tested components in the two (2) buildings exhibited LBP above regulatory thresholds.





## 7 WARRANTY

The information contained in this report is based upon the data furnished by PSI, and observations and test results provided by PSI. These observations and results are time dependent, are subject to changing site conditions, and revisions to Federal, State and local regulations.

PSI warrants that these findings have been promulgated after being prepared in general accordance with generally accepted practices in the asbestos and abatement industries. PSI also recognizes that raw laboratory test data are not usually sufficient to make all abatement and management decisions.

As directed by the client, PSI did not provide any service to investigate or detect the presence of moisture, mold or other biological contaminants in or around any structure, or any service that was designed or intended to prevent or lower the risk of the occurrence of the amplification of the same. The Client acknowledges that mold is ubiquitous to the environment with mold amplification occurring when building materials are impacted by moisture. The Client further acknowledges that site conditions are outside of PSI's control, and that mold amplification will likely occur, or continue to occur, in the presence of moisture. As such, PSI cannot and shall not be held responsible for the occurrence or recurrence of mold amplification.

No other warranties are implied or expressed.

### USE BY THIRD PARTIES

This report was prepared pursuant to the contract PSI has with OCU. That contractual relationship included an exchange of information about the subject site that was unique and between PSI and its client and serves as the basis upon which this report was prepared. Because of the importance of the communication between PSI and its client, reliance or any use of this report by anyone other than OCU for whom it was prepared, is prohibited and therefore not foreseeable to PSI.

Reliance or use by any such third party without explicit authorization in the report does not make said third party a third-party beneficiary to PSI's contract with OCU. Any such unauthorized reliance on or use of this report, including any of its information or conclusions, will be at third party's risk. For the same reasons, no warranties or representations, expressed or implied in this report, are made to any such third party.

### UNIDENTIFIABLE CONDITIONS

This report is necessarily limited to the conditions observed and to the information available at the time of the work. Due to the nature of the work, there is a possibility that there may exist conditions which could not be identified within the scope of work or which were not apparent at the time of our site work. This report is also limited to information available from the client at the time it was conducted. The report may not represent all conditions at the subject site as it only reflects the information gathered from specific locations.

**APPENDIX A**  
**LABORATORY ANALYTICAL REPORTS – ASBESTOS**

## REPORT OF BULK SAMPLE ANALYSIS FOR ASBESTOS

**TESTED FOR:** PSI, Inc.  
 1748 33rd Street  
 Orlando, FL 32839  
 Attn: John Clary

**Project ID:** 06634510  
 E. Regional Water Supply  
 Facility - Bldgs. 50 & 75

**Date Received:** 7/1/2019

**Date Completed:** 7/1/2019

**Date Reported:** 7/2/2019

**Analyst:** Chris Kopar

**Work Order:** 1907008

**Page:** 1 of 2

Client ID	Lab ID (Layer)	Sample Description (Color, Texture, Etc.) <i>Analyst's Comment</i>	Asbestos Content (Percent and Type)	Non-asbestos Fibers (Percent and Type)
R1	001A	(1) Black, Roofing, Homogeneous	NO ASBESTOS DETECTED	20% Synthetic Fiber
R2	002A	(1) Black, Roofing, Homogeneous	NO ASBESTOS DETECTED	20% Synthetic Fiber 20% Fibrous Glass
		(2) Yellow, Foam, Homogeneous	NO ASBESTOS DETECTED	None Reported
R3	003A	(1) Black, Flashing, Homogeneous	NO ASBESTOS DETECTED	20% Synthetic Fiber
R4	004A	(1) Black, Flashing, Homogeneous	NO ASBESTOS DETECTED	20% Synthetic Fiber
R5	005A	(1) Gray, Caulking, Homogeneous	NO ASBESTOS DETECTED	None Reported
R6	006A	(1) Gray, Caulking, Homogeneous	NO ASBESTOS DETECTED	None Reported
R7	007A	(1) White, Caulking, Homogeneous	NO ASBESTOS DETECTED	None Reported
R8	008A	(1) White, Caulking, Homogeneous	NO ASBESTOS DETECTED	None Reported
R9	009A	(1) Gray, Caulking, Homogeneous	NO ASBESTOS DETECTED	None Reported
R10	010A	(1) Gray, Caulking, Homogeneous	NO ASBESTOS DETECTED	None Reported
R11	011A	(1) Gray, Caulking, Homogeneous	NO ASBESTOS DETECTED	None Reported
R12	012A	(1) Gray, Caulking, Homogeneous	NO ASBESTOS DETECTED	None Reported
13	013A	(1) Gray, Caulking, Homogeneous	NO ASBESTOS DETECTED	4% Cellulose Fiber
14	014A	(1) Gray, Caulking, Homogeneous	NO ASBESTOS DETECTED	4% Cellulose Fiber

Quantitation is based on a visual estimation of the relative area of bulk sample components, unless otherwise noted in the "Comments" section of this report. The results are valid only for the item tested. This report may not be used to claim product endorsement by NVLAP or any agency of the U.S. Government. Method used: E.P.A. Interim Method for the Determination of Asbestos in Bulk Insulation Samples (EPA 600/M4-82-020). Polarized Light Microscopy is not consistently reliable in detecting asbestos in floor coverings and similar non-friable organically bound materials. Quantitative Transmission Electron Microscopy is currently the only method that can be used to determine if the material can be considered or treated as non-asbestos containing. Samples will be disposed of within 30 days unless notified in writing by the client. No part of this report may be reproduced, except in full, without written permission of the laboratory. The reporting limit is 1% by weight. NVLAP Lab Code 101350-0.

Respectfully submitted,  
 PSI, Inc.



Approved Signatory  
 Lori Huss

Client ID	Lab ID (Layer)	Sample Description (Color, Texture, Etc.) <i>Analyst's Comment</i>	Asbestos Content (Percent and Type)	Non-asbestos Fibers (Percent and Type)
15	015A	(1) White, Mastic, Homogeneous	NO ASBESTOS DETECTED	None Reported
16	016A	(1) White, Mastic, Homogeneous	NO ASBESTOS DETECTED	None Reported
17	017A	(1) Tan, Mastic, Homogeneous	NO ASBESTOS DETECTED	2% Cellulose Fiber
18	018A	(1) Tan, Mastic, Homogeneous	NO ASBESTOS DETECTED	2% Cellulose Fiber
19	019A	(1) Black, Other, Homogeneous <i>Cloth</i>	NO ASBESTOS DETECTED	80% Fibrous Glass
20	020A	(1) Black, Other, Homogeneous <i>Cloth</i>	NO ASBESTOS DETECTED	80% Fibrous Glass
21	021A	(1) White, Caulking, Homogeneous	NO ASBESTOS DETECTED	None Reported
22	022A	(1) White, Caulking, Homogeneous	NO ASBESTOS DETECTED	None Reported
23	023A	(1) White, Mastic, Homogeneous	NO ASBESTOS DETECTED	None Reported
24	024A	(1) White, Mastic, Homogeneous	NO ASBESTOS DETECTED	None Reported
25	025A	(1) Black, Other, Homogeneous <i>Cloth</i>	NO ASBESTOS DETECTED	25% Fibrous Glass
26	026A	(1) Black, Other, Homogeneous <i>Cloth</i>	NO ASBESTOS DETECTED	25% Fibrous Glass

**Report Notes: (PT) Point Count Results**

Quantitation is based on a visual estimation of the relative area of bulk sample components, unless otherwise noted in the "Comments" section of this report. The results are valid only for the item tested. This report may not be used to claim product endorsement by NVLAP or any agency of the U.S. Government. Method used: E.P.A. Interim Method for the Determination of Asbestos in Bulk Insulation Samples (EPA 600/M4-82-020). Polarized Light Microscopy is not consistently reliable in detecting asbestos in floor coverings and similar non-friable organically bound materials. Quantitative Transmission Electron Microscopy is currently the only method that can be used to determine if the material can be considered or treated as non-asbestos containing. Samples will be disposed of within 30 days unless notified in writing by the client. No part of this report may be reproduced, except in full, without written permission of the laboratory. The reporting limit is 1% by weight. NVLAP Lab Code 101350-0.

Respectfully submitted,  
PSI, Inc.



Approved Signatory  
Lori Huss

**APPENDIX B**  
**PERSONNEL AND LABORATORY CERTIFICATIONS**

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# THE ASBESTOS INSTITUTE

*Certifies that*

## John Clary

has attended and received instruction in the EPA approved course

# AHERA Building Inspector Refresher

on

## April 10, 2019

and successfully completed and passed the competency exam.

ON-4644-1021-041019

Date of Examination:

10-Apr-2019

Date of Expiration:

10-Apr-2020



William T. Cavness  
Director



Approved Instructor

**THE ASBESTOS INSTITUTE**

20033 N. 19<sup>th</sup> Ave, Building 6, Phoenix, AZ 85027  
602-864-6564 – [www.theasbestosinstitute.com](http://www.theasbestosinstitute.com)

*This training meets all requirements for asbestos certification under Toxic Substance Control Act Title II.*

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# THE ASBESTOS INSTITUTE

*Certifies that*

## Jeffery Townsend

has attended and received instruction in the EPA approved course

# AHERA Building Inspector Refresher

on

## November 05, 2018

and successfully completed and passed the competency exam.

4644-7731-110518

Date of Examination:

5-Nov-2018

Date of Expiration:

05-Nov-2019



William T. Cavness  
Director



Approved Instructor

**THE ASBESTOS INSTITUTE**

20033 N. 19<sup>th</sup> Ave, Building 6, Phoenix, AZ 85027  
602-864-6564 – [www.theasbestosinstitute.com](http://www.theasbestosinstitute.com)

*This training meets all requirements for asbestos certification under Toxic Substance Control Act Title II.*



RICK SCOTT, GOVERNOR

JONATHAN ZACHEM, SECRETARY



**STATE OF FLORIDA**  
**DEPARTMENT OF BUSINESS AND PROFESSIONAL REGULATION**  
**ASBESTOS LICENSING UNIT**

THE ASBESTOS CONSULTANT - ENGINEER HEREIN IS LICENSED UNDER THE  
PROVISIONS OF CHAPTER 469, FLORIDA STATUTES

**CRANDALL, SCOTT S**

DIVERSIFIED PROFESSIONAL SERVICES CORP  
3600 10TH ST NE  
ST PETERSBURG FL 33704

**LICENSE NUMBER: EA0000060**

**EXPIRATION DATE: NOVEMBER 30, 2020**

Always verify licenses online at [MyFloridaLicense.com](http://MyFloridaLicense.com)

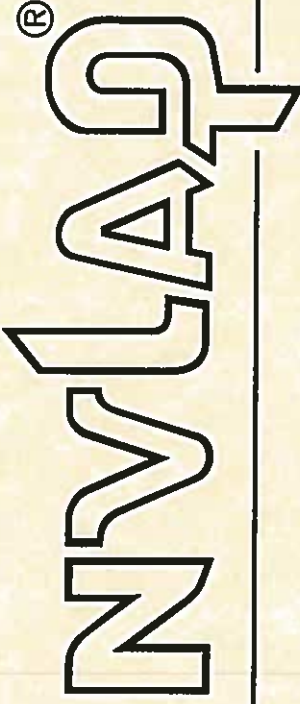


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United States Department of Commerce  
National Institute of Standards and Technology



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# Certificate of Accreditation to ISO/IEC 17025:2005

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NVLAP LAB CODE: 101350-0

**PSI**  
Pittsburgh, PA

*is accredited by the National Voluntary Laboratory Accreditation Program for specific services,  
listed on the Scope of Accreditation, for:*

## **Asbestos Fiber Analysis**

*This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005.  
This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality  
management system (refer to joint ISO-ILAC-IAF Communiqué dated January 2009).*

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2018-07-01 through 2019-06-30  
Effective Dates

A handwritten signature in black ink, appearing to read "Peter S. Lamm".

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For the National Voluntary Laboratory Accreditation Program



**SCOPE OF ACCREDITATION TO ISO/IEC 17025:2005**

**PSI**  
PSI, Inc.  
850 Poplar Street  
Pittsburgh, PA 15220  
Ms. Catherine McNamee  
Phone: 412-922-4010 x286 Fax: 412-922-4014  
Email: [cathy.mcnamee@psiusa.com](mailto:cathy.mcnamee@psiusa.com)  
<http://www.psiusa.com>

**ASBESTOS FIBER ANALYSIS**

**NVLAP LAB CODE 101350-0**

**Bulk Asbestos Analysis**

<u>Code</u>	<u>Description</u>
18/A01	EPA -- 40 CFR Appendix E to Subpart E of Part 763, Interim Method of the Determination of Asbestos in Bulk Insulation Samples
18/A03	EPA 600/R-93/116: Method for the Determination of Asbestos in Bulk Building Materials

**Airborne Asbestos Analysis**

<u>Code</u>	<u>Description</u>
18/A02	U.S. EPA's "Interim Transmission Electron Microscopy Analytical Methods-Mandatory and Nonmandatory-and Mandatory Section to Determine Completion of Response Actions" as found in 40 CFR, Part 763, Subpart E, Appendix A.

A handwritten signature in black ink, appearing to read "Dana S. Leman".

For the National Voluntary Laboratory Accreditation Program

# United States Environmental Protection Agency

This is to certify that



John H Clary

Inspector

has fulfilled the requirements of the Toxic Substances Control Act (TSCA) Section 402, and has received certification to conduct lead-based paint activities pursuant to 40 CFR Part 745.226 as:

**In the Jurisdiction of:**

All EPA Administered Lead-based Paint Activities Program States, Tribes and Territories

This certification is valid from the date of issuance and expires May 02, 2022

LBP-1-942-2

Certification #

April 22, 2019

Issued On



Adrienne Priselac, Manager, Toxics Office

Land Division

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# **The Environmental Institute**

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## *Jeff Townsend*

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Social Security Number - XXX-XX-9820  
Professional Service Industries, Inc. - 1748 33rd Street - Orlando, Florida 32889

*Has completed coursework and satisfactorily passed the hands-on skills assessment and an examination that meets training criteria in accordance with requirements for Lead-Based Paint Activities in Target Housing and Child-Occupied Facilities as regulated by Georgia DNR/EPD Chapter 391-3-24 and U. S. EPA TSCA 40 CFR Part 745 for the refresher course titled*

## *Lead Inspector Refresher*

*October 9, 2017*

Course Date

*1788*

Certificate Number

*October 9, 2017*

Examination Date

*October 8, 2019*

Georgia Expiration Date

*October 8, 2020*

EPA Expiration Date



*Bonnie Maurras*  
Bonnie B. Maurras - Principal Instructor

*David W. Hogue*  
David W. Hogue - Training Manager

Training Location: 95 Chastain Road, NW, Suite 301 - Kennesaw, GA 30144  
(Approved by the ABIH Certification Maintenance Committee for 1 CM point - Approval #11-584)  
TEI - 1841 West Oak Parkway, Suite F - Marietta, GA 30062 - (770) 427-3600 - [www.tei-atl.com](http://www.tei-atl.com)  
(State of Georgia Accredited - Certification No. 20-0799-006SR - September 21, 1999)

## **APPENDIX C**

# **APPENDIX C**

## **PERMITS**



# FLORIDA DEPARTMENT OF Environmental Protection

CENTRAL DISTRICT OFFICE  
3319 MAGUIRE BLVD, SUITE 232  
ORLANDO FLORIDA 32803

**Ron DeSantis**  
Governor

**Jeanette Nuñez**  
Lt. Governor

**Noah Valenstein**  
Secretary

## ELECTRONIC CORRESPONDENCE

### In the matter of an Application for Permit by:

Brandon Bryant, P.E., Chief Engineer  
Orange County Utilities  
9150 Curry Ford Road  
Orlando, FL 32825  
[Brandon.Bryant@ocfl.net](mailto:Brandon.Bryant@ocfl.net)

**DEP File No.** 0080780-1149-WC  
**County:** Orange

## NOTICE OF PERMIT ISSUANCE

Enclosed is Permit Number 0080780-1149-WC for the Eastern Regional Water Supply Facility (WSF) sodium hypochlorite generation system conversion to bulk sodium hypochlorite delivery, issued pursuant to Section 403.861(9), Florida Statutes.

This action is final and effective on the date filed with the Clerk of the Department unless a petition for an administrative hearing is timely filed under Sections 120.569 and 120.57, F.S., before the deadline for filing a petition. On the filing of a timely and sufficient petition, this action will not be final and effective until a subsequent order of the Department. Because the administrative hearing process is designed to formulate final agency action, the subsequent order may modify or take a different position than this action.

### Petition for Administrative Hearing

A person whose substantial interests are affected by the Department's action may petition for an administrative proceeding (hearing) under Sections 120.569 and 120.57, F.S. Pursuant to Rules 28-106.201 and 28-106.301, F.A.C., a petition for an administrative hearing must contain the following information:

- (a) The name and address of each agency affected and each agency's file or identification number, if known;
- (b) The name, address, any e-mail address, any facsimile number, and telephone number of the petitioner, if the petitioner is not represented by an attorney or a qualified representative; the name, address, and telephone number of the petitioner's representative, if any, which shall be the address for service purposes during the course of the proceeding; and an explanation of how the petitioner's substantial interests will be affected by the agency determination;
- (c) A statement of when and how the petitioner received notice of the agency decision;
- (d) A statement of all disputed issues of material fact. If there are none, the petition must so indicate;
- (e) A concise statement of the ultimate facts alleged, including the specific facts that the petitioner contends warrant reversal or modification of the agency's proposed action;

- (f) A statement of the specific rules or statutes that the petitioner contends require reversal or modification of the agency's proposed action, including an explanation of how the alleged facts relate to the specific rules or statutes; and
- (g) A statement of the relief sought by the petitioner, stating precisely the action that the petitioner wishes the agency to take with respect to the agency's proposed action.

The petition must be filed (received by the Clerk) in the Office of General Counsel of the Department at 3900 Commonwealth Boulevard, Mail Station 35, Tallahassee, Florida 32399-3000, or via electronic correspondence at Agency\_Clerk@dep.state.fl.us. Also, a copy of the petition shall be mailed to the applicant at the address indicated above at the time of filing.

#### Time Period for Filing a Petition

In accordance with Rule 62-110.106(3), F.A.C., petitions for an administrative hearing by the applicant and persons entitled to written notice under Section 120.60(3), F.S., must be filed within 14 days of receipt of this written notice. Petitions filed by any persons other than the applicant, and other than those entitled to written notice under Section 120.60(3), F.S., must be filed within 14 days of publication of the notice or within 14 days of receipt of the written notice, whichever occurs first. You cannot justifiably rely on the finality of this decision unless notice of this decision and the right of substantially affected persons to challenge this decision has been duly published or otherwise provided to all persons substantially affected by the decision. While you are not required to publish notice of this action, you may elect to do so pursuant Rule 62-110.106(10)(a).

The failure to file a petition within the appropriate time period shall constitute a waiver of that person's right to request an administrative determination (hearing) under Sections 120.569 and 120.57, F.S., or to intervene in this proceeding and participate as a party to it. Any subsequent intervention (in a proceeding initiated by another party) will be only at the discretion of the presiding officer upon the filing of a motion in compliance with Rule 28-106.205, F.A.C. If you do not publish notice of this action, this waiver may not apply to persons who have not received a clear point of entry.

#### Extension of Time

Under Rule 62-110.106(4), F.A.C., a person whose substantial interests are affected by the Department's action may also request an extension of time to file a petition for an administrative hearing. The Department may, for good cause shown, grant the request for an extension of time. Requests for extension of time must be filed with the Office of General Counsel of the Department at 3900 Commonwealth Boulevard, Mail Station 35, Tallahassee, Florida 32399-3000, or via electronic correspondence at Agency\_Clerk@dep.state.fl.us, before the deadline for filing a petition for an administrative hearing. A timely request for extension of time shall toll the running of the time period for filing a petition until the request is acted upon.

#### Mediation

Mediation is not available in this proceeding.

#### Judicial Review

Once this decision becomes final, any party to this action has the right to seek judicial review pursuant to Section 120.68, F.S., by filing a Notice of Appeal pursuant to Florida Rules of Appellate Procedure 9.110 and 9.190 with the Clerk of the Department in the Office of General Counsel (Station #35, 3900 Commonwealth Boulevard, Tallahassee, Florida 32399-3000) and by filing a copy of the Notice of



Permittee:  
Orange County Utilities  
Brandon Bryant, P.E., Chief Engineer  
Page 3

DEP File No.:  
0080780-1149-WC

Appeal accompanied by the applicable filing fees with the appropriate district court of appeal. The notice must be filed within 30 days from the date this action is filed with the Clerk of the Department.

### **EXECUTION AND CLERKING**

Executed in Orlando, Florida.

STATE OF FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION



Nathan Hess  
Permitting and Waste Cleanup Program Administrator  
Central District Office

Enclosures: Permit No. 0080780-1149-WC

### **CERTIFICATE OF SERVICE**

The undersigned duly designated deputy clerk hereby certifies that this permit and all copies were sent on the filing date below to the following listed persons:

Brandon Bryant, P.E., Orange County Utilities [Brandon.Bryant@ocfl.net]  
Jonathan C. Bundy, P.E., Tetra Tech [jon.bundy@tetrattech.com]  
FDEP: Reggie Phillips Jayson Seyfert, Jill Farris, Viviana Useche, Daissan A. Villareal

### **FILING AND ACKNOWLEDGMENT**

FILED, on this date, pursuant to Section 120.52, F.S., with the designated Department Clerk, receipt of which is hereby acknowledged.



August 6, 2019

**Clerk**

**Date**



# FLORIDA DEPARTMENT OF Environmental Protection

CENTRAL DISTRICT OFFICE  
3319 MAGUIRE BLVD, SUITE 232  
ORLANDO FLORIDA 32803

**Ron DeSantis**  
Governor

**Jeanette Nuñez**  
Lt. Governor

**Noah Valenstein**  
Secretary

August 5, 2019

## ELECTRONIC CORRESPONDENCE

**PERMITTEE:**

Orange County Utilities  
9150 Curry Ford Road  
Orlando, FL 32825

**PWS ID NUMBER:** 3484132

**PERMIT NUMBER:** 0080780-1149-WC

**DATE OF ISSUE:** August 6, 2019

**EXPIRATION DATE:** August 5, 2024

**COUNTY:** Orange

**PROJECT:** Eastern Regional Water Supply  
Facility (WSF) Sodium Hypochlorite Conversion  
to Bulk

This permit is issued under the provisions of Chapter 403, Florida Statutes (F.S.), and Florida Administrative Code (F.A.C.) Chapters 62-4, 62-550, 62-555 and 62-560. The above-named permittee is hereby authorized to perform the work or operate the facility shown on the application and approved drawings, plans, and other documents attached hereto or on file with the Department and made a part hereof and specifically described as follows:

**TO CONSTRUCT:** This project consists of the following:

1. Conversion of the sodium hypochlorite generation system to bulk sodium hypochlorite delivery, storage and feed system.
2. Replacement of the sodium hypochlorite storage tanks in Process Building 75 (Sodium Hypochlorite Generation Building).
3. Replacement of sodium hypochlorite feed pumps and piping.
4. The pre-disinfection feed system and the aerator cleaning feed system will be located in Process Building 75.
5. Modifications to the old generator room in Process 50 (High Service Pump Building) to include new sodium hypochlorite storage tanks and metering pumps for the post disinfection system.
6. Temporary sodium hypochlorite storage and feed system to maintain disinfection capabilities during replacement of the existing metering pumps and storage tanks.
7. Related electrical and instrumentation.
8. Related site improvements and yard piping as required for the new facilities.

The proposed sodium hypochlorite storage and feed system will be sized for a WSF capacity of 62.5 million gallons per day (MGD).

The existing sodium hypochlorite generation system is limiting the capacity of the WSF to 50 MGD. The various unit processes at the Eastern Regional WSF are currently being expanded as part of the County's Eastern Regional WSF Improvements Phase 3B under Permit Number 0080780-1101-WC to support a 62.5 MGD capacity with the exception of the sodium hypochlorite system.

**The proposed sodium hypochlorite storage and feed system expansion under this permit and the proposed WSF improvements currently being constructed under Permit Number 0080780-1101-WC for Eastern Regional WSF Improvements Phase 3B, will increase the maximum day design capacity of the WSF from 50 MGD to 62.5 MGD.**

**Permit No. 0080780-1101-WC for the WSF Improvements and Permit No. 0080780-1149-WC for the Sodium Hypochlorite Conversion to Bulk must be cleared at the same time to increase the maximum day design capacity of the WSF to 62.5 MGD.**

#### **PROPOSED CONSTRUCTION INCLUDES THE FOLLOWING COMPONENTS:**

1. Sodium Hypochlorite Feed Systems
  - a. Chemical Storage Tanks for the storage of 12.5 percent (%) sodium hypochlorite- Three (3) new horizontal fiberglass reinforced plastic (FRP) storage tanks will replace the three-existing horizontal FRP storage tanks in Process Building 75. Two (2) new vertical FRP storage tanks will be installed in Process Building 50. Each of the 3- sodium hypochlorite horizontal tanks shall have a nominal capacity of 36,000-gallons (gals), maximum diameter of 12 feet, sidewall length of 40 feet and provided with a 24-inch manway and all fittings. Each of the 2- sodium hypochlorite vertical tanks shall have a nominal capacity of 7,000 Gals, with a maximum diameter of 10 feet, length/height of 12 feet and provided with a 24-inch manway with tank supported access ladder and safety railing around top manway meeting OSHA ladder and railing requirements. The tanks shall be as manufactured by an established ASME RTP-1 certified manufacturer for fiberglass reinforced polymer vessels. The manufactured tanks shall be stamped with the official symbol for ASME RTP-1 certified vessels, indicating the fabricators full compliance with the design code and standards. The tanks shall be as manufactured by Augusta Fiberglass, Belco Manufacturing Company, or equal.
  - b. Chemical metering pumps, metering pump motor and control and accessories - The chemical metering pumps shall be of the single diaphragm design. With adjustable hydraulic relief valve and provided with precise seating, suction and discharge ball check valves. All pump components that come into contact with drinking water shall be NSF International Standard 61 certified. The pump design requirements are shown in the table below:

Item	Sodium Hypochlorite Pre-Disinfection (Process 75)	Sodium Hypochlorite Post- Disinfection (Process 50)	Sodium Hypochlorite Forced Draft Aeration (FDA) Cleaning (Process 75)
Number of units	4	3	1
Pump Design Capacity (Each), Gallons per Hour (GPH)	94	38.5	200
Minimum Feed Rate (Each), GPH	9	0.65	NA
Minimum Operating pressure, PSI	75	75	50
Power requirements, HP	1	½	1
Approved Pump Models	Milton Roy-MacRoy G, ProMinent-Sigma/3, or Pulsafeeder-PulsaPro 880	Milton Roy-MacRoy D, ProMinent-Sigma/2, or Pulsafeeder-PulsaPro 680	Milton Roy-MacRoy G, ProMinent-Sigma/3, or Pulsafeeder-PulsaPro 7120

- c. Emergency shower and eyewash station for indoor and outdoor use. Emergency shower and eyewash shall be Haws or approved equal.
  - d. Associated chemical piping.
2. One suspended column chemical resistant pumping unit with a minimum of 1 motor HP manufactured by Vanton Series SG 300 or equal.
  3. Temporary chemical feed system and accessories to maintain disinfection capabilities during replacement of the existing metering pumps and chemical storage tanks. The temporary chemical feed system shall provide a fully functional system to supply sodium hypochlorite to the existing pre-disinfection injection and FDA cleaning system locations. The temporary system shall be set up and implemented such that there is no interruption in sodium hypochlorite capacity. Consists of:
    - a. One 30,000-Gals double- walled bulk chemical storage tank
    - b. Four metering pumps (three duty, one standby) for pre-disinfection, one metering pump for the FDA cleaning system. Metering pumps shall be mechanically actuated or hydraulically actuated diaphragm metering pumps with a total firm metering pump

capacity of 285 GPH and capable of providing a minimum sodium hypochlorite flow rate of 9 GPH.

4. Modifications to the old generator room in Process 50 (High Service Pump Building) to include new sodium hypochlorite storage tanks and metering pumps for the post disinfection system.
5. Electrical and instrumentation.
6. Site improvements and yard piping as required for the new facilities.

When the proposed sodium hypochlorite generation system conversion to bulk sodium hypochlorite delivery under this permit and the proposed WSF improvements currently being constructed under Permit Number 0080780-1101-WC for Eastern Regional WSF Improvements Phase 3B are cleared for service, the maximum day design capacity of the plant will increase to 62.5 MGD. Eastern Regional WSF at that time will still be classified as Category V Class C (5.0 MGD and above). Accordingly, as per Rule 62-699, staffing is by Class C or higher operator: 6 hours per day for 5 days per week and one visit on each weekend day. The lead/chief operator must be Class C or higher.

Any change in staffing as per the Rule will be considered by the Department when a request is submitted by the permittee after clearance, substantiated by relevant mitigating conditions for DEP approval and in accordance with Rule 62-699 F.A.C.

**IN ACCORDANCE WITH:** This permit does not pertain to any wastewater, storm water or dredge and fill aspects of the project. This permit is issued based upon the dates and submissions during the application process as follows: Construction plans, specifications and details received on August 5, 2019.

**LOCATION:** The Eastern Regional WTP is located off Curry Ford Road and Econlockhatchee Trail, just west of State Road 417.

Work must be conducted in accordance with the Proposed Construction, General and Specific Conditions, attached hereto.

The permittee shall be aware of and operate under the Permit Conditions below. These applicable conditions are binding upon the permittee and enforceable pursuant to Chapter 403, Florida Statutes. [F.A.C. Rule 62-555.533(1)]

## **A. GENERAL CONDITIONS**

1. The terms, conditions, requirements, limitations and restrictions set forth in this permit, are "permit conditions" and are binding and enforceable pursuant to Sections 403.141, 403.727, or 403.859 through 403.861, F.S. The permittee is placed on notice that the

Department will review this permit periodically and may initiate enforcement action for any violation of these conditions.

2. This permit is valid only for the specific processes and operations applied for and indicated in the approved drawings or exhibits. Any unauthorized deviation from the approved drawings, exhibits, specifications, or conditions of this permit may constitute grounds for revocation and enforcement action by the Department.
3. As provided in Subsections 403.087(6) and 403.722(5), F.S., the issuance of this permit does not convey any vested rights or any exclusive privileges. Neither does it authorize any injury to public or private property or any invasion of personal rights, nor any infringement of federal, state, or local laws or regulations. This permit is not a waiver of or approval of any other department permit that may be required for other aspects of the total project which are not addressed in this permit.
4. This permit conveys no title to land or water, does not constitute State recognition or acknowledgment of title, and does not constitute authority for the use of submerged lands unless herein provided and the necessary title or leasehold interests have been obtained from the State. Only the Trustees of the Internal Improvement Trust Fund may express State opinion as to title.
5. This permit does not relieve the permittee from liability for harm or injury to human health or welfare, animal, or plant life, or property caused by the construction or operation of this permitted source, or from penalties therefore; nor does it allow the permittee to cause pollution in contravention of Florida Statutes and Department rules, unless specifically authorized by an order from the Department.
6. The permittee shall properly operate and maintain the facility and systems of treatment and control (and related appurtenances) that are installed and used by the permittee to achieve compliance with the conditions of this permit, as required by Department rules. This provision includes the operation of backup or auxiliary facilities or similar systems when necessary to achieve compliance with the conditions of the permit and when required by Department rules.
7. The permittee, by accepting this permit, specifically agrees to allow authorized Department personnel, upon presentation of credentials or other documents as may be required by law and at reasonable times (reasonable time may depend on the nature of the concern being investigated), access to the premises where the permitted activity is located or conducted to:
  - a. Have access to and copy any records that must be kept under conditions of the permit;
  - b. Inspect the facility, equipment, practices, or operations regulated or required under this permit; and

- c. Sample or monitor any substances or parameters at any location reasonably necessary to assure compliance with this permit or Department rules.
8. If, for any reason, the permittee does not comply with or will be unable to comply with any condition or limitation specified in this permit, the permittee shall immediately provide the Department with the following information:
  - a. A description of and cause of noncompliance; and
  - b. The period of noncompliance, including dates and times; or, if not corrected, the anticipated time the noncompliance is expected to continue, and steps being taken to reduce, eliminate, and prevent recurrence of the noncompliance. The permittee shall be responsible for any and all damages which may result and may be subject to enforcement action by the Department for penalties or for revocation of this permit.
9. In accepting this permit, the permittee understands and agrees that all records, notes, monitoring data and other information relating to the construction or operation of this permitted source which are submitted to the Department may be used by the Department as evidence in any enforcement case involving the permitted source arising under the Florida Statutes or Department rules, except where such use is prescribed by Sections 403.111 and 403.73, F.S. Such evidence shall only be used to the extent it is consistent with the Florida Rules of Civil Procedure and appropriate evidentiary rules.
10. The permittee agrees to comply with changes in Department rules and Florida Statutes after a reasonable time for compliance; provided, however, the permittee does not waive any other rights granted by Florida Statutes or Department rules. A reasonable time for compliance with a new or amended surface water quality standard, other than those standards addressed in Rule 62-302.500, shall include a reasonable time to obtain or be denied a mixing zone for the new or amended standard.
11. This permit is transferable only upon Department approval in accordance with Rule 62-4.120 and 62-730.300, F.A.C., as applicable. The permittee shall be liable for any non-compliance of the permitted activity until the transfer is approved by the Department.
12. This permit or a copy thereof shall be kept at the work site of the permitted activity.
13. This permit also constitutes:
  - a. Determination of Best Available Control Technology (BACT)
  - b. Determination of Prevention of Significant Deterioration (PSD)
  - c. Certification of compliance with State Water Quality Standards (Section 401, PL 92-500)
  - d. Compliance with New Source Performance Standards
14. The permittee shall comply with the following:

- a. Upon request, the permittee shall furnish all records and plans required under Department rules. During enforcement actions, the retention period for all records will be extended automatically unless otherwise stipulated by the Department.
- b. The permittee shall hold at the facility or other location designated by this permit records of all monitoring information (including all calibration and maintenance records and all original strip chart recordings for continuous monitoring instrumentation) required by the permit, copies of all reports required by this permit, and records of all data used to complete the application for this permit. These materials shall be retained at least three years from the date of the sample, measurement, report, or application unless otherwise specified by Department rule.
- c. Records of monitoring information shall include:
  - i. the date, exact place, and time of sampling or measurements;
  - ii. the person responsible for performing the sampling or measurements;
  - iii. the dates analyses were performed;
  - iv. the person responsible for performing the analyses;
  - v. the analytical techniques or methods used;
  - vi. the results of such analyses.

15. When requested by the Department, the permittee shall within a reasonable time furnish any information required by law which is needed to determine compliance with the permit. If the permittee becomes aware the relevant facts were not submitted or were incorrect in the permit application or in any report to the Department, such facts or information shall be corrected promptly.

## **SPECIFIC CONDITIONS**

### **B. Construction Activities**

#### **1. Permit Modification**

All construction must be in accordance with this permit. Before commencing work on project changes for which a construction permit modification is required per 62-555.536(1), the permittee shall submit to the Department a written request for a permit modification. Each such request shall be accompanied by one copy of a revised construction permit application, the proper processing fee and one copy of either a revised preliminary design report or revised drawings, specifications and design data. [F.A.C. Rule 62-555.536].

#### **2. Professional Engineer Supervision**

Permitted construction or alteration of public water supply systems must be supervised during construction by a professional engineer registered in the State of Florida if the project was designed under the responsible charge of a professional engineer licensed in



the State of Florida. The permittee must retain the service of a professional engineer registered in the State of Florida to observe that construction of the project is in accordance with the engineering plans and specifications as submitted in support of the application for this permit. [F.A.C. Rule 62-555.520(3)].

### **3. Artifacts**

If prehistoric or historic artifacts, such as pottery or ceramics, stone tools or metal implements, dugout canoe remains, or any other physical remains that could be associated with Native American cultures, or early colonial or American settlement are encountered at any time within the project site area, the permitted project should cease all activities involving subsurface disturbance in the immediate vicinity of such discoveries. The permittee, or other designee, should contact the Florida Department of State, Division of Historical Resources, Compliance and Review Section at 850.245.6333 or 800.847.7278, as well as the appropriate permitting agency office. Project activities should not resume without verbal and/or written authorization from the Division of Historical Resources and the permitting agency. In the event that unmarked human remains are encountered during permitted activities, all work shall stop immediately and the proper authorities notified in accordance with Section 872.05, *Florida Statutes*.

### **4. Delays and Extension of Permit**

If delays will cause project completion to extend beyond the expiration date of this permit, the permittee shall submit to the Department a request to extend the expiration date of this permit including the appropriate processing fee. This request shall specify the reasons for the delay and shall be submitted to the Department for approval prior to the expiration date of this permit. Note that no specific construction permit shall be extended so as to remain in effect longer than five years. [F.A.C. Rule 62-555.536(4)].

### **5. Permit Transfer**

In accordance with General Condition #11 of this permit, this permit is transferable only upon Department approval. Persons proposing to transfer this permit must apply jointly for a transfer of the permit within 30 days after the sale or legal transfer of ownership of the permitted project that has not been cleared for service by the Department using form, 62-555.900(8), Application for Transfer of a PWS Construction Permit along with the appropriate fee. [F.A.C. Rule 62-555.536(5)]

### **6. Obligation to Obtain Other Permits**

This permit satisfies Drinking Water permitting requirements only and does not authorize construction or operation of this facility prior to obtaining all other necessary permits from other program areas within the Department, or required permits from other state, federal, or local agencies.

### **7. Limits on Authorizing Connections**

This permit is for **CONSTRUCTION ONLY** of the components listed in the first page of this permit. This permit shall not infer that the clearance necessary for connection will be granted. Partial clearance may be granted, if required.

### **8. Gasoline Contamination**

If gasoline contamination is found at the construction site, work shall be stopped and the proper authorities notified. With the approval of the Department, ductile iron pipe and fittings, and solvent resistant gaskets materials shall be used in the contaminated area. The ductile pipe shall be used in the contaminated area. The ductile iron pipe shall extend 100 feet beyond any solvent noted. Any contaminated soil that is excavated shall be placed on an impermeable mat, covered with waterproof covering, and held for disposal. If the site cannot be properly cleaned, then consultation with the Department is necessary prior to continuing with the project construction.

### **9. Wetlands Jurisdiction**

This permit does not constitute approval of construction on jurisdictional wetland areas; therefore such approval must be obtained separately from the Water Management District or from DEP ERP Section, as applicable, Permittee shall provide a copy of the permit approval to the Department if water main installation involves activities on wetlands.

## **C. Construction Standards**

### **1. National Sanitation Foundation (NSF)**

All products, including paints, which shall come into contact with potable water, either directly or indirectly, shall conform with National Sanitation Foundation (NSF) International, Water Chemicals Codex, Food Chemicals Codex, American Water Works Association (AWWA) Standards and the Food and Drug Administration, as provided in Rule 62-555.320(3), F.A.C.

### **2. American Water Works Association (AWWA)**

Water supply facilities, including mains, pipe, fittings, valves, fire hydrants and other materials shall be installed in accordance with the latest applicable AWWA Standards and Department rules and regulations. The system shall be pressure and leak tested in accordance with AWWA Standard C600 C603, or C605, as applicable, and disinfected in accordance with AWWA Standard C651-653, as well as in accordance with Rule 62-555.340, F.A.C.

### **3. Lead Free**

The installation or repairs of any public water system, or any plumbing in residential or nonresidential facilities providing water for human consumption, which is connected to a public water system shall be lead free in accordance with Rule 62-555.322, F.A.C.

#### 4. **Asbestos**

If any existing asbestos cement (AC) pipes are replaced under this permit, the permittee shall do so in accordance with the applicable rules of Federal Asbestos Regulation and Florida DEP requirements. For specific requirements applicable to AC pipes, the permittee should contact the Central District Office prior to commencing any such activities at (407) 897-4100. Please be aware that a notification is required to be submitted to the Department at least 10 days prior to the start of a regulated project.

#### 5. **Hazard and Reuse Setbacks**

Setback distances between potable water wells and sanitary hazards shall be in accordance with 62-555.312, F.A.C. Reclaimed water land application areas, if applicable, must not be located within the setback distance from potable water supply wells established in Chapter 62-610, F.A.C.

#### 6. **Line Separation**

Permittee shall maintain vertical clearance and horizontal separation between water mains and sanitary sewers, storm sewers, etc. unless approved otherwise by the Department, as provided in Rule 62-555.314, F.A.C., and Section 8.6 of *Recommended Standards for Water Works*, a manual adopted by reference in Rule 62-555.330(3), F.A.C.

#### 7. **Color Coding of Pipes**

The new or altered aboveground piping at the drinking water treatment plant shall be color coded and labeled as recommended in Section 2.14 of "Recommended Standards for Water Works, 1997 Edition". [F.A.C. Rule 62-555.320(10)]

#### 8. **Cross Connections**

Permittee shall ensure that there shall be no cross-connection with any non-potable water source in accordance with Rule 62-555.360, F.A.C.

### **D. Operational Requirements**

#### 1. **Staffing**

When the proposed sodium hypochlorite generation system conversion to bulk sodium hypochlorite delivery under this permit and the proposed WSF improvements currently being constructed under Permit Number 0080780-1101-WC for Eastern Regional WSF Improvements Phase 3B are cleared for service, the maximum day design capacity of the plant will increase to 62.5 MGD. Eastern Regional WSF at that time will still be classified as Category V Class C (5.0 MGD and above). Accordingly, as per Rule 62-699, staffing is by Class C or higher operator: 6 hours per day for 5 days per week and one visit on each weekend day. The lead/chief operator must be Class C or higher. [F.A.C. Rule 62-699.310].

Any change in staffing as per the Rule will be considered by the Department when a request is submitted by the permittee after clearance, substantiated by relevant mitigating conditions for DEP approval and in accordance with Rule 62-699 F.A.C.

**2. Operation and Maintenance to comply with Water Quality Standards**

The supplier of water shall operate and maintain the public water system so as to comply with applicable standards in F.A.C. Rule 62-550 and 62-555.350.

**3. Record Drawings**

The permittee shall have complete record drawings produced for the project in accordance with Rule 62-555.530(4), F.A.C.

**4. State Watch Office**

The permittee or suppliers of water shall telephone the State Watch Office (SWO), at 1-800-320-0519 immediately (i.e., within two hours) after discovery of any actual or suspected sabotage or security breach, or any suspicious incident, involving a public water system in accordance with the F.A.C. Rule 62-555.350(10).

## **E. Monitoring Provisions**

**1. Compliance Monitoring by System Type**

Permittee shall follow the guidelines of Chapters 62-550, 62-555, and 62-560, F.A.C., regarding public drinking water system standards, monitoring, reporting, permitting, construction, and operation.

This facility is a Community Water System as defined in F.A.C. Rule 62-550.200(12) and shall comply with the applicable chemical, radiological, lead and copper, and bacteriological monitoring requirements of F.A.C. Rule 62-550. Such requirements shall be initiated within the quarter that the water treatment facility is placed into service (i.e. calendar quarters such as January through March or April through June) and the results submitted to the Department.

**2. Chlorine Residual**

The Water Treatment Plant shall maintain throughout the distribution system, a minimum continuous and effective free chlorine residual of 0.2 mg/L (or its equivalent). A minimum system pressure of 20 psi must be maintained throughout the system. Also, safety equipment shall be provided and located outside of chlorine room.

## **F. Clearance Requirements**

**1. Clearance Letter**

The permittee must instruct the engineer of record to request system clearance from the Department within sixty (60) days of completion of construction, testing and disinfecting

the system. Bacteriological test results shall be considered unacceptable if the test was completed more than 60 days before the Department receives the results. [F.A.C. Rule 62-555.340(2)(c)]

Permitted construction or alteration of a public water system may not be placed into service until a letter of clearance has been issued by the Department. [F.A.C. Rule 62-555.345]

## 2. Requirements to Obtain Clearance

After submitting the permit clearance package, the permittee will contact [DEP\\_CD@dep.state.fl.us](mailto:DEP_CD@dep.state.fl.us) **to establish a date/time for an inspection of the components contained in this permit.**

Prior to placing this project into service, Permittee shall submit, at a minimum, all of the following to the Department for evaluation and approval for operation, as provided in Rules 62-555.340 and 62-555.345, F.A.C.:

- a. The engineer's *Certification of Construction Completion and Request for Clearance to Place Permitted PWS Components Into Operation* {DEP Form 62-555.900(9)};
- c. Certified record drawings, if there are any changes noted for the permitted project.
- d. Analytical results from two consecutive days of satisfactory bacteriological samples from locations found in paragraph 3 below.
- e. Copy of a satisfactory pressure test of the process piping performed in accordance with AWWA Standards. [F.A.C. Rule 62-555.320(21) (a)(1)].
- f. Photographs of the above ground installation.
- g. Provide evidence that the required operation and maintenance(O&M) manual for the water treatment plant is in place, which will be updated thereafter as necessary to reflect plant modifications. The manual shall contain operation and control procedures, and preventive maintenance and repair procedures, for all plant equipment and shall be made available for reference at the plant or at a convenient location near the plant. Bound and indexed equipment manufacturer manuals shall be considered sufficient to meet the requirements of this subsection. [F.A.C. 62-555.350 (13)].
- h. Permit No. 0080780-1101-WC for the WSF Improvements and Permit No. 0080780-1149-WC for the Sodium Hypochlorite Conversion to Bulk must be cleared at the same time to increase the maximum day capacity of the WSF to 62.5 MGD. Submit the clearance request for Permit No. 0080780-1101-WC.

**No clearance will be issued unless the requested components to be cleared for service are viable and acceptable to the Department.**

### 3. Cleaning, Disinfecting, and Bacteriological Samples

The new facilities shall be cleaned, disinfected, and bacteriologically cleared in accordance with Chapter 62-555, F.A.C. The bacteriological clearance data shall be submitted to the Department with the engineer's certification of construction completion. [Section 62-555.340 and 62-555.315(6)(b), F.A.C.]

**Bacteriological Sampling Locations:** Copies of results from satisfactory bacteriological samples shall be submitted with the clearance package. Samples shall be taken from locations determined by the engineer-of record, in accordance with Rules 62-555.315 (6), 62-555.340 and 62-555.330, F.A.C. and American Water Works Association (AWWA) Standard C 651-92.

Each location shall be sampled on two separate days (at least 6 hours apart) with sample point locations and **chlorine residual readings clearly indicated** on the report and/or drawings.

**Bacteriological sample results will be considered unacceptable if the tests were completed more than 60 days before the Department received the results.**

**Per Rule 62-555.340, F.A.C., and AWWA Standard C653, which is referenced in Rule 62-555.340, F.A.C, all newly constructed chemical feed system components should be cleaned, rinsed with disinfectant, and bacteriologically evaluated unless the system is feeding a chemical upstream of surface water filtration and disinfection facilities or is feeding a disinfectant, in which case the system need only be cleaned.**

**Please submit the entire clearance document package in electronic format to [DEP\\_CD@dep.state.fl.us](mailto:DEP_CD@dep.state.fl.us).** If the file is very large, you may post it to the Water Electronic Submittal folder on the Central District's ftp site at:

[ftp://ftp.dep.state.fl.us/pub/incoming/Central\\_District/Water%20Electronic%20Applications](ftp://ftp.dep.state.fl.us/pub/incoming/Central_District/Water%20Electronic%20Applications).

After posting the document, send an e-mail to [DEP\\_CD@dep.state.fl.us](mailto:DEP_CD@dep.state.fl.us) alerting us that it has been posted.

Any submitted drawings (should be sized 11" x 17") and the engineer of record's signed seal and dates on the required document must be legible for acceptance.

Permittee:  
Orange County Utilities  
Brandon Bryant, P.E., Chief Engineer  
Page 14

DEP File No.:  
0080780-1149-WC

Forms: <http://www.dep.state.fl.us/water/drinkingwater/forms.htm>

STATE OF FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION

A handwritten signature in black ink, appearing to read "Nathan Hess". The signature is written in a cursive, somewhat stylized font.

Nathan Hess  
Permitting and Waste Cleanup Program Administrator  
Central District Office



# St. Johns River

## Water Management District

Ann B. Shortelle, Ph.D., Executive Director

4049 Reid Street • P.O. Box 1429 • Palatka, FL 32178-1429 • 386-329-4500  
On the internet at [www.sjrwmd.com](http://www.sjrwmd.com).

September 20, 2019

Christine Doan  
Orange County Board of Commissioners  
9150 Curry Ford Rd  
Orlando, FL 32825-7600

SUBJECT: 20902-6  
Eastern Regional Water Supply Facility Phase 3A and 3B Improvements

Dear Sir/Madam:

Enclosed is your individual permit issued by the St. Johns River Water Management District on September 20, 2019. This permit is a legal document and should be kept with your other important documents. Permit issuance does not relieve you from the responsibility of obtaining any necessary permits from any federal, state, or local agencies for your project.

### **Technical Staff Report:**

If you wish to review a copy of the Technical Staff Report (TSR) that provides the District's staff analysis of your permit application, you may view the TSR by going to the Permitting section of the District's website at [www.sjrwmd.com/permitting](http://www.sjrwmd.com/permitting). Using the "search applications and permits" feature, you can use your permit number or project name to find information about the permit. When you see the results of your search, click on the permit number and then on the TSR folder.

### **Noticing Your Permit:**

For noticing instructions, please refer to the noticing materials in this package regarding closing the point of entry for someone to challenge the issuance of your permit. Please note that if a timely petition for administrative hearing is filed, your permit will become non-final and any activities that you choose to undertake pursuant to your permit will be at your own risk. Please refer to the attached Notice of Rights to determine any legal rights you may have concerning the District's agency action.

### **Compliance with Permit Conditions:**

To submit your required permit compliance information, go to the District's website at [www.sjrwmd.com/permitting](http://www.sjrwmd.com/permitting). Under the "Apply for a permit or submit compliance data" section, click to sign-in to your existing account or to create a new account. Select the "Compliance Submittal" tab, enter your permit number, and select "No Specific Date" for the Compliance Due Date Range. You will then be able to view all the compliance submittal requirements for your project. Select the compliance item that you are ready to submit and then attach the appropriate information or form. The forms to comply with your permit conditions are available at [www.sjrwmd.com/permitting](http://www.sjrwmd.com/permitting) under the section "Handbooks, forms, fees, final orders". Click on

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#### GOVERNING BOARD

Douglas Burnett, CHAIRMAN  
ST. AUGUSTINE

Ron Howse, TREASURER  
COCOA

Douglas C. Bournique  
VERO BEACH

Daniel Davis  
JACKSONVILLE

Susan Dolan  
SANFORD



forms to view all permit compliance forms, then scroll to the ERP application forms section and select the applicable compliance forms. Alternatively, if you have difficulty finding forms or need copies of the appropriate forms, please contact the Bureau of Regulatory Support at (386) 329-4570.

**Transferring Your Permit:**

Your permit requires you to notify the District within 30 days of any change in ownership or control of the project or activity covered by the permit, or within 30 days of any change in ownership or control of the real property on which the permitted project or activity is located or occurs. You will need to provide the District with the information specified in rule 62-330.340, Florida Administrative Code (F.A.C.). Generally, this will require you to complete and submit Form 62-330.340(1), "Request to Transfer Permit," available at <http://www.sjrwmd.com/permitting/permitforms.html>.

Please note that a permittee is liable for compliance with the permit before the permit is transferred. The District, therefore, recommends that you request a permit transfer in advance in accordance with the applicable rules. You are encouraged to contact District staff for assistance with this process.

Thank you and please let us know if you have additional questions. For general questions contact [e-permit@sjrwmd.com](mailto:e-permit@sjrwmd.com) or (386) 329-4570.

Sincerely,



Michelle Reiber, Bureau Chief  
Division of Regulatory Services  
St. Johns River Water Management District  
525 Community College Parkway, S.E.  
Palm Bay, FL 32909  
(321) 409-2129

Enclosures: Permit  
Notice of Rights  
List of Newspapers for Publication

cc: District Permit File

Michael Thatcher  
Tetra Tech, Inc.  
201 E. Pine St. Ste. 1000  
Orlando, FL 32801

Michael Saxton  
Tetra Tech  
201 E Pine St Ste 1000  
Orlando, FL 32801-2723

Christine Doan  
Orange County Utilities Chief Engineer  
9150 Curry Ford Rd  
Orlando, FL 32825-7600

**ST. JOHNS RIVER WATER MANAGEMENT DISTRICT**  
**Post Office Box 1429**  
**Palatka, Florida 32178-1429**

**PERMIT NO:** 20902-6

**DATE ISSUED:** September 20, 2019

**PROJECT NAME:** Eastern Regional Water Supply Facility Phase 3A and 3B Improvements

**A PERMIT AUTHORIZING:**

Construction and operation of a Stormwater Management System for a 0.29 - acre project known as Eastern Regional Water Supply Facility Phase 3A and 3B Improvements as per plans received by the District on August 22, 2019, and amended Sheet C100 received by the District on September 18, 2019.

**LOCATION:**

Section(s): 7                      Township(s): 23S                      Range(s): 31E  
Orange County

**Receiving Water Body:**

Name	Class
Little Econlockhatchee River	III Fresh, IW

**ISSUED TO:**

Orange County Board of Commissioners  
9150 Curry Ford Rd  
Orlando, FL 32825-7600

Orange County Utilities  
9150 Curry Ford Road  
Orlando, FL 32825

The permittee agrees to hold and save the St. Johns River Water Management District and its successors harmless from any and all damages, claims, or liabilities which may arise from permit issuance. Said application, including all plans and specifications attached thereto, is by reference made a part hereof.

This permit does not convey to the permittee any property rights nor any rights or privileges other than those specified herein, nor relieve the permittee from complying with any law, regulation or requirement affecting the rights of other bodies or agencies. All structures and works installed by permittee hereunder shall remain the property of the permittee.

This permit may be revoked, modified or transferred at any time pursuant to the appropriate provisions of Chapter 373, Florida Statutes.

**PERMIT IS CONDITIONED UPON:**

See conditions on attached "Exhibit A", dated September 20, 2019

**AUTHORIZED BY:** St. Johns River Water Management District  
Division of Regulatory Services

A handwritten signature in black ink that reads "Marjorie D. Cook". The signature is written in a cursive style with a large, looped initial 'M'.

By:

---

Marjorie Cook  
Supervising Professional Engineer

**"EXHIBIT A"**  
**CONDITIONS FOR ISSUANCE OF PERMIT NUMBER 20902-6**  
**Eastern Regional Water Supply Facility Phase 3A and 3B Improvements**  
**DATED September 20, 2019**

1. All activities shall be implemented following the plans, specifications and performance criteria approved by this permit. Any deviations must be authorized in a permit modification in accordance with Rule 62-330.315, F.A.C. Any deviations that are not so authorized may subject the permittee to enforcement action and revocation of the permit under Chapter 373, F.S.
2. A complete copy of this permit shall be kept at the work site of the permitted activity during the construction phase, and shall be available for review at the work site upon request by the District staff. The permittee shall require the contractor to review the complete permit prior to beginning construction.
3. Activities shall be conducted in a manner that does not cause or contribute to violations of state water quality standards. Performance-based erosion and sediment control best management practices shall be installed immediately prior to, and be maintained during and after construction as needed, to prevent adverse impacts to the water resources and adjacent lands. Such practices shall be in accordance with the State of Florida Erosion and Sediment Control Designer and Reviewer Manual (Florida Department of Environmental Protection and Florida Department of Transportation June 2007), and the Florida Stormwater Erosion and Sedimentation Control Inspector's Manual (Florida Department of Environmental Protection, Nonpoint Source Management Section, Tallahassee, Florida, July 2008), which are both incorporated by reference in subparagraph 62-330.050(9)(b)5, F.A.C., unless a project-specific erosion and sediment control plan is approved or other water quality control measures are required as part of the permit.
4. At least 48 hours prior to beginning the authorized activities, the permittee shall submit to the District a fully executed Form 62-330.350(1), "Construction Commencement Notice," (October 1, 2013) (<http://www.flrules.org/Gateway/reference.asp?No=Ref-02505>), incorporated by reference herein, indicating the expected start and completion dates. A copy of this form may be obtained from the District, as described in subsection 62-330.010(5), F.A.C., and shall be submitted electronically or by mail to the Agency. However, for activities involving more than one acre of construction that also require a NPDES stormwater construction general permit, submittal of the Notice of Intent to Use Generic Permit for Stormwater Discharge from Large and Small Construction Activities, DEP Form 62-621.300(4)(b), shall also serve as notice of commencement of construction under this chapter and, in such a case, submittal of Form 62-330.350(1) is not required.
5. Unless the permit is transferred under Rule 62-330.340, F.A.C., or transferred to an operating entity under Rule 62-330.310, F.A.C., the permittee is liable to comply with the plans, terms and conditions of the permit for the life of the project or activity.
6. Within 30 days after completing construction of the entire project, or any independent portion of the project, the permittee shall provide the following to the Agency, as applicable:
  - a. For an individual, private single-family residential dwelling unit, duplex, triplex, or quadruplex — "Construction Completion and Inspection Certification for Activities Associated with a Private Single-Family Dwelling Unit" [Form 62-330.310(3)]; or
  - b. For all other activities — "As-Built Certification and Request for Conversion to Operation Phase" [Form 62-330.310(1)].

- c. If available, an Agency website that fulfills this certification requirement may be used in lieu of the form.
7. If the final operation and maintenance entity is a third party:
  - a. Prior to sales of any lot or unit served by the activity and within one year of permit issuance, or within 30 days of as-built certification, whichever comes first, the permittee shall submit, as applicable, a copy of the operation and maintenance documents (see sections 12.3 thru 12.3.4 of Volume I) as filed with the Florida Department of State, Division of Corporations and a copy of any easement, plat, or deed restriction needed to operate or maintain the project, as recorded with the Clerk of the Court in the County in which the activity is located.
  - b. Within 30 days of submittal of the as- built certification, the permittee shall submit "Request for Transfer of Environmental Resource Permit to the Perpetual Operation and Maintenance Entity" [Form 62-330.310(2)] to transfer the permit to the operation and maintenance entity, along with the documentation requested in the form. If available, an Agency website that fulfills this transfer requirement may be used in lieu of the form.
8. The permittee shall notify the District in writing of changes required by any other regulatory District that require changes to the permitted activity, and any required modification of this permit must be obtained prior to implementing the changes.
9. This permit does not:
  - a. Convey to the permittee any property rights or privileges, or any other rights or privileges other than those specified herein or in Chapter 62-330, F.A.C.;
  - b. Convey to the permittee or create in the permittee any interest in real property;
  - c. Relieve the permittee from the need to obtain and comply with any other required federal, state, and local authorization, law, rule, or ordinance; or
  - d. Authorize any entrance upon or work on property that is not owned, held in easement, or controlled by the permittee.
10. Prior to conducting any activities on state-owned submerged lands or other lands of the state, title to which is vested in the Board of Trustees of the Internal Improvement Trust Fund, the permittee must receive all necessary approvals and authorizations under Chapters 253 and 258, F.S. Written authorization that requires formal execution by the Board of Trustees of the Internal Improvement Trust Fund shall not be considered received until it has been fully executed.
11. The permittee shall hold and save the District harmless from any and all damages, claims, or liabilities that may arise by reason of the construction, alteration, operation, maintenance, removal, abandonment or use of any project authorized by the permit.
12. The permittee shall notify the District in writing:
  - a. Immediately if any previously submitted information is discovered to be inaccurate; and
  - b. Within 30 days of any conveyance or division of ownership or control of the property or the system, other than conveyance via a long-term lease, and the new owner shall

request transfer of the permit in accordance with Rule 62-330.340, F.A.C. This does not apply to the sale of lots or units in residential or commercial subdivisions or condominiums where the stormwater management system has been completed and converted to the operation phase.

13. Upon reasonable notice to the permittee, District staff with proper identification shall have permission to enter, inspect, sample and test the project or activities to ensure conformity with the plans and specifications authorized in the permit.
14. If prehistoric or historic artifacts, such as pottery or ceramics, projectile points, stone tools, dugout canoes, metal implements, historic building materials, or any other physical remains that could be associated with Native American, early European, or American settlement are encountered at any time within the project site area, the permitted project shall cease all activities involving subsurface disturbance in the vicinity of the discovery. The permittee or other designee shall contact the Florida Department of State, Division of Historical Resources, Compliance Review Section (DHR), at (850) 245-6333, as well as the appropriate permitting agency office. Project activities shall not resume without verbal or written authorization from the Division of Historical Resources. If unmarked human remains are encountered, all work shall stop immediately and the proper authorities notified in accordance with Section 872.05, F.S. For project activities subject to prior consultation with the DHR and as an alternative to the above requirements, the permittee may follow procedures for unanticipated discoveries as set forth within a cultural resources assessment survey determined complete and sufficient by DHR and included as a specific permit condition herein.
15. Any delineation of the extent of a wetland or other surface water submitted as part of the permit application, including plans or other supporting documentation, shall not be considered binding unless a specific condition of this permit or a formal determination under Rule 62-330.201, F.A.C., provides otherwise.
16. The permittee shall provide routine maintenance of all components of the stormwater management system to remove trapped sediments and debris. Removed materials shall be disposed of in a landfill or other uplands in a manner that does not require a permit under Chapter 62-330, F.A.C., or cause violations of state water quality standards.
17. This permit is issued based on the applicant's submitted information that reasonably demonstrates that adverse water resource-related impacts will not be caused by the completed permit activity. If any adverse impacts result, the District will require the permittee to eliminate the cause, obtain any necessary permit modification, and take any necessary corrective actions to resolve the adverse impacts.
18. A Recorded Notice of Environmental Resource Permit may be recorded in the county public records in accordance with Rule 62-330.090(7), F.A.C. Such notice is not an encumbrance upon the property.
19. This permit for construction will expire five years from the date of issuance.
20. At a minimum, all retention and detention storage areas must be excavated to rough grade prior to building construction or placement of impervious surface within the area to be served by those facilities. To prevent reduction in storage volume and percolation rates, all accumulated sediment must be removed from the storage area prior to final grading and stabilization.
21. All wetland areas or water bodies that are outside the specific limits of construction authorized by this permit must be protected from erosion, siltation, scouring or excess turbidity, and dewatering.

22. The operation and maintenance entity shall inspect the stormwater or surface water management system once within two years after the completion of construction and every two years thereafter to determine if the system is functioning as designed and permitted. The operation and maintenance entity must maintain a record of each required inspection, including the date of the inspection, the name and contact information of the inspector, and whether the system was functioning as designed and permitted, and make such record available for inspection upon request by the District during normal business hours. If at any time the system is not functioning as designed and permitted, then within 30 days the entity shall submit a report electronically or in writing to the District using Form 62-330.311(1), "Operation and Maintenance Inspection Certification," describing the remedial actions taken to resolve the failure or deviation.
23. This permit does not authorize the permittee to cause any adverse impact to or "take" of state listed species and other regulated species of fish and wildlife. Compliance with state laws regulating the take of fish and wildlife is the responsibility of the owner or applicant associated with this project. Please refer to Chapter 68A-27 of the Florida Administrative Code for definitions of "take" and a list of fish and wildlife species. If listed species are observed onsite, FWC staff are available to provide decision support information or assist in obtaining the appropriate FWC permits. Most marine endangered and threatened species are statutorily protected and a "take" permit cannot be issued. Requests for further information or review can be sent to [FWCConservationPlanningServices@MyFWC.com](mailto:FWCConservationPlanningServices@MyFWC.com).
24. The proposed project must be constructed and operated as per plans received by the District on August 22, 2019, and amended Sheet C100 received by the District on September 18, 2019.

## Notice Of Rights

1. A person whose substantial interests are or may be affected has the right to request an administrative hearing by filing a written petition with the St. Johns River Water Management District (District). Pursuant to Chapter 28-106 and Rule 40C-1.1007, Florida Administrative Code, the petition must be filed (received) either by delivery at the office of the District Clerk at District Headquarters, P. O. Box 1429, Palatka Florida 32178-1429 (4049 Reid St., Palatka, FL 32177) or by e-mail with the District Clerk at [Clerk@sjrwmd.com](mailto:Clerk@sjrwmd.com), within twenty-six (26) days of the District depositing the notice of District decision in the mail (for those persons to whom the District mails actual notice), within twenty-one (21) days of the District emailing the notice of District decision (for those persons to whom the District emails actual notice), or within twenty-one (21) days of newspaper publication of the notice of District decision (for those persons to whom the District does not mail or email actual notice). A petition must comply with Sections 120.54(5)(b)4. and 120.569(2)(c), Florida Statutes, and Chapter 28-106, Florida Administrative Code. The District will not accept a petition sent by facsimile (fax), as explained in paragraph no. 4 below.
2. Please be advised that if you wish to dispute this District decision, mediation may be available and that choosing mediation does not affect your right to an administrative hearing. If you wish to request mediation, you must do so in a timely-filed petition. If all parties, including the District, agree to the details of the mediation procedure, in writing, within 10 days after the time period stated in the announcement for election of an administrative remedy under Sections 120.569 and 120.57, Florida Statutes, the time limitations imposed by Sections 120.569 and 120.57, Florida Statutes, shall be tolled to allow mediation of the disputed District decision. The mediation must be concluded within 60 days of the date of the parties' written agreement, or such other timeframe agreed to by the parties in writing. Any mediation agreement must include provisions for selecting a mediator, a statement that each party shall be responsible for paying its pro-rata share of the costs and fees associated with mediation, and the mediating parties' understanding regarding the confidentiality of discussions and documents introduced during mediation. If mediation results in settlement of the administrative dispute, the District will enter a final order consistent with the settlement agreement. If mediation terminates without settlement of the dispute, the District will notify all the parties in writing that the administrative hearing process under Sections 120.569 and 120.57, Florida Statutes, is resumed. Even if a party chooses not to engage in formal mediation, or if formal mediation does not result in a settlement agreement, the District will remain willing to engage in informal settlement discussions.
3. A person whose substantial interests are or may be affected has the right to an informal administrative hearing pursuant to Sections 120.569 and 120.57(2), Florida Statutes, where no material facts are in dispute. A petition for an informal hearing must also comply with the requirements set forth in Rule 28-106.301, Florida Administrative Code.



## Notice Of Rights

4. A petition for an administrative hearing is deemed filed upon receipt of the complete petition by the District Clerk at the District Headquarters in Palatka, Florida during the District's regular business hours. The District's regular business hours are 8:00 a.m. – 5:00 p.m., excluding weekends and District holidays. Petitions received by the District Clerk after the District's regular business hours shall be deemed filed as of 8:00 a.m. on the District's next regular business day. The District's acceptance of petitions filed by e-mail is subject to certain conditions set forth in the District's Statement of Agency Organization and Operation (issued pursuant to Rule 28-101.001, Florida Administrative Code), which is available for viewing at [sjrwmd.com](http://sjrwmd.com). These conditions include, but are not limited to, the petition being in the form of a PDF or TIFF file and being capable of being stored and printed by the District. Further, pursuant to the District's Statement of Agency Organization and Operation, attempting to file a petition by facsimile is prohibited and shall not constitute filing.
5. Failure to file a petition for an administrative hearing within the requisite timeframe shall constitute a waiver of the right to an administrative hearing. (Rule 28-106.111, Florida Administrative Code).
6. The right to an administrative hearing and the relevant procedures to be followed are governed by Chapter 120, Florida Statutes, Chapter 28-106, Florida Administrative Code, and Rule 40C-1.1007, Florida Administrative Code. Because the administrative hearing process is designed to formulate final agency action, the filing of a petition means the District's final action may be different from the position taken by it in this notice. A person whose substantial interests are or may be affected by the District's final action has the right to become a party to the proceeding, in accordance with the requirements set forth above.
7. Pursuant to Section 120.68, Florida Statutes, a party to the proceeding before the District who is adversely affected by final District action may seek review of the action in the District Court of Appeal by filing a notice of appeal pursuant to Rules 9.110 and 9.190, Florida Rules of Appellate Procedure, within 30 days of the rendering of the final District action.
8. A District action is considered rendered, as referred to in paragraph no. 7 above, after it is signed on behalf of the District and filed by the District Clerk.
9. Failure to observe the relevant timeframes for filing a petition for judicial review as described in paragraph no. 7 above will result in waiver of that right to review.

## NOTICING INFORMATION

Please be advised that the St. Johns River Water Management District will not publish a notice in the newspaper advising the public that it has issued a permit for this project.

Newspaper publication, using the District's notice form, notifies members of the public of their right to challenge the issuance of the permit. If proper notice is given by newspaper publication, then there is a 21-day time limit for someone to file a petition for an administrative hearing to challenge the issuance of the permit.

To close the point of entry for filing a petition, you may publish (at your own expense) a one-time notice of the District's decision in a newspaper of general circulation within the affected area as defined in Section 50.011 of the Florida Statutes. If you do not publish a newspaper notice to close the point of entry, the time to challenge the issuance of your permit will not expire and someone could file a petition even after your project is constructed.

A copy of the notice form and a partial list of newspapers of general circulation are attached for your convenience. However, you are not limited to those listed newspapers. If you choose to close the point of entry and the notice is published, the newspaper will return to you an affidavit of publication. In that event, it is important that you either submit a scanned copy of the affidavit by emailing it to [compliancesupport@sjrwmd.com](mailto:compliancesupport@sjrwmd.com) (preferred method) or send a copy of the original affidavit to:

Office of Business and Administrative Services  
4049 Reid Street  
Palatka, FL 32177

If you have any questions, please contact the Office of Business and Administrative Services at (386) 329-4570.

NOTICE OF AGENCY ACTION TAKEN BY THE  
ST. JOHNS RIVER WATER MANAGEMENT DISTRICT

Notice is given that the following permit was issued on \_\_\_\_\_:

(Name and address of applicant) \_\_\_\_\_  
permit# \_\_\_\_\_. The project is located in \_\_\_\_\_ County, Section  
\_\_\_\_\_, Township \_\_\_\_\_ South, Range \_\_\_\_\_ East. The permit authorizes a surface  
water management system on \_\_\_\_\_ acres for \_\_\_\_\_ known as  
\_\_\_\_\_. The receiving water body is \_\_\_\_\_.

A person whose substantial interests are or may be affected has the right to request an administrative hearing by filing a written petition with the St. Johns River Water Management District (District). Pursuant to Chapter 28-106 and Rule 40C-1.1007, Florida Administrative Code (F.A.C.), the petition must be filed (received) either by delivery at the office of the District Clerk at District Headquarters, P.O. Box 1429, Palatka FL 32178-1429 (4049 Reid St, Palatka, FL 32177) or by e-mail with the District Clerk at Clerk@sjrwm.com, within twenty-one (21) days of newspaper publication of the notice of District decision (for those persons to whom the District does not mail or email actual notice). A petition must comply with Sections 120.54(5)(b)4. and 120.569(2)(c), Florida Statutes (F.S.), and Chapter 28-106, F.A.C. The District will not accept a petition sent by facsimile (fax). Mediation pursuant to Section 120.573, F.S., may be available and choosing mediation does not affect your right to an administrative hearing.

A petition for an administrative hearing is deemed filed upon receipt of the complete petition by the District Clerk at the District Headquarters in Palatka, Florida during the District's regular business hours. The District's regular business hours are 8 a.m. – 5 p.m., excluding weekends and District holidays. Petitions received by the District Clerk after the District's regular business hours shall be deemed filed as of 8 a.m. on the District's next regular business day. The District's acceptance of petitions filed by e-mail is subject to certain conditions set forth in the District's Statement of Agency Organization and Operation (issued pursuant to Rule 28-101.001, Florida Administrative Code), which is available for viewing at [www.sjrwm.com](http://www.sjrwm.com). These conditions include, but are not limited to, the petition being in the form of a PDF or TIFF file and being capable of being stored and printed by the District. Further, pursuant to the District's Statement of Agency Organization and Operation, attempting to file a petition by facsimile (fax) is prohibited and shall not constitute filing.

The right to an administrative hearing and the relevant procedures to be followed are governed by Chapter 120, Florida Statutes, Chapter 28-106, Florida Administrative Code, and Rule 40C-1.1007, Florida Administrative Code. Because the administrative hearing process is designed to formulate final agency action, the filing of a petition means the District's final action may be different from the position taken by it in this notice. **Failure to file a petition for an administrative hearing within the requisite time frame shall constitute a waiver of the right to an administrative hearing. (Rule 28-106.111, F.A.C.)**

If you wish to do so, please visit [http://www.sjrwm.com/nor\\_dec/](http://www.sjrwm.com/nor_dec/) to read the complete Notice of Rights to determine any legal rights you may have concerning the District's decision(s) on the permit application(s) described above. You can also request the Notice of Rights by contacting the Director of Business and Administrative Services, 4049 Reid St., Palatka, FL 32177-2529, tele. no. (386)329-4570.

## **NEWSPAPER ADVERTISING**

### **ALACHUA**

The Alachua County Record, Legal Advertising  
P. O. Box 806  
Gainesville, FL 32602  
352-377-2444/ fax 352-338-1986

### **BRAFORD**

Bradford County Telegraph, Legal Advertising  
P. O. Drawer A  
Starke, FL 32901  
904-964-6305/ fax 904-964-8628

### **CLAY**

Clay Today, Legal Advertising  
1560 Kinsley Ave., Suite 1  
Orange Park, FL 32073  
904-264-3200/ fax 904-264-3285

### **FLAGLER**

Flagler Tribune, c/o News Journal  
P. O. Box 2831  
Daytona Beach, FL 32120-2831  
386-681-2322

### **LAKE**

Daily Commercial, Legal Advertising  
P. O. Drawer 490007  
Leesburg, FL 34749  
352-365-8235/fax 352-365-1951

### **NASSAU**

News-Leader, Legal Advertising  
P. O. Box 766  
Fernandina Beach, FL 32035  
904-261-3696/fax 904-261-3698

### **ORANGE**

Sentinel Communications, Legal Advertising  
633 N. Orange Avenue  
Orlando, FL 32801  
407-420-5160/ fax 407-420-5011

### **PUTNAM**

Palatka Daily News, Legal Advertising  
P. O. Box 777  
Palatka, FL 32178  
386-312-5200/ fax 386-312-5209

### **SEMINOLE**

Seminole Herald, Legal Advertising  
300 North French Avenue  
Sanford, FL 32771  
407-323-9408

### **BAKER**

Baker County Press, Legal Advertising  
P. O. Box 598  
MacLenny, FL 32063  
904-259-2400/ fax 904-259-6502

### **BREVARD**

Florida Today, Legal Advertising  
P. O. Box 419000  
Melbourne, FL 32941-9000  
321-242-3832/ fax 321-242-6618

### **DUVAL**

Daily Record, Legal Advertising  
P. O. Box 1769  
Jacksonville, FL 32201  
904-356-2466 / fax 904-353-2628

### **INDIAN RIVER**

Vero Beach Press Journal, Legal Advertising  
P. O. Box 1268  
Vero Beach, FL 32961-1268  
772-221-4282/ fax 772-978-2340

### **MARION**

Ocala Star Banner, Legal Advertising  
2121 SW 19th Avenue Road  
Ocala, FL 34474  
352-867-4010/fax 352-867-4126

### **OKEECHOBEE**

Okeechobee News, Legal Advertising  
P. O. Box 639  
Okeechobee, FL 34973-0639  
863-763-3134/fax 863-763-5901

### **OSCEOLA**

Little Sentinel, Legal Advertising  
633 N. Orange Avenue  
Orlando, FL 32801  
407-420-5160/ fax 407-420-5011

### **ST. JOHNS**

St. Augustine Record, Legal Advertising  
P. O. Box 1630  
St. Augustine, FL 32085  
904-819-3439

### **VOLUSIA**

News Journal Corporation, Legal Advertising  
P. O. Box 2831  
Daytona Beach, FL 32120-2831  
(386) 681-2322



# St. Johns River

## Water Management District

Ann B. Shortelle, Ph.D., Executive Director

4049 Reid Street • P.O. Box 1429 • Palatka, FL 32178-1429 • 386-329-4500  
On the internet at [www.sjrwmd.com](http://www.sjrwmd.com).

September 20, 2019

Charles Parker  
Orange County Utilities  
9150 Curry Ford Road  
Orlando, FL 32825

SUBJECT: 20902-6  
Eastern Regional Water Supply Facility Phase 3A and 3B Improvements

Dear Sir/Madam:

Enclosed is your individual permit issued by the St. Johns River Water Management District on September 20, 2019. This permit is a legal document and should be kept with your other important documents. Permit issuance does not relieve you from the responsibility of obtaining any necessary permits from any federal, state, or local agencies for your project.

### **Technical Staff Report:**

If you wish to review a copy of the Technical Staff Report (TSR) that provides the District's staff analysis of your permit application, you may view the TSR by going to the Permitting section of the District's website at [www.sjrwmd.com/permitting](http://www.sjrwmd.com/permitting). Using the "search applications and permits" feature, you can use your permit number or project name to find information about the permit. When you see the results of your search, click on the permit number and then on the TSR folder.

### **Noticing Your Permit:**

For noticing instructions, please refer to the noticing materials in this package regarding closing the point of entry for someone to challenge the issuance of your permit. Please note that if a timely petition for administrative hearing is filed, your permit will become non-final and any activities that you choose to undertake pursuant to your permit will be at your own risk. Please refer to the attached Notice of Rights to determine any legal rights you may have concerning the District's agency action.

### **Compliance with Permit Conditions:**

To submit your required permit compliance information, go to the District's website at [www.sjrwmd.com/permitting](http://www.sjrwmd.com/permitting). Under the "Apply for a permit or submit compliance data" section, click to sign-in to your existing account or to create a new account. Select the "Compliance Submittal" tab, enter your permit number, and select "No Specific Date" for the Compliance Due Date Range. You will then be able to view all the compliance submittal requirements for your project. Select the compliance item that you are ready to submit and then attach the appropriate information or form. The forms to comply with your permit conditions are available at [www.sjrwmd.com/permitting](http://www.sjrwmd.com/permitting) under the section "Handbooks, forms, fees, final orders". Click on

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#### GOVERNING BOARD

Douglas Burnett, CHAIRMAN  
ST. AUGUSTINE

Ron Howse, TREASURER  
COCOA

Douglas C. Bournique  
VERO BEACH

Daniel Davis  
JACKSONVILLE

Susan Dolan  
SANFORD

forms to view all permit compliance forms, then scroll to the ERP application forms section and select the applicable compliance forms. Alternatively, if you have difficulty finding forms or need copies of the appropriate forms, please contact the Bureau of Regulatory Support at (386) 329-4570.

**Transferring Your Permit:**

Your permit requires you to notify the District within 30 days of any change in ownership or control of the project or activity covered by the permit, or within 30 days of any change in ownership or control of the real property on which the permitted project or activity is located or occurs. You will need to provide the District with the information specified in rule 62-330.340, Florida Administrative Code (F.A.C.). Generally, this will require you to complete and submit Form 62-330.340(1), "Request to Transfer Permit," available at <http://www.sjrwmd.com/permitting/permitforms.html>.

Please note that a permittee is liable for compliance with the permit before the permit is transferred. The District, therefore, recommends that you request a permit transfer in advance in accordance with the applicable rules. You are encouraged to contact District staff for assistance with this process.

Thank you and please let us know if you have additional questions. For general questions contact [e-permit@sjrwmd.com](mailto:e-permit@sjrwmd.com) or (386) 329-4570.

Sincerely,



Michelle Reiber, Bureau Chief  
Division of Regulatory Services  
St. Johns River Water Management District  
525 Community College Parkway, S.E.  
Palm Bay, FL 32909  
(321) 409-2129

Enclosures: Permit  
Notice of Rights  
List of Newspapers for Publication

cc: District Permit File

Michael Thatcher  
Tetra Tech, Inc.  
201 E. Pine St. Ste. 1000  
Orlando, FL 32801

Michael Saxton  
Tetra Tech  
201 E Pine St Ste 1000  
Orlando, FL 32801-2723

Christine Doan  
Orange County Utilities Chief Engineer  
9150 Curry Ford Rd  
Orlando, FL 32825-7600

**ST. JOHNS RIVER WATER MANAGEMENT DISTRICT**  
**Post Office Box 1429**  
**Palatka, Florida 32178-1429**

**PERMIT NO:** 20902-6

**DATE ISSUED:** September 20, 2019

**PROJECT NAME:** Eastern Regional Water Supply Facility Phase 3A and 3B Improvements

**A PERMIT AUTHORIZING:**

Construction and operation of a Stormwater Management System for a 0.29 - acre project known as Eastern Regional Water Supply Facility Phase 3A and 3B Improvements as per plans received by the District on August 22, 2019, and amended Sheet C100 received by the District on September 18, 2019.

**LOCATION:**

Section(s): 7                      Township(s): 23S                      Range(s): 31E  
Orange County

**Receiving Water Body:**

Name	Class
Little Econlockhatchee River	III Fresh, IW

**ISSUED TO:**

Orange County Board of Commissioners  
9150 Curry Ford Rd  
Orlando, FL 32825-7600

Orange County Utilities  
9150 Curry Ford Road  
Orlando, FL 32825

The permittee agrees to hold and save the St. Johns River Water Management District and its successors harmless from any and all damages, claims, or liabilities which may arise from permit issuance. Said application, including all plans and specifications attached thereto, is by reference made a part hereof.

This permit does not convey to the permittee any property rights nor any rights or privileges other than those specified herein, nor relieve the permittee from complying with any law, regulation or requirement affecting the rights of other bodies or agencies. All structures and works installed by permittee hereunder shall remain the property of the permittee.

This permit may be revoked, modified or transferred at any time pursuant to the appropriate provisions of Chapter 373, Florida Statutes.

**PERMIT IS CONDITIONED UPON:**

See conditions on attached "Exhibit A", dated September 20, 2019

**AUTHORIZED BY:** St. Johns River Water Management District  
Division of Regulatory Services

A handwritten signature in black ink that reads "Marjorie D. Cook". The signature is written in a cursive style with a large, looped 'M' and 'C'.

By:

---

Marjorie Cook  
Supervising Professional Engineer



**"EXHIBIT A"**  
**CONDITIONS FOR ISSUANCE OF PERMIT NUMBER 20902-6**  
**Eastern Regional Water Supply Facility Phase 3A and 3B Improvements**  
**DATED September 20, 2019**

1. All activities shall be implemented following the plans, specifications and performance criteria approved by this permit. Any deviations must be authorized in a permit modification in accordance with Rule 62-330.315, F.A.C. Any deviations that are not so authorized may subject the permittee to enforcement action and revocation of the permit under Chapter 373, F.S.
2. A complete copy of this permit shall be kept at the work site of the permitted activity during the construction phase, and shall be available for review at the work site upon request by the District staff. The permittee shall require the contractor to review the complete permit prior to beginning construction.
3. Activities shall be conducted in a manner that does not cause or contribute to violations of state water quality standards. Performance-based erosion and sediment control best management practices shall be installed immediately prior to, and be maintained during and after construction as needed, to prevent adverse impacts to the water resources and adjacent lands. Such practices shall be in accordance with the State of Florida Erosion and Sediment Control Designer and Reviewer Manual (Florida Department of Environmental Protection and Florida Department of Transportation June 2007), and the Florida Stormwater Erosion and Sedimentation Control Inspector's Manual (Florida Department of Environmental Protection, Nonpoint Source Management Section, Tallahassee, Florida, July 2008), which are both incorporated by reference in subparagraph 62-330.050(9)(b)5, F.A.C., unless a project-specific erosion and sediment control plan is approved or other water quality control measures are required as part of the permit.
4. At least 48 hours prior to beginning the authorized activities, the permittee shall submit to the District a fully executed Form 62-330.350(1), "Construction Commencement Notice," (October 1, 2013) (<http://www.flrules.org/Gateway/reference.asp?No=Ref-02505>), incorporated by reference herein, indicating the expected start and completion dates. A copy of this form may be obtained from the District, as described in subsection 62-330.010(5), F.A.C., and shall be submitted electronically or by mail to the Agency. However, for activities involving more than one acre of construction that also require a NPDES stormwater construction general permit, submittal of the Notice of Intent to Use Generic Permit for Stormwater Discharge from Large and Small Construction Activities, DEP Form 62-621.300(4)(b), shall also serve as notice of commencement of construction under this chapter and, in such a case, submittal of Form 62-330.350(1) is not required.
5. Unless the permit is transferred under Rule 62-330.340, F.A.C., or transferred to an operating entity under Rule 62-330.310, F.A.C., the permittee is liable to comply with the plans, terms and conditions of the permit for the life of the project or activity.
6. Within 30 days after completing construction of the entire project, or any independent portion of the project, the permittee shall provide the following to the Agency, as applicable:
  - a. For an individual, private single-family residential dwelling unit, duplex, triplex, or quadruplex — "Construction Completion and Inspection Certification for Activities Associated with a Private Single-Family Dwelling Unit" [Form 62-330.310(3)]; or
  - b. For all other activities — "As-Built Certification and Request for Conversion to Operation Phase" [Form 62-330.310(1)].

- c. If available, an Agency website that fulfills this certification requirement may be used in lieu of the form.
7. If the final operation and maintenance entity is a third party:
- a. Prior to sales of any lot or unit served by the activity and within one year of permit issuance, or within 30 days of as-built certification, whichever comes first, the permittee shall submit, as applicable, a copy of the operation and maintenance documents (see sections 12.3 thru 12.3.4 of Volume I) as filed with the Florida Department of State, Division of Corporations and a copy of any easement, plat, or deed restriction needed to operate or maintain the project, as recorded with the Clerk of the Court in the County in which the activity is located.
  - b. Within 30 days of submittal of the as- built certification, the permittee shall submit "Request for Transfer of Environmental Resource Permit to the Perpetual Operation and Maintenance Entity" [Form 62-330.310(2)] to transfer the permit to the operation and maintenance entity, along with the documentation requested in the form. If available, an Agency website that fulfills this transfer requirement may be used in lieu of the form.
8. The permittee shall notify the District in writing of changes required by any other regulatory District that require changes to the permitted activity, and any required modification of this permit must be obtained prior to implementing the changes.
9. This permit does not:
- a. Convey to the permittee any property rights or privileges, or any other rights or privileges other than those specified herein or in Chapter 62-330, F.A.C.;
  - b. Convey to the permittee or create in the permittee any interest in real property;
  - c. Relieve the permittee from the need to obtain and comply with any other required federal, state, and local authorization, law, rule, or ordinance; or
  - d. Authorize any entrance upon or work on property that is not owned, held in easement, or controlled by the permittee.
10. Prior to conducting any activities on state-owned submerged lands or other lands of the state, title to which is vested in the Board of Trustees of the Internal Improvement Trust Fund, the permittee must receive all necessary approvals and authorizations under Chapters 253 and 258, F.S. Written authorization that requires formal execution by the Board of Trustees of the Internal Improvement Trust Fund shall not be considered received until it has been fully executed.
11. The permittee shall hold and save the District harmless from any and all damages, claims, or liabilities that may arise by reason of the construction, alteration, operation, maintenance, removal, abandonment or use of any project authorized by the permit.
12. The permittee shall notify the District in writing:
- a. Immediately if any previously submitted information is discovered to be inaccurate; and
  - b. Within 30 days of any conveyance or division of ownership or control of the property or the system, other than conveyance via a long-term lease, and the new owner shall

request transfer of the permit in accordance with Rule 62-330.340, F.A.C. This does not apply to the sale of lots or units in residential or commercial subdivisions or condominiums where the stormwater management system has been completed and converted to the operation phase.

13. Upon reasonable notice to the permittee, District staff with proper identification shall have permission to enter, inspect, sample and test the project or activities to ensure conformity with the plans and specifications authorized in the permit.
14. If prehistoric or historic artifacts, such as pottery or ceramics, projectile points, stone tools, dugout canoes, metal implements, historic building materials, or any other physical remains that could be associated with Native American, early European, or American settlement are encountered at any time within the project site area, the permitted project shall cease all activities involving subsurface disturbance in the vicinity of the discovery. The permittee or other designee shall contact the Florida Department of State, Division of Historical Resources, Compliance Review Section (DHR), at (850) 245-6333, as well as the appropriate permitting agency office. Project activities shall not resume without verbal or written authorization from the Division of Historical Resources. If unmarked human remains are encountered, all work shall stop immediately and the proper authorities notified in accordance with Section 872.05, F.S. For project activities subject to prior consultation with the DHR and as an alternative to the above requirements, the permittee may follow procedures for unanticipated discoveries as set forth within a cultural resources assessment survey determined complete and sufficient by DHR and included as a specific permit condition herein.
15. Any delineation of the extent of a wetland or other surface water submitted as part of the permit application, including plans or other supporting documentation, shall not be considered binding unless a specific condition of this permit or a formal determination under Rule 62-330.201, F.A.C., provides otherwise.
16. The permittee shall provide routine maintenance of all components of the stormwater management system to remove trapped sediments and debris. Removed materials shall be disposed of in a landfill or other uplands in a manner that does not require a permit under Chapter 62-330, F.A.C., or cause violations of state water quality standards.
17. This permit is issued based on the applicant's submitted information that reasonably demonstrates that adverse water resource-related impacts will not be caused by the completed permit activity. If any adverse impacts result, the District will require the permittee to eliminate the cause, obtain any necessary permit modification, and take any necessary corrective actions to resolve the adverse impacts.
18. A Recorded Notice of Environmental Resource Permit may be recorded in the county public records in accordance with Rule 62-330.090(7), F.A.C. Such notice is not an encumbrance upon the property.
19. This permit for construction will expire five years from the date of issuance.
20. At a minimum, all retention and detention storage areas must be excavated to rough grade prior to building construction or placement of impervious surface within the area to be served by those facilities. To prevent reduction in storage volume and percolation rates, all accumulated sediment must be removed from the storage area prior to final grading and stabilization.
21. All wetland areas or water bodies that are outside the specific limits of construction authorized by this permit must be protected from erosion, siltation, scouring or excess turbidity, and dewatering.

22. The operation and maintenance entity shall inspect the stormwater or surface water management system once within two years after the completion of construction and every two years thereafter to determine if the system is functioning as designed and permitted. The operation and maintenance entity must maintain a record of each required inspection, including the date of the inspection, the name and contact information of the inspector, and whether the system was functioning as designed and permitted, and make such record available for inspection upon request by the District during normal business hours. If at any time the system is not functioning as designed and permitted, then within 30 days the entity shall submit a report electronically or in writing to the District using Form 62-330.311(1), "Operation and Maintenance Inspection Certification," describing the remedial actions taken to resolve the failure or deviation.
23. This permit does not authorize the permittee to cause any adverse impact to or "take" of state listed species and other regulated species of fish and wildlife. Compliance with state laws regulating the take of fish and wildlife is the responsibility of the owner or applicant associated with this project. Please refer to Chapter 68A-27 of the Florida Administrative Code for definitions of "take" and a list of fish and wildlife species. If listed species are observed onsite, FWC staff are available to provide decision support information or assist in obtaining the appropriate FWC permits. Most marine endangered and threatened species are statutorily protected and a "take" permit cannot be issued. Requests for further information or review can be sent to [FWCConservationPlanningServices@MyFWC.com](mailto:FWCConservationPlanningServices@MyFWC.com).
24. The proposed project must be constructed and operated as per plans received by the District on August 22, 2019, and amended Sheet C100 received by the District on September 18, 2019.

## Notice Of Rights

1. A person whose substantial interests are or may be affected has the right to request an administrative hearing by filing a written petition with the St. Johns River Water Management District (District). Pursuant to Chapter 28-106 and Rule 40C-1.1007, Florida Administrative Code, the petition must be filed (received) either by delivery at the office of the District Clerk at District Headquarters, P. O. Box 1429, Palatka Florida 32178-1429 (4049 Reid St., Palatka, FL 32177) or by e-mail with the District Clerk at [Clerk@sjrwmd.com](mailto:Clerk@sjrwmd.com), within twenty-six (26) days of the District depositing the notice of District decision in the mail (for those persons to whom the District mails actual notice), within twenty-one (21) days of the District emailing the notice of District decision (for those persons to whom the District emails actual notice), or within twenty-one (21) days of newspaper publication of the notice of District decision (for those persons to whom the District does not mail or email actual notice). A petition must comply with Sections 120.54(5)(b)4. and 120.569(2)(c), Florida Statutes, and Chapter 28-106, Florida Administrative Code. The District will not accept a petition sent by facsimile (fax), as explained in paragraph no. 4 below.
2. Please be advised that if you wish to dispute this District decision, mediation may be available and that choosing mediation does not affect your right to an administrative hearing. If you wish to request mediation, you must do so in a timely-filed petition. If all parties, including the District, agree to the details of the mediation procedure, in writing, within 10 days after the time period stated in the announcement for election of an administrative remedy under Sections 120.569 and 120.57, Florida Statutes, the time limitations imposed by Sections 120.569 and 120.57, Florida Statutes, shall be tolled to allow mediation of the disputed District decision. The mediation must be concluded within 60 days of the date of the parties' written agreement, or such other timeframe agreed to by the parties in writing. Any mediation agreement must include provisions for selecting a mediator, a statement that each party shall be responsible for paying its pro-rata share of the costs and fees associated with mediation, and the mediating parties' understanding regarding the confidentiality of discussions and documents introduced during mediation. If mediation results in settlement of the administrative dispute, the District will enter a final order consistent with the settlement agreement. If mediation terminates without settlement of the dispute, the District will notify all the parties in writing that the administrative hearing process under Sections 120.569 and 120.57, Florida Statutes, is resumed. Even if a party chooses not to engage in formal mediation, or if formal mediation does not result in a settlement agreement, the District will remain willing to engage in informal settlement discussions.
3. A person whose substantial interests are or may be affected has the right to an informal administrative hearing pursuant to Sections 120.569 and 120.57(2), Florida Statutes, where no material facts are in dispute. A petition for an informal hearing must also comply with the requirements set forth in Rule 28-106.301, Florida Administrative Code.

## Notice Of Rights

4. A petition for an administrative hearing is deemed filed upon receipt of the complete petition by the District Clerk at the District Headquarters in Palatka, Florida during the District's regular business hours. The District's regular business hours are 8:00 a.m. – 5:00 p.m., excluding weekends and District holidays. Petitions received by the District Clerk after the District's regular business hours shall be deemed filed as of 8:00 a.m. on the District's next regular business day. The District's acceptance of petitions filed by e-mail is subject to certain conditions set forth in the District's Statement of Agency Organization and Operation (issued pursuant to Rule 28-101.001, Florida Administrative Code), which is available for viewing at [sjrwmd.com](http://sjrwmd.com). These conditions include, but are not limited to, the petition being in the form of a PDF or TIFF file and being capable of being stored and printed by the District. Further, pursuant to the District's Statement of Agency Organization and Operation, attempting to file a petition by facsimile is prohibited and shall not constitute filing.
5. Failure to file a petition for an administrative hearing within the requisite timeframe shall constitute a waiver of the right to an administrative hearing. (Rule 28-106.111, Florida Administrative Code).
6. The right to an administrative hearing and the relevant procedures to be followed are governed by Chapter 120, Florida Statutes, Chapter 28-106, Florida Administrative Code, and Rule 40C-1.1007, Florida Administrative Code. Because the administrative hearing process is designed to formulate final agency action, the filing of a petition means the District's final action may be different from the position taken by it in this notice. A person whose substantial interests are or may be affected by the District's final action has the right to become a party to the proceeding, in accordance with the requirements set forth above.
7. Pursuant to Section 120.68, Florida Statutes, a party to the proceeding before the District who is adversely affected by final District action may seek review of the action in the District Court of Appeal by filing a notice of appeal pursuant to Rules 9.110 and 9.190, Florida Rules of Appellate Procedure, within 30 days of the rendering of the final District action.
8. A District action is considered rendered, as referred to in paragraph no. 7 above, after it is signed on behalf of the District and filed by the District Clerk.
9. Failure to observe the relevant timeframes for filing a petition for judicial review as described in paragraph no. 7 above will result in waiver of that right to review.

## NOTICING INFORMATION

Please be advised that the St. Johns River Water Management District will not publish a notice in the newspaper advising the public that it has issued a permit for this project.

Newspaper publication, using the District's notice form, notifies members of the public of their right to challenge the issuance of the permit. If proper notice is given by newspaper publication, then there is a 21-day time limit for someone to file a petition for an administrative hearing to challenge the issuance of the permit.

To close the point of entry for filing a petition, you may publish (at your own expense) a one-time notice of the District's decision in a newspaper of general circulation within the affected area as defined in Section 50.011 of the Florida Statutes. If you do not publish a newspaper notice to close the point of entry, the time to challenge the issuance of your permit will not expire and someone could file a petition even after your project is constructed.

A copy of the notice form and a partial list of newspapers of general circulation are attached for your convenience. However, you are not limited to those listed newspapers. If you choose to close the point of entry and the notice is published, the newspaper will return to you an affidavit of publication. In that event, it is important that you either submit a scanned copy of the affidavit by emailing it to [compliancesupport@sjrwmd.com](mailto:compliancesupport@sjrwmd.com) (preferred method) or send a copy of the original affidavit to:

Office of Business and Administrative Services  
4049 Reid Street  
Palatka, FL 32177

If you have any questions, please contact the Office of Business and Administrative Services at (386) 329-4570.

NOTICE OF AGENCY ACTION TAKEN BY THE  
ST. JOHNS RIVER WATER MANAGEMENT DISTRICT

Notice is given that the following permit was issued on \_\_\_\_\_:

(Name and address of applicant) \_\_\_\_\_  
permit# \_\_\_\_\_. The project is located in \_\_\_\_\_ County, Section  
\_\_\_\_\_, Township \_\_\_\_\_ South, Range \_\_\_\_\_ East. The permit authorizes a surface  
water management system on \_\_\_\_\_ acres for \_\_\_\_\_ known as  
\_\_\_\_\_. The receiving water body is \_\_\_\_\_.

A person whose substantial interests are or may be affected has the right to request an administrative hearing by filing a written petition with the St. Johns River Water Management District (District). Pursuant to Chapter 28-106 and Rule 40C-1.1007, Florida Administrative Code (F.A.C.), the petition must be filed (received) either by delivery at the office of the District Clerk at District Headquarters, P.O. Box 1429, Palatka FL 32178-1429 (4049 Reid St, Palatka, FL 32177) or by e-mail with the District Clerk at Clerk@sjrwm.com, within twenty-one (21) days of newspaper publication of the notice of District decision (for those persons to whom the District does not mail or email actual notice). A petition must comply with Sections 120.54(5)(b)4. and 120.569(2)(c), Florida Statutes (F.S.), and Chapter 28-106, F.A.C. The District will not accept a petition sent by facsimile (fax). Mediation pursuant to Section 120.573, F.S., may be available and choosing mediation does not affect your right to an administrative hearing.

A petition for an administrative hearing is deemed filed upon receipt of the complete petition by the District Clerk at the District Headquarters in Palatka, Florida during the District's regular business hours. The District's regular business hours are 8 a.m. – 5 p.m., excluding weekends and District holidays. Petitions received by the District Clerk after the District's regular business hours shall be deemed filed as of 8 a.m. on the District's next regular business day. The District's acceptance of petitions filed by e-mail is subject to certain conditions set forth in the District's Statement of Agency Organization and Operation (issued pursuant to Rule 28-101.001, Florida Administrative Code), which is available for viewing at [www.sjrwm.com](http://www.sjrwm.com). These conditions include, but are not limited to, the petition being in the form of a PDF or TIFF file and being capable of being stored and printed by the District. Further, pursuant to the District's Statement of Agency Organization and Operation, attempting to file a petition by facsimile (fax) is prohibited and shall not constitute filing.

The right to an administrative hearing and the relevant procedures to be followed are governed by Chapter 120, Florida Statutes, Chapter 28-106, Florida Administrative Code, and Rule 40C-1.1007, Florida Administrative Code. Because the administrative hearing process is designed to formulate final agency action, the filing of a petition means the District's final action may be different from the position taken by it in this notice. **Failure to file a petition for an administrative hearing within the requisite time frame shall constitute a waiver of the right to an administrative hearing. (Rule 28-106.111, F.A.C.).**

If you wish to do so, please visit [http://www.sjrwm.com/nor\\_dec/](http://www.sjrwm.com/nor_dec/) to read the complete Notice of Rights to determine any legal rights you may have concerning the District's decision(s) on the permit application(s) described above. You can also request the Notice of Rights by contacting the Director of Business and Administrative Services, 4049 Reid St., Palatka, FL 32177-2529, tele. no. (386)329-4570.



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Orange Park, FL 32073  
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Orlando, FL 32801  
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386-312-5200/ fax 386-312-5209

### **SEMINOLE**

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Sanford, FL 32771  
407-323-9408

### **BAKER**

Baker County Press, Legal Advertising  
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Daily Record, Legal Advertising  
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904-356-2466 / fax 904-353-2628

### **INDIAN RIVER**

Vero Beach Press Journal, Legal Advertising  
P. O. Box 1268  
Vero Beach, FL 32961-1268  
772-221-4282/ fax 772-978-2340

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2121 SW 19th Avenue Road  
Ocala, FL 34474  
352-867-4010/fax 352-867-4126

### **OKEECHOBEE**

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Okeechobee, FL 34973-0639  
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